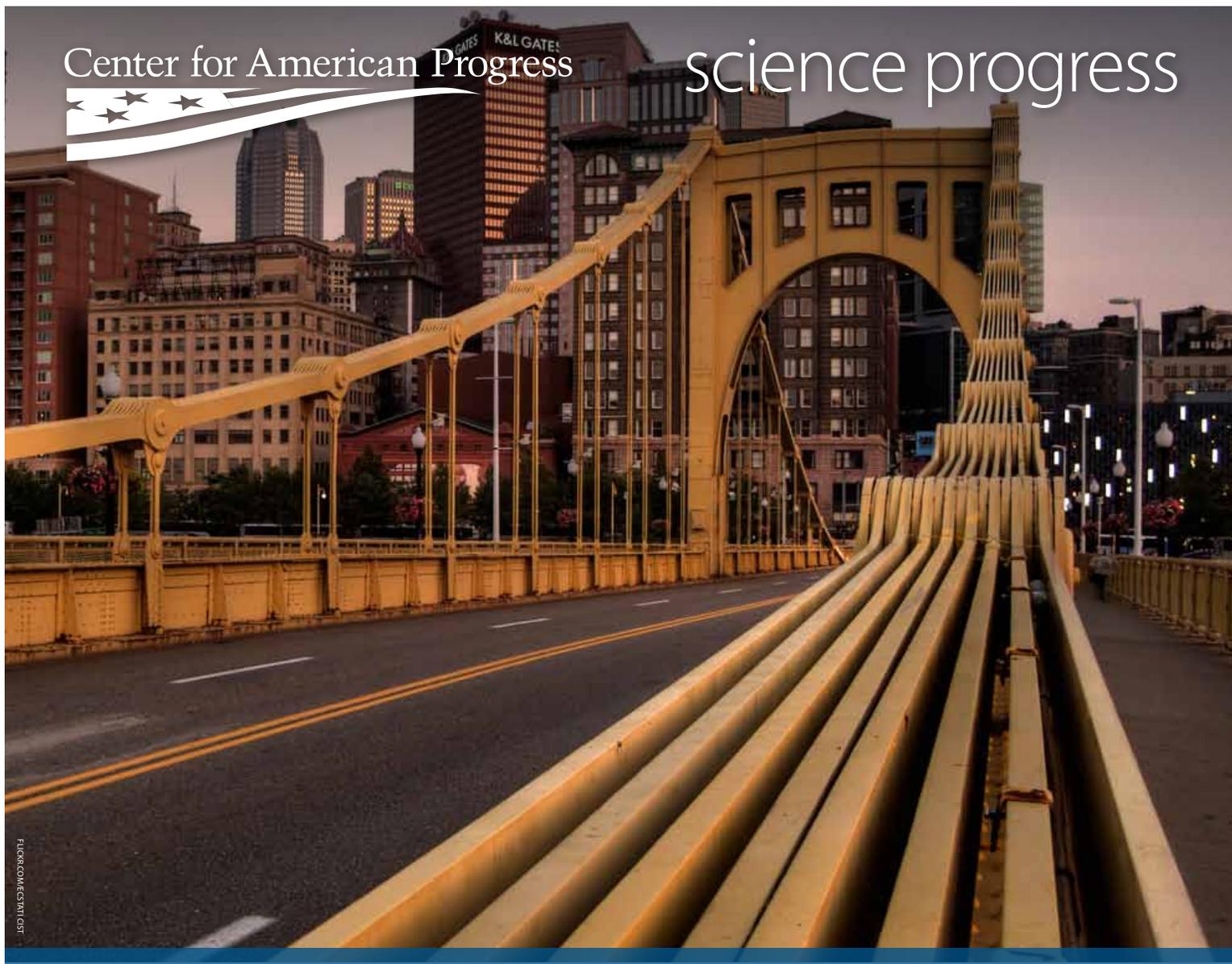


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Silos of Small Beer

A Case Study of the Efficacy of Federal Innovation Programs
in a Key Midwest Regional Economy

Maryann Feldman and Lauren Lanahan September 2010

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Introduction and summary

Amid today’s stumbling economic recovery, policymakers are examining a variety of measures to help businesses compete and grow their workforces. As part of this effort, it is critical that they understand how regional economies across our country stitch themselves together from the bottom up—what makes them tick and what they need to grow and thrive in the 21st century. Alas, federal innovation policies aimed at boosting the competitiveness of our economy through investments in science and technology commercialization are often grounded in 20th-century economic development strategies that overlook the importance of regional economies and no longer match the needs of the 21st-century global economy.

Academics and policymakers alike understand the limitations of our current policies at the macroeconomic level. Federal funding for these commercialization programs, at less than 10 percent of the \$150 billion a year we invest in basic scientific research, is “small beer”—a trivial amount given the challenges our nation faces from our global competitors. And federal programs designed to implement these policies are divided into a chaotic array of “silos”—policy speak for mutually unconnected programs—that make it exceedingly hard for the federal government to act upon any strategy designed to overcome our nation’s economic policy limitations.¹

At the regional level, however, many businesses and universities, state economic development agencies and community colleges, venture capitalists and commercial bankers all depend on current federal innovation policy funds to pay for or complement their own efforts to boost commercialization of game-changing discoveries, incremental manufacturing, and service innovation alike. Despite the clear limitations of existing federal innovation programs, they remain important to our national economic competitiveness. So understanding the efficacy of these federal innovation programs is the first step toward understanding how to improve them or replace them.

That is what we set out to do in this paper in one regional economy of our country—the eastern Midwest region that includes Pittsburgh in western Pennsylvania; and Cleveland, Akron, and Youngstown in northeast Ohio. This

Eastern midwest region



region, anchored by its major cities Pittsburgh and Cleveland, faces distinct challenges and opportunities. Regional economic growth, of course, is everywhere local and interconnected, but how much so depends on the vibrancy of each region's innovative ecosystem. Silicon Valley in California, or the Route 128 corridor around Boston are famous "regional innovation clusters" in which businesses large and small, universities, federal labs, and financiers interact every day in a heady mix of creativity that powers our nation's innovation economy. Places that have tried to copy their unique recipes, however, have not been very successful. And those places that succeeded at creating a high technology regional economy, such as North Carolina's

Research Triangle Park and San Diego's Connect project, found that they needed to pave their own path.²

In similar vein, Hollywood has a different mix of players who achieve the same thing in southern California for our entertainment industries. And Nashville serves the same purpose for country music. The upshot: Every successful regional innovation cluster defines itself idiosyncratically and specifically to its own context, depending on its own defining economic activity—be it entertainment, biotechnology, information technology, or advanced manufacturing.

But older industrial areas such as Pittsburgh, Cleveland, Akron, and Youngstown are places with substantial infrastructure and a proud industrial heritage that are struggling to redefine themselves in the global economy. The large corporations headquartered there that served as the backbone of the region's 20th-century industrial economy are neither as numerous as they were 50 years ago nor as central to the region's core economic competitiveness. In many different ways these companies have squandered their competitive advantages or watched as the forces of globalization overwhelmed those advantages.³

This leaves entrepreneurship (defined as new firm formation and scale-up) and innovation (defined as the creation of value in an economy no matter the size of the company or the source of the idea) as the most viable strategies for the economic

future of the region. Our study sought out these new players in this region's innovation ecosystem to ask them not only about the efficacy of federal innovation programs but also about how they interact with each other—how much they felt they worked and lived in an emerging regional innovation cluster. Along the way, we also asked these players about the region in search of the strengths and weaknesses of this once-thriving, metal-bending region of our country in the 21st century.

Our survey of these firms and players on these subjects is the first one ever conducted. And our one-on-one interviews with dozens of key players in this new ecosystem only buttressed what we learned from our survey. We found in the eastern Midwest of our country an ecosystem of innovation and entrepreneurship that is emerging and vibrant, but also fragile, requiring the sustained efforts of local, state, and federal agencies working together to help firms survive and thrive. Problem is, we also found that local innovation programs that connect well with entrepreneurs are limited in scale, and the handoff with federal programs can be problematic at best because these programs are also limited as well as disconnected from each other.

Within this one region, we find examples of companies that have worked well with the limited resources available to them. But many others still have a ways to go. We also find universities and state economic development agencies that thoroughly understand the role they need to play in developing a thriving regional innovation cluster. But we also learn about the limitations these institutions face.

In the pages that follow, we will detail the results of our survey then present our overarching analysis of this seminal and difficult data-gathering effort accompanied by our on-the-ground interviews. The information we gleaned is admittedly difficult to assemble into succinct categories. The complexity of the region's rolling transformation from industrial heartland to a new innovation-driven ecosystem for the 21st century is very hard to capture in clean "snapshots." Briefly, however, we discovered that:

- Financing is lacking both for young innovative companies and for established medium-sized companies as they try to carry promising new or incremental technologies to market.
- Accessing federal innovation funds is exceedingly time consuming, often self-defeating, and in the end usually too small to be of enduring use.

Local innovation programs that connect well with entrepreneurs are limited in scale, and the handoff with federal programs can be problematic at best because these programs are also limited as well as disconnected from each other.

- State and local innovation funds are pursued to a greater degree than federal programs but are too small for the needs of the region's firms.
- Federal, state, and local funding programs nonetheless can be useful in attracting private financing even though these programs are not well-coordinated.

These findings are troubling for a variety of reasons. Many entrepreneurial business ventures depend on these government programs as they discover, develop, and begin to move innovation toward the market. Without critical public support, these entrepreneurs may not be able to survive. For a long time, economic development policymakers have recognized that the infamous “valleys of death,” where good ideas lack the financing to become companies that hire well-paid workers, seriously threaten the creation of new firms and the expansion of existing firms. This debilitating financing gap is compounded by current economic conditions and a banking crisis. The result: The entire spectrum of small- and medium-sized firms and even larger firms in the region face a crisis in securing expansion and working capital.

But our survey turned up some promising news, too. Specifically:

- Finding management, engineering talent, and well-trained workers in the region is not a significant challenge for companies.
- Startup companies and established small- and medium-sized firms are building on the region's historical strength in industrial activity to create new products and services in emerging industry clusters within the region.
- These companies recognize they operate in clusters and would welcome a regional innovation cluster coordinator who could bring together private sector companies; nonprofit organizations such as universities; and federal, state, and local government officials to better align economic policy with the needs of companies in the region.

These core findings underscore the need for the federal government to overhaul its innovation policies and to work more closely with state and local leaders in the public and private sectors to sort out what works and what does not. Our study also points to the need to completely rethink how we go about encouraging regional economic development in the 21st century.

Proposing specific policy proposals based on one survey of one regional economy would not be wise, but there is enough academic research and policymaking experience about innovation to support a set of policy principles that are buttressed significantly by the research we have just completed.⁴ We will detail these, too, in the pages that follow, but briefly we believe that:

- Bottom-up, locally organized innovation programs that stitch together federal, state, and local economic development programs would serve our national economy best in the 21st century. This should be financed through public-private partnerships that include all the players in a given regional innovation cluster.
- The federal government has a major facilitating role to play in this process—one that includes significant increases in financing without monopolizing decision making.
- Each locally organized cluster will be different and thus will need region-specific support from federal, state, and local governments.

We believe our survey and our analysis demonstrates the need for the Obama administration and especially Congress to embrace these principles as they go about reforming our economic development programs to meet the needs of the 21st-century innovation economy. Pittsburgh, Cleveland, Akron, Youngstown, and their surrounding communities are changing rapidly because of globalization and in reaction to globalization. Our policymakers in Washington, in statehouses, and in municipal town halls need to give them the tools they need to succeed.

The Silicon Valley of its day

Beginning in the 1870s and continuing for about 90 years, the Pittsburgh-Cleveland-Akron-Youngstown region was arguably the Silicon Valley of its day—the best place for ambitious young people to realize their dreams. The biographic accounts of the lives of business leaders such as John D. Rockefeller, Andrew Carnegie, H.J. Heinz, Benjamin Franklin Goodrich, George Westinghouse, and Charles Diebold, as well as social innovators such as George Washington Crile, founder of the Cleveland Clinic, and Frederick C. Goff, founder of The Cleveland Foundation, all highlight the ways these critical actors enriched the region and built it into an economic hub.⁵

The fortunes of regions, of course, are tied to the fortunes of their firms and industries. The success and specialization of 19th-century achievements are still visible and still define many of the expectations, capabilities, and obstacles in this region. Writing in 1936, economic geographer Richard Hartshorne noted that the Pittsburgh-Cleveland region—geographically situated in western Pennsylvania and northeastern Ohio—was one of the most important regional economies in the United States.⁶

Pittsburgh and Youngstown historically specialized in steel. The famous economist Benjamin Chinitz noted in a 1961 article in the *American Economics Review* that Pittsburgh was much more specialized than any other city in the United States with the exception of Detroit.⁷ While one single company, the Youngstown Iron Sheet and Tube Company, dominated Youngstown, industrialists such as Andrew Carnegie, Henry Clay Frick, Andrew W. Mellon, and Charles M. Schwab made their fortunes in Pittsburgh. Gulf Oil, Westinghouse Electric, Alcoa, National Steel, Jones & Laughlin Steel, and PPG Industries all were Pittsburgh entrepreneurial ventures that became Fortune 500 companies during the latter half of the 20th century.⁸

Indeed, this region dominated world steel production until a lack of investment and a failure to innovate in steel products and processes amid increased global competition led to massive plant closings and layoffs. The steel industry that sustained the small- and medium-sized communities that line the river valleys in

the region for decades suddenly gave way to these outside competitive pressures. With the sudden demise of the steel industry, these communities experienced an immediate and painful adjustment and have since been working steadily to build more innovative and entrepreneurial economies—ones that build on the still-formidable innovative infrastructure of the region, especially its universities.

Cleveland historically had the more diversified economy and traditionally was the most successful and largest city in the region. The city primarily built component parts, providing the essential industrial pieces to other mostly producer products. Companies such as Parker Hannifin, Standard Products, Cleveland-Cliffs, the Eaton Corporation, Yale & Towne, TRW, White Motor, and Sherwin-Williams exemplify the entrepreneurial efforts that built Cleveland.⁹

This proud historical legacy is a blessing and a curse. It is a curse because the industrial decline of Cleveland has been more gradual, punctuated by many efforts to restructure alongside a common belief that corners were being turned—only to face another setback amid the steady decline of employment in industrial manufacturing across the Midwest. But it is a blessing because many parts and components are still manufactured in the city, along with the important service components that accompany their distribution. These industries remain highly competitive in the global economy, sustaining the region for export markets and defining a source of expertise and strength.

Akron is synonymous with tires. Four local companies—Goodyear, Firestone, BFGoodrich, and General Tire and Rubber—were the world’s largest tire producers and controlled 100 percent of the domestic market until 1970. Akron became the tire capital because of a historical accident—Benjamin Franklin Goodrich was there as an innovative producer of bicycle tires. As the market evolved to automobile tires, B.F. Goodrich adapted, built on its strengths, and became a pioneer in the rubber industry. Over time, due to Goodrich’s success, Akron became the place to be for tire manufacturing and research. Other tire firms started in Akron and related firms filled in the industrial landscape, with an agglomeration of successful companies developing in Akron to create the supporting conditions that we associate with clusters. Akron’s ability to respond to changing markets and economic conditions are evident today, too, in the city’s advanced materials industries that have adapted by building on Akron’s expertise.¹⁰

Tom Kelley, the Silicon Valley guru on innovation, grew up in Akron and built his work on the lessons he observed there. “My dad worked for Goodyear,” Kelley said in a recent newspaper interview. “Every tire for the U.S. passenger car was made

This proud
historical legacy is
a blessing and
a curse.

within a 10-mile radius of our house. Because they had the market locked up, these firms could coast for decades. They didn't have to innovate. Others came along and did, and Akron lost the market," he recalls. "If you don't innovate, you die."¹¹

What happened? Radial tires made by Michelin. Kelley says that the response in Akron was, "Who's going to buy tires from French people?" Now we know that radials upended the traditional tire industry and today Michelin is the world's biggest tire maker. Tire manufacturers in Akron failed to respond to increased competition—from France, no less, where manufacturing wages are generally higher and unions are decidedly dominant. The demise of the tire industry resulted from a failure to respond to changing market conditions. Akron companies failed to innovate and lost market share to a French company that understood that consumers would pay more for superior performance. Rather than compete on the basis of cost—a clear race to the bottom—competition, under this circumstance, was refined by superior performance.

Today, no tires are manufactured in Akron. In response to this loss, the city refocused and expanded their materials industry to advanced polymers, which not surprisingly included the general class for the materials of synthetic rubber, fibers, and engineered plastics.¹² Although once crowned the "tire capital of the world," this city was able to successfully restructure and specialize in polymers—advanced materials that directly build upon the city's expertise.

The rich industrial heritage of these four cities defines the parameters of this region's economic development possibilities in the 21st century—not just in the ways most commonly associated with this part of the American Rust Belt, which include industrial decline, falling wages, and diminished employment opportunities. As we will demonstrate briefly in the next section of the paper, historic business and economic connections, a shared industrial experience, robust innovation, and energetic efforts at the state and local levels to build upon these assets are all resulting in a more vibrant, 21st-century regional economic cluster.

Still a competitive regional economy despite the setbacks

The question of how to define a successful regional economy is one of the most important and controversial issues in economic development today. Economists mostly agree on the definition—an integrated economic and social spatial unit that is geographically contiguous and has enough similar characteristics to benefit from similar strategies, internal collaboration, and a coherent set of policies—but they rarely agree when the specifics of a region are matched with the definition.¹³ Alternatively described by regional insiders as “Pittsland” or “Cleveburg,” there are at least three reasons why our study area remains a regional economy.

In addition to the rich, industrial history where the metropolitan areas of Cleveland, Pittsburgh, Akron, and Youngstown served to complement one another in the manufacturing of the key industrial products, parts, and components of the 20th century, a degree of similarity unites them and makes them more alike to each other than to the other cities in their respective states. Thus, the region’s businesses continue to self-organize due to the need to achieve critical mass in innovation, and as a result the outside world recognizes these efforts and continues to view this as the same region. To these specific attributes we now turn.

Regional similarity

Even though the region covers three states—including northern West Virginia around the city of Wheeling—and more than 250 cities and incorporated municipalities, the places in this region have more in common with each other than they do with other parts of their respective states. The late Supreme Court Justice Brandeis first coined the term “laboratories of democracy” in the early 1930s to capture the experimentation and adaptation to local conditions that were occurring in states, but even though states are very active and certainly learn from one another, it is increasingly clear that in many cases state boundaries seem artificial.

The reasons are varied depending on the regional economy in question, but broad suburbanization creates a seamless pattern of activity that tends to weave together the local businesses and communities centered in and around the region's metropolitan areas. When these businesses themselves boast historic relations with one another, the links are even further solidified.¹⁴ These common similarities create a sense of shared experience.

In Silicon Valley, for example, high-tech manufacturers in and around San Jose are near to venture capitalists along Sand Hill Road in Menlo Park and close to Stanford University. The many software engineers working up and down the San Francisco peninsula create the critical mass necessary for sustained economic growth.¹⁵ The region comprised of the nation's capital, northern Virginia, and the suburbs of Maryland stretching up to and around Baltimore is another multijurisdiction economic engine that drew upon expertise in research and development to create a regional entrepreneurial economy engaged in telecommunications, information technology, and biotechnology.

Similar links unite northeast Ohio and western Pennsylvania. Cleveland certainly has more in common with Pittsburgh than it does with the faster-growing areas of Columbus and Cincinnati, where retail and professional services dominate the industry. Pittsburgh has little in common with Philadelphia and the vast region that lies in between, but is well-connected to Wheeling, West Virginia; and the communities between Cleveland, Akron, and Youngstown.

In every one of our interviews with business executives, university administrators, and economic development experts in the region, the idea of a common region was acknowledged and accepted. We heard several times that when venture capitalists come from Silicon Valley they visit other companies in the next state, noting similarities in technology and target market. To someone from either coast, the drive between Pittsburgh and Cleveland is straightforward and stress free. All combined, the region has sufficient deal flow to attract late-stage venture capital from the coasts.

Given that economic advantage often correlates to a region's distinctiveness, this region is now forced to work harder, to be more productive, and to define its edge in advanced manufacturing and other products and services. Lower cost labor, lax environmental standards, and favorable tax treatment are reasons why American manufacturing has moved a lot of production and jobs offshore. While manufacturing jobs have declined, manufacturing's share of U.S. gross domestic product

has been constant at about 13 percent since 1980. The reason is U.S. manufacturers have achieved productivity gains and have moved to higher-value specialized products and services, despite an actual decrease in the number of employees in the manufacturing sector. This is exactly what has happened in northeast Ohio and western Pennsylvania.¹⁶

The manufacturing that remains in the Pittsburgh-Cleveland-Akron-Youngstown region is highly innovative and linked to R&D capabilities. Innovation in this economic arena is typically not the type of high-risk, high-reward disruptive innovation that has captured our national imagination. Manufacturing innovation is gradual and incremental: Think Akron. When Goodrich switched from bicycle tires to automobile tires and later to airplane tires, adapting to new markets required innovating with pneumatic tires and tubeless tires that provide a more comfortable ride and greater safety. Historically this search for innovation led to the creation of entire new categories of materials. When Waldo Semon, a Goodrich scientist, invented polyvinyl chloride in 1926, the result was a multibillion-dollar business in vinyl and synthetic rubber.

Today, similar advances in innovation are happening across the region via the science and engineering infrastructure amassed in the 20th century. The region is engaged in initiatives in biotechnology that leverage their universities and medical centers alongside nanotechnology and advanced materials to utilize engineering expertise and green technology because of its articulated strategic importance. This region competes with other regions of the country and the world in these endeavors, however, and the competition is tough and getting tougher. (See charts on page 12 for comparisons of the region's economy with the national economy)

Fortune 500 firms

Although this region was one of the nation's industrial leaders between the end of the 19th century and the first half of the 20th century, over the past 50 years the region experienced a decrease in its industrial and, more broadly speaking, economic influence over the nation. Data from the Fortune 500 list from the years 1965, 1987, and 2009 highlight a steady decline in rankings for Fortune 500 firms in the Akron-Cleveland-Pittsburgh-Youngstown region.

In 1965, this region was home to 42 of the country's top 500 largest firms, with four located in Akron, 16 in Cleveland, 21 in Pittsburgh, and one in Youngstown.

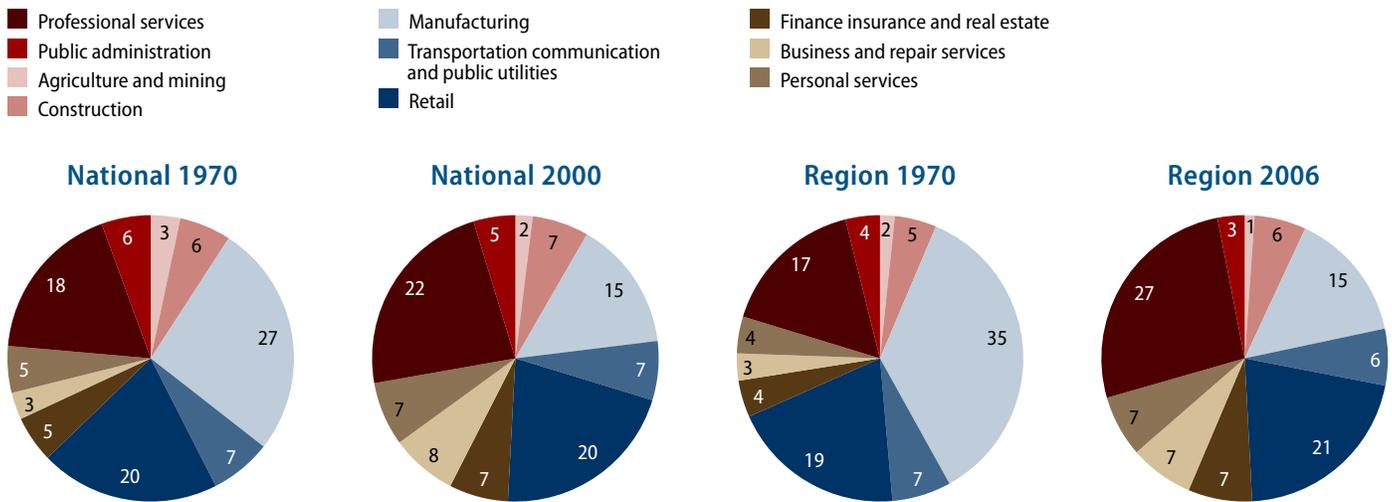
The manufacturing that remains in the Pittsburgh-Cleveland-Akron-Youngstown region is highly innovative and linked to R&D capabilities.

Twelve of these firms were ranked within the top 100 largest firms, with Gulf Oil ranked largest as number 10 in the Fortune 500 list. Twenty-two years later, the number of Fortune 500 firms in the region decreased to 28, with a subsequent dip in the average rankings for Akron and Cleveland. In 1987 only eight of the firms were located within the top 100 largest firms, with BP America in Cleveland ranked highest at number 22.

This downward trend and consequential loss of large corporations continued over the next 22 years. In 2009, the region only had 11 firms in the Fortune 500 list. In this year, none of those firms in the region was ranked within the top 100 largest companies. PNC Financial in Pittsburgh was ranked highest at number 123, and only five of those firms were ranked within the top 200. The data illustrate a substantial industrial loss for the region over the past 50 years. (See Table 1 on page 13)

The region's changing economic mix

Employment by industry in the Cleveland-Pittsburgh-Akron-Youngstown region*



Source: State of the Cities Data System; U.S. Census Economic Fact Sheet

*Data are typically collected for states and for cities, not regions. We aggregate data for the four major cities in the study region to provide a regional profile. Unfortunately the most recent data for cities are for 2006, before the downturn in the economy; employment by industry, national in 1970, regional in 1970, and regional in 2006;¹⁷ national in 2007.¹⁸

TABLE 1
Declining fortunes

Top Fortune 500 firms in Akron, Cleveland, Pittsburgh, and Youngstown in 1965, 1987, and 2009

	Akron		Cleveland		Pittsburgh		Youngstown	
	Frequency	Average ranking	Frequency	Average ranking	Frequency	Average ranking	Frequency	Average ranking
1965	4	46	16	271	21	219	1	85
1987	3	238	10	287	15	204	--	--
2009	2	160	4	275	5	241	--	--

Source: *Fortune Magazine*¹⁹

Despite this loss of Fortune 500 companies for Pennsylvania and Ohio, the Cleveland-Akron-Youngstown-Pittsburgh region has undergone a significant and arguably disproportionate loss. The state of Ohio and the commonwealth of Pennsylvania lost approximately 50 percent of their Fortune 500 firms over this period, yet the cities in our region of interest—Cleveland, Akron, Youngstown, and Pittsburgh—lost on average 75 percent of their Fortune 500 firm rankings.

Fortune 500 headquarters, in addition to the obvious employment benefits, are focal points for activity and serve as anchor tenants for the regional economy, increasing the flow of people and ideas in the regional economy. Many other firms develop as suppliers to large firms, which also support business services. Fortune 500 companies also increase civic capital through their philanthropic and community efforts. The loss of these large firms is greater than the associated loss of employment because employment may fluctuate while a firm remains in the region, but once a large headquarters firm is gone there is a gaping hole in the economy and the community.

With this notable decrease of big business in this region, the area has collectively suffered considerable economic and social losses during this time. This has sparked not only an economic overhaul for the region but also a concerted effort from a myriad of actors to save and rebuild the vibrant culture of the region, which is discussed in greater detail below.

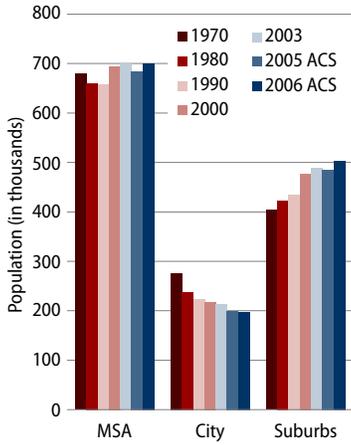
Fewer people, more suburbs

There are other regional similarities. Over the past 35 years, the region has suffered from population decline. The charts on page 14 provide population distributions by the metropolitan statistical area, city, and suburb for the Akron,

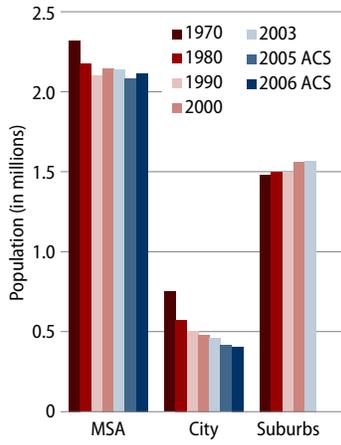
Changing patterns of living

The region's four major cities share a similar experience with suburbanization

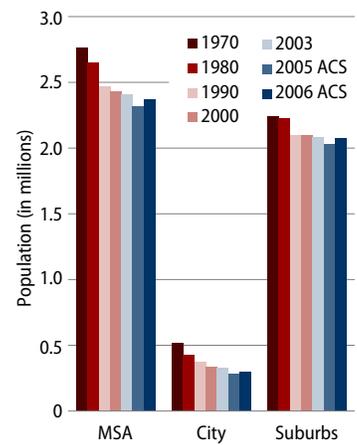
Akron



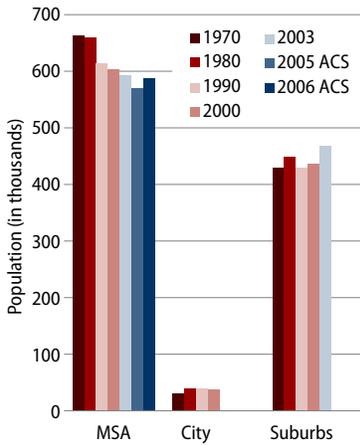
Cleveland



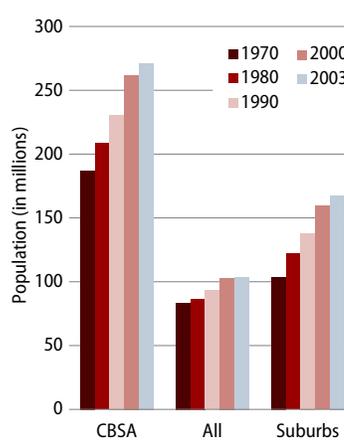
Pittsburgh



Youngstown



National



Source: Department of Housing and Urban Development, Policy Development and Research Information Service, State of the Cities Data Systems

Cleveland, Pittsburgh, and Youngstown metropolitan areas for the following years: 1970; 1980; 1990; 2000; and 2003.²⁰ This provides for a compelling comparison of population trends between the major cities in this region and the nation over the past 35 years.²¹

The region's population has declined since 1970, despite national increasing trends. What is more, each of the four major cities in the region is dwarfed in population by its suburbs. Compared to the national average, the difference between the city and suburb populations is much more pronounced for Akron, Cleveland, Pittsburgh, and Youngstown, with the suburban population approximately double that of its city counterpart. As the national averages illustrate, this difference in population is not as nearly as pronounced between the city and suburbs as it is for this region.

Local governance for this region and its unbalanced population distribution is complicated by the fact that the political systems in place were designed for a larger population size, resulting in a redundancy in service provision and competing government services. These inefficiencies result in higher taxes. Indeed, the geographic spread of the region cumulatively covers some 220 cities, towns, and villages for the Akron-Cleveland-Pittsburgh-Youngstown metropolitan area.

More specifically, the Pittsburgh metropolitan area is comprised of approximately 100 separate municipalities, the contiguous region of Cleveland and Akron comprise approximately 85, and the greater Youngstown area comprises 37 separate municipalities.²² This rapid suburbanization of the region has lessened boundaries between the four cities in the region even though the welter of government jurisdictions remains and complicates business decision making.²³

Spirit of cooperation

Despite the loss of Fortune 500 firms and population declines, the historic connections that knit this region together are now complemented by explicit private- and public-sector initiatives at the state and local level to boost regional cooperation in research, innovation, and commercialization. Many of these are state based, among them Innovation Works, the Pittsburgh Life Sciences Greenhouse in western Pennsylvania, and their counterparts Jumpstart and BioEnterprise in northeastern Ohio. Specifically:

- Innovation Works aims to create a vibrant technology-based economy in southwestern Pennsylvania by providing investment and business assistance to high-growth companies.
- The Pittsburgh Life Sciences Greenhouse, or PLSG, seeks to support a growing life-sciences industry in western Pennsylvania.
- JumpStart focuses on providing resources to entrepreneurs leading high-potential, early-stage companies in northeast Ohio.
- BioEnterprise supports bioscience commercialization in northeast Ohio by creating, attracting, and accelerating the growth of high-potential bioscience businesses.²⁴

These state-based initiatives are financed and guided by Pennsylvania's Ben Franklin Technology Partners program and Ohio's Third Frontier program, respectively.

There also are efforts to forge links across state lines. Life-sciences collaboration, for example, is underway between PLSG and the Cleveland Clinic. Then there is Cleveland-based NorTech,²⁵ an economic development agency serving as a catalyst for growing northeast Ohio's technology industries, which is led by Pennsylvania's former head of technology-based economic development, Rebecca Bagley, who is keen to forge cross-state relations.

More formally, there is the TechBelt initiative. Lee Weingart, president of the LNE Group, a Cleveland-based high-tech advisory firm, highlights the TechBelt program as a promising initiative for reinvigorating the region. Moving beyond the brand of the RustBelt, which stood as a prominent symbol for the region up until the 1970s and 1980s, the TechBelt initiative emerged as a response to assist the region in transitioning to a technology and knowledge-based economy. Drawing from the region's supply of prominent researchers and universities, TechBelt is designed "to accelerate the region's ongoing economic transformation by identifying and facilitating technology-based collaborative partnerships and leveraging its unique and high value assets."²⁶

Inventiveness in the region

Patents are one metric used to evaluate inventive capacity and understand a regional economy. In this region, from January 2006 to May 2010, a total of 8,640 published U.S. patents were granted or filed as applications.²⁷ Firms located in the city of Cleveland applied for 3,129 U.S. patents and applications (36.2 percent of the region's total patent activity) while the Cleveland suburbs and outskirts accounted for 1,594 patents and applications, or 18.4 percent. The pattern is similar for Pittsburgh with 1,587 patents and applications, or 18.3 percent, granted within the city of Pittsburgh versus 199, or approximately 2.3 percent, for the suburbs and outlying areas.

Firms located in the city of Akron applied for 1,272 U.S. patents and applications (14.7 percent of the region's total), while the patent activity in the surrounding suburbs and outskirts only totaled 494, or 5.7 percent. Firms located in the city of Youngstown applied for 33 U.S. patents and applications, or 0.4 percent of the region's total patent activity. But in contrast to the trends in the suburbs and outlying areas in Cleveland, Pittsburgh, and Akron, there was greater patent activity outside the city of Youngstown though of a considerably smaller scale. Firms located in the suburbs and outskirts of the city of Youngstown applied for 60 U.S. patents and applications, or 0.7 percent.

These data show that most of the innovative and creative work takes place within the city bounds, leaving a portion of activity in the region's connecting suburbs. The data reveal some other patterns consistent with our findings about the region gleaned from our survey, which is discussed in detail in the next section of the paper. Cleveland accounts for the largest number of firms and the greatest amount of activity. Cleveland also has a greater proportion of larger and older firms.

The data reveal that there are about 1,000 firms in the region actively engaged in inventive activity and creating intellectual property. The majority of these firms are very small, with exactly one patent or application (53 percent) between 2006 and May 2010. Moreover, 90 percent of the firms in the region hold 12 or fewer patents.

The distribution has what economists call a "long tail," with some large established firms in the region applying for several hundred patents. Indeed, the largest firms in the region still account for the largest amount of patent activity. Goodyear accounted for just under a thousand patents (944) while the Eaton Corporation accounted for 794. Universities and medical centers are among the top patenting

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entities in each of the cities: The University of Pittsburgh applied for 198 patents, followed by Carnegie Mellon (119), Cleveland Clinic (118), Case Western Reserve University (109), and the University of Akron (86). The most inventive firms represent a range of industrial sectors from chemicals and paints to advanced materials and defense contracting. (See Table 2)

TABLE 2
The top ten in innovation

The ten most active inventing firms in each major city in the region

Akron		Cleveland		Pittsburgh		Youngstown	
Assignee/firm	Patents/ applications	Assignee/firm	Patents/ applications	Assignee/firm	Patents/ applications	Assignee/firm	Patents/ applications
Goodyear	944	Eaton Corp.	792	University of Pittsburgh	195	R & L Marketing & Sales, Inc.	11
University of Akron	86	PPG Industries	497	Alcoa Inc.	181	Exal Corporation	8
Theken Spine, LLC	17	Electrolux Home Products	243	Chem Image Corp.	154	Gasser Chair Company, Inc.	6
Apteryx, Inc.	16	Parker Hannifin	201	Carnegie Mellon	119	Maui Toys, Inc.	2
Lockheed Martin	16	The Cleveland Clinic Foundation	118	Bayer Material Science LLC.	76	George A. Mitchell Company	1
Advanced Elastomer System, L.P.	14	Case Western Reserve University	109	Westinghouse Electric Co. LLC	48	King Tool & Manufacturing Company, Inc.	1
Ecology Coating, Inc.	14	Ferro Corporation	108	Vocollect Healthcare Systems, Inc.	35	Next Energy Wave, Inc.	1
OrthoHelix Surgical Designs, Inc.	12	Sherwin Williams	80	Dynamics Inc.	32	Renal Clean Technology	1
GOJO Industries, Inc.	8	Lubrizol Advanced Materials, Inc.	58	Jenmar Corporation	31	The Ink Factory, Inc.	1
Akron Special Machinery; Khyber Technologies Corporation; Spinematrix, Inc.; T. K. M. Unlimited, Inc.	6	The L.D. Kichler Co.	50	Emerson Process Management Power & Water Solutions, Inc.	27	Turning Technologies, LLC	1

Source: Delphion Patent Database. The counts include the number of published U.S. patents and applications from January 2006 to May 2010 for Akron, Cleveland, Pittsburgh, and Youngstown municipalities.²⁸

The upshot of all these shared characteristics? The cities and the surrounding suburbs of this region share much in common that defines their experience—a similar shared industrial history and recognition of the need to develop new companies that can grow to prominence and provide jobs and prosperity—alongside overlapping sets of suppliers, management personnel, and well-trained workforces. In addition and most pragmatically, there is wide recognition that new thinking is needed about how to best move the region forward. There is receptivity to trying new things to rebuilding the economy.²⁹ A new generation of talented leaders and innovators are making a deliberate and conscientious choice to stay in the region and are dedicated to building its success.

Robust innovative and energetic efforts at the state and local level are working to build upon the regions substantial assets to create a more vibrant, 21st-century regional economic cluster. The Center for American Progress Regional Firm Survey captures these regional strengths, but we also learn that there are critical missing elements necessary for this “Silicon Valley of its Time” in the 19th and 20th centuries to become something different in the 21st century—missing ingredients that the federal government is not providing and which the state and local governments increasingly cannot afford to provide. To this we now turn.

The view of the region's businesses

Our focus in this report is to study the innovative firms in this region to see how they interact with federal, state, and local innovation policy programs; with each other; and with markets outside of their region. See our methodology section in Appendix One for a comprehensive breakdown of how we went about sampling and surveying these companies, which were promised anonymity in return for their candid participation. But briefly, one of our sources for companies to survey came from patent applications—new ideas that are protected as intellectual property. This provides one means to understand innovative capacity in a regional economy.

The patent data reveal an interesting pattern. The regional economy has three distinct categories of inventive firms. The first consists of large established companies that started from 1870 to the tail of end of World War II; these are Fortune 500 or former Fortune 500 or spin-off companies from these big firms that have thrived in the region. The second consists of new startups launched in 2000 or later, with the number of employees ranging from 10 to 50 employees, with some a bit larger. And the third consists of older midsized firms that started between 1946 and 1999 and, on average, have about 85 employees.

Our survey of firms found similar patterns. More than half of our survey respondents had applied for U.S. patents. And firms that did not apply for patents were younger or working on software, research, or professional services that do not require patent protection. From our survey we also find that the midsized firms were just as likely as small firms to apply for patents and to have licensed intellectual property from a university. The midsized firms were more likely to pursue other strategies to gain access to intellectual property, such as acquiring other firms and participating in cross-licensing agreements.

This is the first top-line finding of our survey—that these midsized firms are an underappreciated and underserved innovative resource in the economy. Other than the Manufacturing Extension Partnership, a program funded through the Department of Commerce's National Institute of Standards and Technology to

support U.S. manufacturers with innovation,³⁰ little activity is targeted to these kinds of firms, and we find that they participate less in government programs. This is unfortunate because these older firms have already demonstrated that they understand customer demand and distribution channels. They know how to meet a payroll and hire employees. This group of firms is sadly underserved by federal innovation programs. As an economic development strategy, it might be easier to take firms with a track record and help them grow to the next level, expanding into new markets or product segments.

In contrast, the smaller and younger firms who responded to our survey have a host of public programs to tap. At the state level there is Pennsylvania's Ben Franklin program and Ohio's Third Frontier program. And at the federal level, these programs include the Small Business Innovation Research, or SBIR grants, and Small Business Technology Transfer, or STTR research grants, which are distributed by 11 federal agencies under the administrative guidance of the Small Business Administration; and the National Science Foundation's Partnerships for Innovation competitive grant program, which fosters collaboration between academia, government, and the private sector; and its Advanced Technology Education program and Industry-University Cooperative Research Partnership program promote collaboration with technical colleges.

Then there's the Department of Commerce's Technology Innovation Program, which makes competitive grants to businesses, universities, and nonprofit groups to invest in high-risk, high-reward research in areas of critical national need; and the Department of Labor's two grant programs designed to help regional economic development and workforce development: the Employment and Training Administration's WIRED program and the Community-Based Job Training program. (See Appendix Two for a broad look at all of these federal innovation programs, including those which are not strictly innovation financing programs but also innovation nurturing programs, such as the MEP and the Labor Department programs.)

We chose to ask companies in this region about the efficacy of these specific programs because they most obviously represent the core federal programs designed to boost our nation's effort to commercialize our nation's most innovative ideas. To understand how well or poorly they work we sought to answer the following questions:

The smaller and younger firms who responded to our survey have a host of public programs to tap.

- Do firms use these federal programs and funding?
- How does federal funding help firms?
- Do firms use state and local programs and funding?
- How do these state and local programs help firms?
- Do federal, state, and local programs work together?
- What challenges are faced by firms in the region?
- Could better cluster coordination help this region?

The results are detailed in our analysis below.

We asked firms about their use of the largest federal programs that focus on innovation listed in Table 3 on page 23. We asked about program participation and funding since 2007, the year that the economic slowdown started and when currently available federal data stops. The majority of firms (63 percent) did not seek federal funding or work with federal programs, responding that they did not know about programs or did not believe that they qualified.

This result suggests that there is a lack of information about federal programs that could potentially benefit the firms, though the nature of our self-reported survey could not assess whether the firms would have been eligible for any of these programs had they known about them and applied for them. Still, when firms were asked about their future plans, about a third of those firms that had not worked with federal agencies indicated that they would like the opportunity to work with the federal agencies in the future. These firms were interested in working with one of these federal programs, whereas only 5.37 percent of the firms specifically said that they would not work with the federal programs.

Thirty-seven percent of the firms did apply or receive funding or services from a federal agency over the three-year period. The SBIR/STTR programs were the most active of the federal programs, targeted toward firms with less than 500 employees. The largest 11 federal agencies allocate 2.5 percent of the annual extramural budget to the program.³¹ Almost half of the firms (45.5 percent) that had applied for federal funding applied to SBIR/STTR, and a total of 40 awards were made to 34 firms in the sample since 2007.

With regards to Phase I SBIR and STTR grants,³² which provides funding for up to six months in amounts up to \$150,000 for a firm to evaluate the scientific and technical merit of an idea, 29 firms received one SBIR or STTR award. Five firms reported more than one SBIR or STTR Phase I award during this time, with four firms receiving two SBIR awards and one firm receiving three awards.

TABLE 3
Tapping federal innovation programs

Firm involvement with federal programs

Federal agencies & programs	Would not want to work with (percent)	Would like to explore/work with (percent)	Applied or received funding (percent) ³³
SBIR/STTR, all agencies	6.56	59.84	45.45
National Science Foundation: Partnerships for Innovation (PFI)	3.35	43.10	4.69
National Science Foundation: Advanced Technological Education Program	4.61	28.11	3.13
National Science Foundation: Industry-University Cooperative Research Centers	5.29	33.04	3.17
Dept. of Commerce: Manufacturing Extension Partnership	4.52	29.86	7.81
Dept of Commerce: Technology Innovation Program	4.70	41.03	6.45
Dept. of Labor: WIRED Program ³⁴	6.02	18.06	6.25
Dept. of Labor: Community-Based Job Training Program	7.91	20.47	4.76
Total	5.37	34.19	10.21

Source: Center for American Progress Regional Firm Survey

Examining this distribution by the study area in each state, we find that a larger percentage of Phase I awards were granted to firms in the study area in Pennsylvania than compared to Ohio. Although a number of federal programs administer the SBIR and STTR federal program, within this sample of firms one firm received support from the Department of Commerce, four from the Department of Defense, two from the Department of Energy, 18 from the National Institutes of Health, two from NASA, and one from the National Science Foundation.³⁵ As for the other SBIR and STTR programs administered through the Department of Agriculture, Department of Education, Department of Homeland Security, Department of Homeland Security, and Environmental Protection Agency, a number of firms in the sample commented that either they did not know about the SBIR and STTR program through those agencies or believed that they did not qualify for funding.

As for Phase II SBIR and STTR awards,³⁶ which award funds of up to two years in amounts of up to \$1,000,000 to recipients of Phase I funding to expand and develop the results of their preliminary work, 24 awards were granted to 22 firms in the sample during the same timeframe. Two firms received two Phase II awards, while the remaining 20 firms were recipients of one Phase II grant. As for the distribution of Phase II grants by the two study areas, 11 were granted to firms in the study area of Pennsylvania, 12 to firms in the study area of Ohio, and one

to Minnesota (through a subsidiary based in Cleveland). With regards to which agency administered the grant, five firms received Phase II grants through NSF, two through NASA, 12 through NIH, and five through the Department of Defense.

We then asked respondents to comment on the size of the funding award they received. The Phase I awards, on average, were \$116,529 and the Phase II awards averaged \$694,126. One measure of success is for a firm to receive a follow-on Phase II award. This was the case for approximately half of the recipients. Firms reported that SBIR financing was important to their survival and innovative activity, something we will return to later.

The SBIR/STTR programs also piqued the greatest interest among firms. Of the eight federal R&D programs, the largest percentage (60 percent) expressed interest in working with the SBIR/STTR programs in the future. Other federal programs, however, also drew interest, including NSF-Partnerships for Innovation³⁷ and the Department of Commerce's Technology Innovation Program.³⁸ Approximately 40 percent of the firms expressed interest in working with either of those two programs.

The results of our survey suggest that companies find these federal programs useful and supportive, but only up to a point. As we demonstrate in a section of the paper below, companies find the size of the grant to be too small and thus public support rarely helps them traverse the so-called "valley of death" between the discovery of a useful innovative product or service and its successful commercialization. In short, they are "small beer"—too small to be really effective even if useful given inherent limitations.

In addition, firms find federal programs to be useful only to the extent that the time and effort to apply for federal funding was not a burden, which often is not the case given the daily business demands they face. Interestingly, we also find that a majority of companies surveyed believed the federal programs did a poor job fostering the kind of regional, cluster-based economic development they think is needed to boost their own fortunes and those of the region. This, too, we discuss later in the report, but first we need to examine briefly how companies tapped the American Recovery and Reinvestment Act of 2009.

American Recovery and Reinvestment Act

ARRA provided an opportunity for firms to apply for a special category of grants and contracts aimed at stimulating economic activity. Thirty-five percent of firms reported applying for funding from the various federal programs in 2009 (we did not ask in the survey about specific ARRA funding programs or attempt to ascertain whether any of the firms were in fact eligible for ARRA funding). These were applications for individual firm funding and the results were not encouraging. Of the 35 percent of the firms that applied for ARRA funding, the majority (57 percent) were denied funding (see Table 4). Another 17 percent had not yet received a decision. For firms, this was disappointing and seemed to be against the intention of the program—to seed a speedy recovery.

Seventeen percent of the firms that applied did receive ARRA funding. One firm noted that ARRA funding kept the firm solvent during this economic downturn; another firm found that the funds provided expansion capital. All six firms reported that the funding was useful for developing new products and processes. Nevertheless, the recipients noted that the administrative burdens affiliated with the program were substantial and potentially outweighed the benefits of participating in the program. It is interesting to note that, given the severity of the economic climate at the time, only 13 percent of the total sample of firms took advantage in applying for this federal program.

Overall, then, the view of small- and medium-sized businesses in the region about the efficacy of federal innovation programs was, well, not very positive among those firms that tapped the programs—even though many of these companies said that tapping them was still worthwhile. Yet our survey also reveals that many firms have not taken advantage of these programs because they did not know about them until our survey, which begs the question: Are they better off for not having done so? The answer, which we detail in the next section of this report, should be revealing for policymakers.

TABLE 4
Stimulus Act funding not a great source of financing

Results from the American Recovery and Reinvestment Act of 2009

Answers	Percentage
Applied for ARRA Funding	35.0
Application pending	17.1
Application denied	57.1
Funding to keep solvent	2.9
Expansion capital	2.9
Funding for new products/processes	17.1
Created burdens that outweighed benefits	8.6

Source: Center for American Progress Regional Firm Survey

Outcomes of federal funding for firms in the region

The firms we surveyed were asked to comment on any outcomes from their federal funding. Specifically, we asked if the funding resulted in new or significantly improved goods, services, methods of manufacturing, logistics, delivery or distribution methods of inputs, and support for processes, including maintenance systems or operations for purchasing, accounting, or computing. The results indicate that slightly more than half of the firms (54.4 percent) introduced a new or significantly improved product as a result of federal funding. Federal funding enabled almost half of firms to introduce new or improved production methods.

TABLE 5
How well do federal funds foster innovation?

Firms responded that they helped them develop new or significantly improved goods and services most of all

Outcomes of federal funding	Percentage
New or significantly improved goods	54.4
New or significantly improved services	39.1
New or significantly improved methods of manufacturing or producing goods or services	45.7
New or significantly improved logistics, delivery, or distribution methods of inputs	2.2
New or significantly improved support for processes, including maintenance systems or operations for purchasing, accounting, or computing	8.7

Source: Center for American Progress Regional Firm Survey

Approximately 40 percent of the firms reported that federal funding allowed them to improve services. One firm, for example, reported that federal funding helped secure its ISO certification—a key industry and service standard that enables companies to expand their business—while another reported that its SBIR funding allowed them to develop a new motor for the commercial market. These results suggest that federal funding has the greatest influence over improving products and production processes. There was less effect on helping firms improve logistics or improve their systems for purchasing, accounting, or computing and achieve operating efficiencies, all of which are complementary activities that increase firm competitiveness.

Overall, the results suggest that federal programs do contribute to incremental innovation and enhance firm competitiveness even though firms could benefit from additional help in supply chain management and logistics, and in realizing greater operating efficiencies to enhance the development of goods and services. In other words, federal policymakers should focus on a broader meaning of “innovation” further down the value chain of goods and services delivery. That additional help would enable them to be in a better position to hire additional workers. (See Table 5)

We then asked firms to assess how government funding affected their current development using a classic question used by economic development academics that was first attributed to Edwin Mansfield, professor of economics at the

University of Pennsylvania.³⁹ The question tries to assess the contribution of government funding by asking “if your organization did not receive this funding, what percentage of current products would not have been developed or would have taken longer to develop?” For federal programs, 53 respondents said that, on average, about 40 percent of their current products would not have been developed, and half of their products would have been developed but would have taken longer to develop.

We also asked the recipients of federal funding whether they experienced additional benefits from receiving federal funding. Specifically, we wanted to find out whether the funding assisted the firms in:

- Gaining expertise that was not elsewhere available
- Securing additional state and local funding
- Securing additional private funding
- Providing contacts for federal procurement contracts and/or sales
- Providing industrial contacts
- Helping with business development
- Providing no benefit other than receiving the R&D funding

Sixty-eight firms from the sample responded to this question. About 40 percent of the firms noted that they gained expertise that was not elsewhere available and also found the federal funding to be useful in securing additional state and local funding. Roughly a third of the respondents found the federal funding assisted the firm in securing additional private funding, providing industrial contacts, and improving business development. These are important functions for further business development.

Only 11.8 percent of the firms found federal funding to be beneficial in securing federal contracts for good and services. This is unfortunate as government procurement could be an important stable customer for firms. Finally, 19.1 percent of the firms commented that they received no other benefit other than the funding from the federal grant. (See Table 6)

Overall, then, the results of our survey indicate that federal programs serve a useful purpose for businesses trying to innovate to compete in the global economy. They provide significant benefit to individual firms. Yet firms that receive federal funding tend to rely on one program, such as an SBIR/STTR from a particular agency, which means they are not tapping into a range of programs to help them

TABLE 6
The benefits of federal funding

New expertise and access to other sources of capital were the two significant benefits for firms

Additional benefits of federal funding	Percentage
Gained expertise that was not elsewhere available	39.7
Helped secure additional state and local government funding	38.2
Helped secure additional private funding	32.4
Provided contacts for federal procurement contracts and/or sales	11.8
Provided industrial contacts	29.4
Provided help with business development	32.4
No other benefit than R&D funding received	19.1
Other	14.7

Source: Center for American Progress Regional Firm Survey

innovate and then commercialize those innovations as their businesses grow and develop. This strongly suggests federal innovation programs exist in mutually non-connected “silos” and are unable to be as effective as they might otherwise be.

Nevertheless, federal programs are complemented by other kinds of public- and private-sector programs that provide financing, boost commercialization, and provide new expertise in their specialized product categories. The results from our survey in the next section show that firms experience a variety of benefits from federal funding that are more often directly linked to state and local innovation programs. These results point to some intriguing conclusions.

Outcomes of state and local funding

Since 2007, 44.2 percent of the firms that responded to our survey received funding from state or local agencies or programs. Given that only 37.2 percent of the firms in the sample applied for and/or received federal funding, this suggests a greater degree of activity between the firms and the state and local programs. In addition, the results suggest that firms in the study area in Pennsylvania are more active in seeking state and local funding than their Ohio counterparts.

The state of Ohio, however, provides larger awards to firms, on average. The maximum award came from the Ohio Third Frontier program—a state-funded program to create an “innovation ecosystem” that supports the efficient transition of great ideas from the laboratory to the marketplace—which offered a \$6,600,000 award. The minimum came from the Keystone Innovation Zone⁴⁰ program in Pennsylvania—an economic development agency designed to provide support for community/university partnerships to generate growth through technology transfer and entrepreneurship—which provided a \$5,000 award. On average, firms received approximately \$200,000 per grant through the state and local funding agencies during the three-year time period.

Firms reported that they would like to engage with state and local programs. More than half of the firms from the study area in Ohio (55 percent) would like to work with the Third Frontier program while a quarter of the firms from the study in Pennsylvania mentioned they would like to work with the program. Importantly, from our visit to the region and in survey responses it is clear that firms are aware of programs in their neighboring state and would like to be able to participate.

About 40 percent of the firms indicated that they were interested in working with agencies in their state in the future. Almost half of the Pennsylvania firms (48 percent) want to work with small business development centers, while 37 percent of the Ohio firms were so inclined, perhaps reflecting the fact that the Ohio firms were older and more established. (See Table 7)

Firms reported that they would like to engage with state and local programs.

TABLE 7
Firms want more state-level innovation funding

Firms' response by study area to the use of top state and local innovation programs and their interest in these programs (by percentage)

State programs	Would not want to work with		Would like to explore/work with	
	Eastern Ohio	Western Pennsylvania	Eastern Ohio	Western Pennsylvania
BioEnterprise (OH)	2.41	4.92	38.55	15.57
Catalyst Connection (PA)	5.13	7.14	16.67	28.57
Idea Foundry (PA)	9.10	9.68	22.08	42.74
Innova (WV)	3.85	5.93	14.10	14.41
Innovation Works (PA)	6.25	7.52	36.25	65.41
JumpStart (OH)	5.88	6.67	32.94	20.00
Keystone Innovation Zones (PA)	5.06	4.13	24.05	44.63
Pittsburgh Entrepreneur Fund (PA)	5.19	3.13	20.51	46.09
Pittsburgh Gateways (PA)	6.41	4.07	17.95	30.08
Pittsburgh Life Science Greenhouse (PA)	6.41	8.73	23.08	36.51
Small Business Development Centers (PA, OH, WV)	8.33	6.30	36.90	48.03
StartingGate (PA)	5.13	5.13	17.95	23.93
Technology Collaborative (PA)	7.79	4.10	20.78	32.79
Third Frontier (OH)	4.40	5.65	54.95	24.19
Total Average	5.81	5.94	26.91	33.78
Average for OH organizations	5.255	5.885	40.835	26.95
Average for PA organizations	6.48	5.99	23.62	39.88

Source: Center for American Progress Regional Firm Survey

Outcomes of state and local funding

Respondents also were asked to comment on any outcomes that may have resulted from their state and local funding. These two questions on the outcomes were identical to the questions asked in the federal funding section with the exception of the state and local focus. Compared to the results of this similar set of questions focusing on the outcomes of federal funding programs, these results suggest that the financial support from state and local programs were not as successful at supporting incremental improvements in goods and services. Indeed, only 24.4 percent, 17.7 percent, and 10.9 percent of the firms noted that the state and local funding resulted in incremental new or improved goods, services, and production methods, respectively. This compared to the 54.4 percent, 39.1 percent, and 45.7 percent of firms who responded to this question in federal funding section. (See Table 8 on page 31)

As for additional benefits from the funding, the data similarly suggest that state and local funding did not have the same impact for firms seeking to secure additional funding, create contacts, and improve the business development of the firm as it did for firms who were recipients of federal funding. The most prevalent benefit of state and local funding reported was providing industrial contacts (19.3 percent), help in securing additional funding (18.5 percent), and help with business development (16.8 percent). (See Table 9)

Overall, then, we believe there is a complementary, though not necessarily complimentary, conclusion we can draw from firms' responses to our questions about the efficacy of state and local funding in and of itself and in relation to federal funding. Proportionally more firms reported higher levels of benefits from the federal programs than the state and local programs. While we are unable to accurately generalize about these state and local programs from these survey results alone, it is compelling that the results suggest there is more activity on the local and state level yet there are more beneficial results from the federal funding.

This is perhaps not surprising because federal awards are larger on average. Yet state and local programs are closer to firms, with easier interaction and more tailored programs. This information suggests that federal policymakers could learn from these state and local programs, and that federal, state, and local programs working in concert are essential to the vitality of the region as it transitions from its 20th-century roots to compete more effectively in the 21st century. The relevant question then is how much cooperation is evident today in federal, state, and local innovation programs? Not very much, alas, as our next section of the report attempts to gauge.

TABLE 8
States help startups, not incremental innovation

Outcomes of state and local funding	Percentage
New or significantly improved goods	24.4
New or significantly improved services	17.7
New or significantly methods of manufacturing or producing goods or services	10.9
New or significantly improved logistics, delivery, or distribution methods of inputs	4.2
New or significantly improved support for processes, including maintenance systems or operations for purchasing, accounting, or computing	5.0

Source: Center for American Progress Regional Firm Survey

TABLE 9
Additional benefits resulting from federal funding

Benefits	Percentage
Gained expertise that was not elsewhere available	6.7
Helped secure additional state and local government funding	16.8
Helped secure additional private funding	18.5
Provided contacts for federal procurement contracts and/or sales	12.6
Provided industrial contacts	19.3
Provided help with business development	16.8
No other benefit than R&D funding received	4.2
Other	3.4

Source: Center for American Progress Regional Firm Survey

How government programs work together

So how well do these various federal, state, and local programs work together today? To really answer this question would require so-called “time series data”—information on the support that firms received over time—ideally from the funding agencies rather than self-reported. Our data are a cross section, or more commonly referred to as a “snapshot” of information relying on firms self-reporting. Still, we believe our survey provides some useful first insights into the handoff between levels of government and what firms perceive is missing or could be augmented.

We asked firms to provide comments of their opinions regarding intergovernmental cooperation between the federal, state, and local levels (see Table 10). Firms were asked to gauge how well state and local governments do the following:

- Provide information about federal R&D programs
- Provide matching funds for federal programs
- Assist with grant applications for federal programs
- Work with federal programs

TABLE 10
How effective is intergovernmental cooperation?

Intergovernmental cooperation	Agree (percent)	Disagree (percent)
State/local economic development agencies provide good information about federal R&D programs	26.46	41.44
State/local economic development agencies provide matching funds for federal programs	12.64	41.76
State/local economic development agencies help with grant applications for federal programs	26.33	39.31
State and local programs work with federal programs	16.92	33.08

Source: Center for American Progress Regional Firm Survey

This is a subjective question and responses varied from strongly agree to strongly disagree. But for all four questions, on average, the firms felt that intergovernmental cooperation between the federal, state, and local programs could be improved. Most notably, more than 40 percent of the firms disagreed with the following statements: “State/local economic development agencies provide good information and matching funds for federal programs.”

The results from the survey also suggest that there is an underlying skepticism among firms regarding how well the different levels of government cooperate with one another. Although these results represent the opinions of the firms, it is important to note

that there is a certain level of frustration shared among firms when it comes to working with the various levels of government. Taking an even closer look at these responses, we find that the opinions regarding intergovernmental cooperation vary by each of the study areas in Ohio and Pennsylvania (see Tables 11 and 12).

Reporting the data by state, we find that there is a greater degree of skepticism about government cooperation expressed by firms located in northeast Ohio as opposed to those in western Pennsylvania, perhaps because Ohio’s innovation funding programs were launched more recently. On average, 43.6 percent of the firms from the Ohio study area disagreed with the statements pertaining to intergovernmental cooperation between the federal, state, and local levels of government. Most notably, approximately 45 percent of the firms from that area expressed frustrations with the government’s ability to provide information, match funds, and assist with the grant application process for the various levels. The firms in western Pennsylvania did not express frustrations to the same degree as their counterparts in northeast Ohio. Nevertheless, they did express more skepticism than agreement with the effectiveness of intergovernmental cooperation.

These responses from firms, taken together, illustrate two fundamental flaws in the federal government’s traditional approach to economic development and state government’s capabilities of tapping into those federal programs. The first flaw is that federal innovation programs are not deployed around the country with any regard for the cluster-based development objectives of state-level innovation programs. The federal government has greater resources to allocate for innovation and their efforts might be more effective if coordinated with local objectives.

The second flaw is that these federal programs are so complicated and “siloeed” that state agencies cannot easily help their company clients tap these federal programs to face the challenges they must overcome to grow. And the companies we surveyed were clear about the kinds of challenges they face—ones that federal, state, and local innovation programs together and separately are not adequately equipped to help resolve. This is the subject of the next section.

TABLE 11
Northeastern Ohio’s view of intergovernmental cooperation

Intergovernmental cooperation: OH	Agree (percent)	Disagree (percent)
State/local economic development agencies provide good information about federal R&D programs	24.75	45.54
State/local economic development agencies provide matching funds for federal programs	15.84	46.53
State/local economic development agencies help with grant applications for federal programs	24.75	44.55
State and local programs work with federal programs	15.84	37.62

Source: Center for American Progress Regional Firm Survey

TABLE 12
Western Pennsylvania’s view of intergovernmental cooperation

Intergovernmental cooperation: PA	Agree (percent)	Disagree (percent)
State/local economic development agencies provide good information about federal R&D programs	27.84	37.34
State/local economic development agencies provide matching funds for federal programs	10.90	37.18
State/local economic development agencies help with grant applications for federal programs	28.03	34.39
State and local programs work with federal programs	18.06	29.03

Source: Center for American Progress Regional Firm Survey

Challenges facing firms in the region

Firms in the region said they faced many of the same challenges, beginning with a lack of expansion capital, then a lack of short-term funding, and then the cost of health insurance. More than a third of the firms reported that these challenges were significant problems facing their firm. The ranking of concerns are remarkably similar between the firms in northeast Ohio and the firms in western Pennsylvania, indicating regional similarities.

TABLE 13
Firms biggest challenge—lack of expansion capital

The next biggest challenge was a lack of short-term funding

Eastern Ohio		Western Pennsylvania	
Challenge: Significant problem	Percent	Challenge: Significant problem	Percent
Lack of expansion capital	48	Lack of expansion capital	59.87
Lack of short-term funding	42.42	Lack of short-term funding	48.41
Health insurance costs	32.67	Health insurance costs	35.44

Source: Center for American Progress Regional Firm Survey

TABLE 14
Challenges that are less of a problem

These issues indicate that much of the critical mass for company development exists in the region

Challenge: Not a problem	Percent
Lack of other vendors (accountants, suppliers, service providers, etc.) with expertise matched to firm's industry sector or growth stage	53.75
Lack of legal expertise matched to the issues of the firm's industry sector or growth stage	49.19
Lack of university expertise in our industry/technology	48.24
Lack of capable suppliers	43.20
Lack of management talent	41.02

Source: Center for American Progress Regional Firm Survey

What young startups felt most acutely was the need for additional short-term funding. Half of the firms started since 2007 report that short-term funding is a significant problem. And for firms started between 2000 and 2007, 54 percent reported that short-term financing was their most significant problem. About a quarter of the firms that responded to our survey were started before 2000 but after 1945. For this group, 45 percent reported that the lack of expansion capital was a significant problem. Otherwise, the responses were remarkably similar to their younger counterparts.

Notably, firms did not report that they were significantly challenged by either domestic competition (less than 10 percent noted this as a significant challenge) or global competition (15 percent reported as a significant problem). Government regulation was reported as a significant challenge by 22 percent of the firms. In addition, approximately half of the firms responding to this question commented that lack of vendors, lack of legal expertise, and lack of university expertise were not a problem for this region (see Tables 13 through 15).

When we consider these responses from the firms launched since 2000 or 2007, we find that the usual complaints from startup companies, such as lack of available management and workforce talent, are reported to be significant problems by less than 15 percent (13.3 percent for firms started after 2000 and 14.1 percent for firms started after 2007). The presence of established large firms in the region who have hired and trained the workforce and the relatively high unemployment rate may be the reason for this finding.

The region boasts other strengths as well. More than half of the firms reported that demand for their product remained strong during the recession. Firms also report that there were capable suppliers in the region and there were no problems with recruiting production and/or semi-skilled workers. Notably the responses between firms in the study areas of Ohio and Pennsylvania are remarkably similar.

These results suggest that the region has the infrastructure for sustained economic growth based in part on these growing entrepreneurial firms. What is lacking, however, is the short-term financing needed for supporting these firms during their initial stages of growth alongside the expansion capital needed to grow over the long term. The third challenge, health care costs, will be dealt with over the coming decade as the Obama administration's recently enacted comprehensive health reform law is put in place.⁴¹

These regional strengths and weaknesses are critical to understanding how state and federal innovation programs can be better deployed to help this region's economy grow. The region clearly boasts plenty of well-trained workers and management talent alongside a healthy complement of suppliers and customers. What firms need to compete is simply better access to startup and expansion capital. But before we can develop any firm principles about how to overcome this weakness and boost these strengths, policymakers need to understand a bit more about the different regional industry clusters in this region.

TABLE 15
Challenges that are not a major problem

These findings in both states show regional competitiveness is strong

Eastern Ohio		Western Pennsylvania	
Challenge: Not a problem	Percent	Challenge: Not a problem	Percent
Lack of product demand	53.06	Lack of product demand	51.61
Lack of capable suppliers	47.00	Lack of capable suppliers	49.03
Lack of skilled production workers	44.55	Recruiting production and/or semi-skilled workers	45.81

Source: Center for American Progress Regional Firm Survey

Regional industry clusters

Once again, the data are inadequate to the task of determining a comprehensive industrial distribution in the region. Ideally, we would like to understand the commonalities between firms in the region. The Standard Industrial Classification codes used by the federal government to classify different types of industries provide one snapshot of firm activity in the region, but usually every firm is assigned one category to represent its dominant activity. We provided a detailed list of the so-called North American Industry Classification System, or NAICS categories, and asked firms to check all relevant activities that applied to their business.

Information Technology received the highest number of mentions among our respondents: just under a quarter of all firms in the region reporting that they worked in information technology goods and services. This was higher in western Pennsylvania and confirms the development of a cluster of information technology firms around Carnegie Mellon University. Firms in northeast Ohio reported Aerospace and Defense as their top business activity (10.9 percent), but about 15 percent of the responses here fall into the nondescript category of Not Elsewhere Classified (see Table 16). This data illustrates few strong concentrations of activities among firms.

TABLE 16
One snapshot of the region’s different industry clusters

Identity of firms by Standard Industrial Classification codes, by percentage

Industry	Total	Eastern Ohio	Western Pennsylvania
Aerospace and defense	7.76	10.94	5.73
Automobiles, motorcycles, and components	3.73	3.91	3.65
Bioscience	5.90	5.47	6.25
Capital goods	6.83	7.81	5.73
Commercial and commercial services	6.52	6.25	6.77
Consumer goods and services	3.73	3.91	3.65
Energy	7.76	10.16	6.25
Finance	0.62	0.78	0.52
Health care	14.29	8.59	18.23
Information technology—goods and services	23.29	11.72	31.25
Materials	6.83	9.38	4.69
Telecommunication services	1.24	0.78	1.56
Transportation services	0.62	1.56	0.00
Utilities	1.86	3.91	0.52
Not elsewhere classified	9.01	14.84	5.21

Source: Center for American Progress Regional Firm Survey

The more detailed NAICS categories provide additional detail. These responses reveal that software publishing is the dominant activity within Information Technology. This is the particular specialization among western Pennsylvania’s firms. Northeast Ohio has a concentration in Electric Power Generation, Transmission & Distribution and in the elusive category of Miscellaneous Manufacturing. (See Table 17 on page 37)

In our survey, we also asked firms for the name of their cluster as an open-ended question. Any reader familiar with survey design knows this is a risky and uncertain undertaking—and one that requires making sense of what is filled in. Still, we wanted to see if any patterns emerged. In alphabetic order and with some interpretation, seven firms reported their cluster as advanced energy;

15 firms reported bio-medical, biotech, biosciences, and life sciences; and another three firms reported medical devices. Two additional firms reported health care and were focused on health delivery and health informatics. Chemicals, contract manufacturing, financial security, gas well drilling, nanotechnology, new media, speech recognition, and telecomm each received one vote each. Another two firms reported fuel cells. Three firms mentioned robotics, four firms mentioned materials, and three firms mentioned industrial instrumentation and controls. These are not very satisfying or useful results.

To better interpret firm activity in the area, we triangulated these series of questions about firm activity, including the five-digit NAICS code system, which identifies detailed industry category, an open-ended question about the primary activity of the organization, and an open-ended question about the name of the cluster with which the firm identified. Where possible, we verified information from company websites and secondary sources. The objective was to discern a set of coherent activities that were prominent in the region. This should be recognized as an interpretive exercise. There were 253 responses where the pattern of activity was identifiable.

We present the data in aggregate by state, and then by firm age. Our sample is small and the intention is to identify patterns of expertise. Rather than report raw numbers, we provide percentage to give an idea of relative importance. (See Table 18 on page 38)

The numbers provided are the percentage of activity that falls within each category. For instance, manufacturing represents 29 percent of firm activity in northeast Ohio and 19 percent in western Pennsylvania. Manufacturing represents 23 percent of all firms started in northeastern Ohio after 2007 and 7 percent of similar new startups in western Pennsylvania. For firms started from 2000 to 2006, manufacturing accounted for 22 percent in Cleveland, Akron, and Youngstown, and 15 percent in western Pennsylvania.

TABLE 17
Another snapshot of the region's different industry clusters

Identity of firms under the North American Industry Classification System by frequency

Industry	Industry ID number	Total	Eastern Ohio	Western Pennsylvania
Aerospace product and parts manufacturing	33641	14	7	7
Medical, dental, and hospital equipment and supplies merchant wholesale	423450	10	4	6
Scientific research and development services	54170	10	4	6
Electric power generation, transmission, and distribution	22110	12	9	2
Pharmaceutical, medicinal, botanical, and biological products (except diagnostic) manufacturing	32540	10	1	8
Software publishers	51120	21	4	17
Information services (not elsewhere listed)	51900	11	3	8
Computer systems design and related services	54150	13	2	11
Miscellaneous manufacturing (not elsewhere listed)	33990	14	11	3
Professional, scientific, and technical services (not elsewhere listed)	54190	11	6	5

Source: Center for American Progress Regional Firm Survey

TABLE 18
Types of industry clusters in the region

Manufacturing and machinery top the list, followed by software

Focus	Ohio study area					Pennsylvania study area				
	Total (by percent)	Newest startups	Firms started 2000-2007	Middle	Older firms	Total	Newest startups	Firms started 2000-2007	Middle	Older firms
Business services	10	9	16	11	0	12	20	8	6	
Consumer service	3		3			1	2	2		
Medical diagnostics	1		3			2	4			
Energy	1			3						
Green technology	10	18	6	8		6		7	3	
ICT		6				6	4	12	3	
Machinery	16	18	3	24	40	6	4	2	20	
Manufacturing	29	23	22	38	60	19	7	15	31	86
Materials	4		3	5		4	4	5	3	
Medical devices	8	5	19	3		12	9	15	14	
Biotechnology research	4	5	6	3		4		7	6	14
Software	11	23	13	5		24	31	25	14	
Human therapeutics	2		6			3	7	2		

Source: Center for American Progress Regional Firm Survey

These results indicate that manufacturing is still important as a startup activity in this region—perhaps not a surprise given the region’s industrial legacy. Unfortunately there is a perception that manufacturing is an old economy activity; nothing could be further from reality.

Manufacturing is an innovative and knowledge-intensive activity that builds upon this region’s traditional strengths. Our survey results strongly indicate that manufacturing in this region is highly innovative and warrants support. The new manufacturing is concentrated in instruments and products that use advanced materials. This activity reflects the ready availability of skilled labor and the available supply of components. The older industrial legacy lives on but is innovative as turbine manufacturers retool to manufacture wind turbines and high-precision manufacturing finds a profitable niche. Another strong activity in northeast Ohio was machinery, which has strong synergies with manufacturing.

Clusters can be built around manufacturing. Our respondents were not as worried about global competition as a threat because the lack of expansion capital was seen as the real threat. Much of the future of these endeavors depends on financing because manufacturing is capital intensive. Just as specialty steel mills have

replaced the steel industry, a new robust and innovative manufacturing industry based on specialty products and mass customization could be feasible if sufficient financing were available.

Yet the needs of manufacturing firms are very different from the other developing industries in this region, such as software, which is more strongly represented in Pittsburgh, or medical devices or biotechnology research. Targeted sector-specific policies could help, too.

Problem is, clusters develop in stages, gathering critical mass and deepening expertise over time even as they build on the foundations of past economic activity. This region is in transition and perhaps still at the earliest stage of cluster development in many of its new industries. As policymakers search for the recipe for industrial cluster development and economic vitality, there is evidence that cluster genesis can be facilitated by government action.⁴² The next section examines firms' views toward cluster coordination. Policymakers: Take notes.

Industry cluster coordinator

Firms in our survey who responded to our queries about organized self-defined clusters pointed to FlexMatters as the most identifiable cluster coordinator in the region. Formed in 2006, FlexMatters is building a new industrial cluster in northeast Ohio based on manufacturing emerging products on flexible plastic substrates, including displays, complex electronics, and solar cells. The articulated goal of FlexMatters is to create new industries, companies, and jobs in the state of northeast Ohio by leveraging existing technology strengths and assets, including the enabling technologies and manufacturers established in the region.

MAGNET, which stands for Manufacturing Advocacy & Growth Network, an Ohio MEP-funded cluster coordinator, and Ohio's Edison Technology Center were also mentioned frequently as a cluster leader in northeast Ohio. And a number of universities, agencies, and even individuals were mentioned as leading cluster efforts. The Pittsburgh Life Sciences Greenhouse was identified as the leader for western Pennsylvania's biosciences industries.

We also asked firms if they would work with an industry cluster coordinator if one were available. Overwhelmingly, 87.4 percent of the firms said they would work with a cluster coordinator. There was no difference between firms in northeast Ohio and western Pennsylvania. About half of the respondents (47 percent) felt that the cluster coordinator should be a regional function—that is multistate, rather than federal (10.4 percent), state (10.0 percent), local (19.4 percent), or private (19.1 percent).

The majority of respondents (52 percent) responded that public sources should fund the cluster coordinator function jointly with private sources but it should be privately run. Another 18 percent thought that cluster coordination should be publicly funded but privately run.

Finally, several respondents provided thoughtful comments. “A consistent economic development strategy with a long-term commitment to success with well-defined milestones and objectives would be useful,” says one respondent. “These strategies should be driven not by political policy but the reality of market dynamics, demand, and opportunities.” Another respondent suggests that “identifying ‘hot’ areas of technology based upon media hype does not support local capabilities.”

Both respondents’ points are well-taken—federal innovation financing must be directed to build upon existing, bottom-up competitive advantages of a region.

Conclusion: Time to support home-brewed innovation

Building better federal, state, and local innovation programs

The title of this report, “Silos of Small Beer,” was perhaps initially for readers a not-so-obvious but nonetheless apt play on words for the trivial amount of public money dedicated to the commercialization of our nation’s deep well of innovation, as well as the uncoordinated focus of our nation’s existing innovation policies. After reading our report, the meaning of the title of this conclusion should be readily apparent. Home-brewed innovation, nurtured in regional economies playing to the competitive advantages, needs better-targeted and better-coordinated federal, state, and local support.

In an ideal world, entrepreneurs with good ideas would be able to develop those ideas into new products and processes that would generate good-paying jobs and bring wealth and prosperity to their local and regional communities, in turn helping the national economy grow and prosper. Regions like northeast Ohio and western Pennsylvania are making progress at reinventing their local economies, but there are some principles that might make this task easier for policymakers to act upon—principles suggested by the responses of firms to our survey. Specifically, we believe that:

- Bottom-up, locally organized innovation programs would serve our national economy best in the 21st century, financed through public-private partnerships that include and connect all the players in a given regional innovation cluster.
- The federal government has a major facilitating role to play in this process. This includes significant increases in financing without imposing a monopoly on decision making or restricting the industries and companies that are eligible—recognizing the full range of firms that participate in a region’s value chain and aiming to increase the diversity of those participants so that the creation of high-quality jobs is an articulated objective.

- Each locally organized cluster will be different and thus will need flexibility in using support from the federal, state, and local governments.
- The federal government needs to streamline its innovation-financing programs to make it easier for all companies to access them and to foster relationships with local regions and firms that can help facilitate broader regional economic growth.

The federal government needs to streamline its innovation-financing programs

Imagine a process that would be seamless as ideas were vetted and augmented by good advice and sound mentoring, moving along the stages of financing in support of strong regional economic development based on the regions' self-organized competitive strengths. Entrepreneurs in startup firms and innovators in existing small- and medium-sized firms would be encouraged and advised. Funding would be available for idea development, prototyping, and proof of concept. An entire portfolio of ideas would be nurtured—some more high risk but high opportunity, while others more incremental and immediate with well-defined ready markets. A diverse group of interested regional champions would help keep the ideas on track. The best ideas would percolate to the top and be able to scale up using early-stage funding and then graduate to other types of funding and partnerships to secure the larger amounts of debt and equity funding available in our nation's deep capital markets.

Imagining, of course, then requires doing. One of the strengths of American federalism is that each level of government does what it does best. In this case, regional and local agencies are better able to tailor programs to the specific needs of industry. Regional programs are desirable because they create scale and critical mass for small cities and the suburban areas that unite them. We found that firms are more involved with local programs, but federal programs, perhaps because of larger funding amounts, are more beneficial in terms of realized outcomes that create those new goods and processes requiring well-paid workers. Policymakers need to pull all this together.

Each locally organized cluster will be different and thus will need flexibility in using support from the federal, state, and local governments. Various actors who we interviewed in the Pittsburgh-Cleveland-Akron-Youngstown region provided a variety of suggestions, such as bringing back community block grants and giving local government the ability to fund the program they know will work for their local area. And the firms we spoke with appreciate federal government grants but feel the pain of complicated forms, restrictive requirements, and lengthy processes. There is a frustration with not being able to find information about government programs and then finding conflicting or out-of-date information.

Moreover, there was real concern about local government inefficiency and overlap in provision of services. These inefficiencies are lost resources for the region. Innovative for-profit firms now try to guide firms through the maze of government funding and help them write winning grants. That should not be necessary; nevertheless, firms today need funding and will continue to apply to federal programs.

The bottom line is that for federal outlays of \$150 billion a year for basic R&D to realize their potential, the federal government in league with state and local governments needs to provide the mechanisms and (only when needed) public financing to help commercialize our small- and medium-sized firms' most promising ideas. And for our region of study in particular, the fact that manufacturing continues to hold a prominent presence in the regional economy warrants increased levels of support for the manufacturing sector.

Appendix One: Methodology

Survey objectives

The overarching scope of this research project is to study the efficacy of federal innovation programs in the Pittsburgh-Akron-Cleveland-Youngstown regional economy. With support from the Center for American Progress and The Heinz Endowments, Ed Paisley, the Vice President for Editorial at the Center for American Progress and Editorial Director of its Science Progress project, and Maryann Feldman, the S.K. Heninger Distinguished Chair in Public Policy at the University of North Carolina, Chapel Hill, led a research team in designing and conducting a survey of over 4,000 firms to identify how well or how poorly federal funding helps high-tech companies in this region grow and prosper.

The survey was comprised of 38 questions asking each firm to identify recent federal, state, and local public support, to comment on the outcomes from the public funding, to note challenges faced both by the firm and regional economy, to assess the level of intergovernmental cooperation between the federal, state, and local governments, and to provide general information on the organizational characteristics of the firm. To complement the survey, the research team interviewed more than 25 individuals in the region from a mix of enterprises engaged in innovation, from university incubators to state-funded technology-based economic development organizations, from startups and small- and medium-sized companies to state development agencies, and from angel investors to venture capitalists engaged in innovation funding and implementation.

How the survey was designed

Through a collaborative effort, the research team designed the Center for American Progress Regional Firm Survey with a concerted aim to measure the efficacy of federal innovation programs and intergovernmental cooperation. Lloyd Corder, from CorCom Inc., provided technical support for the computa-

tional design and implementation of the survey. Representatives from a number of regional economic development partners in the area were actively involved throughout all stages of the survey design—ranging from the initial outline of the survey instrument to final revisions. These regional partners included representatives from JumpStart, NorTech, and BioEnterprises in Ohio, and Innovation Works and the Pittsburgh Life Sciences Greenhouse in Pennsylvania.

In addition to this collaborative support, the survey was pretested and vetted with two firms, both of whom are clients of InnovationWorks. During the final phases of the design process, the survey was circulated within the academic community to researchers AnnaLee Saxenian, professor in the department of city and regional planning at the University of California at Berkeley; John Walsh, professor in the School of Public Policy at the Georgia Institute for Technology, and Professor Gary Herrigel at the University of Chicago's department of political science for final comments and revisions.

How the firms were chosen to take the survey

We first turned to local technology-focused economic development agencies that have an interest in keeping track of their client firms or the firms with which they have some relationship or contact. Firms approach these agencies for funding or to participate in programs. We used these lists as the initial basis for our study. Of the 4,195 firms surveyed, 2,895 were affiliated with a regional economic development agency—Innovation Works, NorTech, Pittsburgh Life Sciences Greenhouse, and BioEnterprises. For this sample of firms, a representative from each of the regional economic development firms administered the survey directly to their clients via a mail merge. This strategy was intentionally utilized to increase the response rate of the survey recipients.

What we lacked, however, was a comprehensive census of innovative firms. Of course, such a list would be out of date as soon as it was available as new firms are started and others fail all the time. But this is the target group with the potential to transform the regional economy. Available government data at the time of this analysis were from 2006 or 2007, before the onset of the Great Recession in December 2007. We wanted to sample firms for more current information.

Another problem we faced is that the majority of information on firm activity is presented on the city or state level, rather than the regional level. We felt that it was imperative to analyze this information on a regional level despite the many methodological hindrances that arose in custom tailoring a sample for this region. We needed to find those small- and medium-sized firms that are the intended target of most federal innovation programs to see if they are as aware of the range of state, local, and federal programs that can support innovation as the firms that work with the technology-based economic development entities in Ohio and Pennsylvania study area.

Economic development agencies do a good job working with their clients but have limited resources to serve the entire population of firms that might benefit, but patent applications provide one means to understand innovative capacity in a regional economy—new ideas that are protected as intellectual property. So we began our inquiry by gathering data on all published patents that had been issued or applied for from 2006 to the present in order to understand where we would need to look for the companies to which we needed to send our survey beyond the local economic development agencies. We then expanded upon our list of U.S. patent assignees between January 2006 and May 2010 who were located in the regional area to include a list of federal research grant recipients from the region.⁴³

Every firm selected in these searches was subject to comply with the industrial and geographic restrictions for this scope of study. In addition, the timeframe specified for these searches spanned from January 1, 2006 to May 20, 2010 to include the most recent activity. The federal research grants recipients included—SBIR and STTR awardees; Technology Innovation Program- and Manufacturing Extension Partnership-affiliated firms, specifically those associated with Catalyst Connection, the WVMEP program and MAGNET; NSF Partnerships for Innovation, Advanced Technological Education, and I/UCRC awardees; and NIH research grants recipients. As for the U.S. patent search, the research team consulted the Delphion database to pull U.S. assignees with active patents and applications within the specified time period and geographic region noted above.

Lastly, the team utilized the Capital IQ financial transactions database to pull a list of firms and dealmakers in the regional area. The result was an additional 1,300 firms added to the sample. For this second subset of firms, the research team administered the survey via email. During that time the research team and collaborative partners sent a request to take the survey two times.

How the survey was conducted

The survey was administered online to 4,195 firms; it was open for six and a half weeks between June 9, 2010 and July 23, 2010. With the firm as the level of analysis for this project, the survey was sent via email to one of the top executive administrators who served as a proxy representing each firm in the sample. Those who received the survey held one of the following positions—president, vice president, founder, chief executive officer, and/or chief financial officer.

Response rate to the Center for American Progress Regional Firm Survey

Source	Number of firms receiving survey	Response rate	
		Frequency	Percent
NorTech	1,432	102	7.1
PLSG	103	15	14.6
BioEnterprise	65	5	7.7
Innovation Works	1,295	99	7.6
Center for American Progress research team	1,312	51	3.9

In sum, 4,195 surveys were electronically submitted. Approximately 850, or roughly 20 percent of the full list bounced back due to invalid/inactive email addresses, thus yielding 3,345 recipients for this survey. The relatively large number of emails that bounced back reflected the turbulent and sporadic nature of startups and was indicative of entrepreneurial activity. Overall, the response rate for those firms with a valid email address, after sending two electronic requests to complete the survey, was

8.13 percent or 272 responses. We eliminated three responses due to incomplete information; thus yielding a final response rate of 8.04 percent, or 269 responses. The table above provides information on the response rate for the survey.

Appendix Two

Existing federal innovation programs⁴⁴

In this appendix, we will briefly present each of five sets of federal innovation programs that the Economic Development Administration would work with in league with a White House innovation team. We chose these policy programs because we believe they should be linked together by an explicit federal clusters initiative.

The five sets of policies we review include, first, the Small Business Administration's Small Business Innovation Research program and the Small Business Technology Transfer program, with the SBIR program spread across 11 different executive-branch departments and agencies and the STTR program involving five departments and agencies.⁴⁵ In 2004, the last year for which comprehensive data is available, the SBIR program provided over \$2 billion in funding to startup companies and the STTR program over \$208 million.⁴⁶

Second, federal funding for innovation is provided by the National Science Foundation. The NSF's Partnerships for Innovation competitive grant program fosters collaboration between academia, government, and the private sector, and its Advanced Technology Education program and Industry-University Cooperative Research Partnership program promote collaboration with technical colleges.

Third, the Department of Commerce runs federal innovation programs such as the Manufacturing Extension Program, or MEP, which consists of 59 manufacturing extension centers and 393 satellite locations throughout the United States and Puerto Rico, each center working directly with local companies to provide expertise and services tailored to their most critical needs, including employee training, new business practices, the application of information technology, and basic process improvements.

The Department of Commerce also funds the Technology Innovation Program, a new enterprise that makes competitive grants to businesses, universities, and non-profit groups to invest in high-risk, high-reward research in areas of critical national need.

Fourth, to boost workforce training, the Department of Labor runs two grant programs designed to help regional economic development: The Employment and Training Administration's WIRED program and the Community-Based Job Training program. These programs provide regions with funding, ongoing technical assistance and support from a group of experts to expand employment and advancement opportunities for American workers and catalyze the creation of high-skill and high-wage jobs.

Fifth, the Department of Energy has proposed the creation of a regional innovation hubs program to tackle hard problems in the science of energy.

This selection of programs is by no means exhaustive—there are many other programs in many other agencies, such as the Rural Business Enterprise Grants Program in the Department of Agriculture, the Enterprise Zones Initiative in the Department of Housing and Urban Development, the Brownfield Redevelopment Programs in the Environmental Protection Agency, among others. All of them contribute in some way or another to the development of innovation clusters, although not explicitly. The programs outlined below are the programs of the greatest size, impact, and prominence.

SBIR/STTR programs

The Small Business Innovation Research program, or SBIR, founded in 1982 by the Small Business Innovation Development Act, and the Small Business Technology Transfer program, or STTR, founded in 1992 by the Small Business Research and Development Enhancement Act, provide competitive small-business grants to encourage and foster commercialization and innovation. These grants have become essential to helping small businesses get off the ground and cultivate the entrepreneurial culture and network that spur the development of innovation clusters.

The SBIR program's goals are “to stimulate technological innovation; to use small business to meet federal research and development needs; to foster and encourage participation by minority and disadvantaged persons in technological innovation; and to increase private sector commercialization derived from

federal research and development.”⁴⁷ The program involves 11 agencies, most prominently the Department of Defense, the National Institutes of Health, the National Aeronautics and Space Administration, the Department of Energy, and the National Science Foundation, each of which contributes 2.5 percent of their annual extramural R&D funds to the program. The Small Business Administration directs the 11 agencies’ implementation of SBIR, reviews their progress, and reports annually to Congress on the program’s operation. In 2004, the last year for which comprehensive data is available, SBIR made over \$2.01 billion in grants.⁴⁸

An exhaustive report on the SBIR program by the National Academy of Science highlighted the program’s great success, calling it “sound in concept and effective in practice.”⁴⁹ The study found that the program is effectively “stimulating technological innovation, increasingly private-sector commercialization of innovations, using small businesses to meet federal research and development needs, providing widely distributed support for innovation activity, and fostering participation by minority and disadvantaged persons in technological innovation.”⁵⁰

The STTR program’s goals are similar to that of the SBIR program, different only in the fact that “central to the program is expansion of the public-private sector partnership to include the joint venture opportunities for small business and the nation’s premier nonprofit research institutions.”⁵¹ In other words, the STTR program has a more direct technology-transfer focus than SBIR, linking small businesses with federally funded nonprofit research centers. The STTR program will distribute funds, for example, to a small gene sequencing startup with the local medical school research group doing genetics research. The STTR program directs five federal department and agencies to contribute 0.3 percent of their annual extramural R&D funds to the program. The STTR program granted over \$208 million in 2004, the last year for which comprehensive data is available.⁵²

Despite the highly complimentary report on the program by the National Academies, it is clear that there are several problems with SBIR-STTR that deserve serious consideration. In fact, Congress is currently considering making several substantive changes to the program in its imminent reauthorization legislation, some of which come directly from the recommendations of the National Academies.

Firstly, grant sizes have not increased since they were first set in 1982 at \$100,000 for Phase I grants and \$750,000 for Phase II grants. These grant sizes are significantly too low. There is a strong consensus among business leaders and poli-

cymakers alike that federal SBIR/STTR program awards grants are insufficient for small companies doing the expensive high-tech research that the program is designed to support.

Case in point: the National Institutes of Health has seen a significant reduction in the number of applicants for SBIR funding over the past few years, indicating that the SBIR funding is not significant enough for small biotech companies doing cutting-edge R&D to even apply. The House of Representative's reauthorization legislation calls for an increase in Phase I grants to \$250,000 and Phase II grants to \$2 million.

Secondly, as currently structured, small businesses in which venture capital firms hold a controlling interest cannot be supported by SBIR grants. This structure was established only recently, in a 2002 directive that stated that eligible small businesses must be "at least 51 percent owned and controlled by one or more individuals who are citizens of, or permanent resident aliens in, the United States."⁵³ This policy has been met with strong criticism from small businesses and many policymakers alike, who assert that it is not sound good policy to penalize companies merely because they have already proven sufficiently attractive to private-sector investment. According to the National Academies study on the SBIR program at NIH:

Even firms benefiting from venture funding may well seek SBIR awards as a means of exploring a new concept, or simply as a means of capitalizing on existing research expertise and facilities to address a health-related need or, as one participant firm explained, to explore product-oriented processes not 'amenable to review' by academics who review the NIH RO1 grants. Some of the most successful NIH SBIR award-winning firms have been successful only because they were able to attract substantial amounts of venture funding as well as SBIR awards.⁵⁴

As this paper went to press, both the House and the Senate have included in their SBIR reauthorization bills different ways of dealing with this issue. The House bill has no caps on the amount of the SBIR-STIR funding that can be allocated to venture-backed companies—so long as the firm is not majority owned by just one venture firm and does not have the majority of board seats held by one venture firm. The Senate version proposes a cap of 8 percent for each federal agency that provides SBIR funding to venture-backed startups, except for the Department of Health of Human Services, which has a proposed cap of 18 percent.

Overall, the SBIR/STTR programs have carved out a respectable niche as flexible, well-managed, and well-leveraged federal innovation enterprises, serving as a model for many state as well as international efforts. But the SBIR/STTR system must undergo a significant expansion and reorientation if it is to continue to play a central role in the overall federal innovation policy system for our 21st century high-tech economy.

Cluster strategy must be at the center of this reorientation. With a focused, explicit, and clear set of federal cluster policies, SBIR/STTR can work within the larger and more cogent framework of committing to regional economic growth and leverage its unique strengths in pursuit of more structured goals. Federal cluster policy would both strengthen the work of the SBIR/STTR program and be strengthened by it.

National Science Foundation programs

NSF's Partnerships for Innovation program, created in 2000, fosters connections between public and private organizations to spur innovation in a technology area, industry, or region. Academic institutions are the core organization, but they must have a private or non-profit business partner. Ten to 15 awards are given per year for up to \$600,000 each, with an award length of two to three years. Partnerships can be made in three different areas: Research, technology transfer, or commercialization; workforce education and training; and creating the infrastructure for facilitating and disseminating innovation.⁵⁵

NSF's Advanced Technology Education program, or ATE, helps facilitate the education of high-technology technicians via our two-year colleges. The program partners academic institutions and employers to promote the education of science and engineering technicians at the undergraduate and graduate school levels. The ATE program supports curriculum development, professional development of college faculty and secondary school teachers, career pathways to two-year colleges from secondary schools and from two-year colleges to four-year institutions, among other activities.

NSF's Industry-University Cooperative Research Partnership program develops Industry-University Cooperative Research Centers that perform the basic research that results in technology transfer from academia to industry. NSF

provides seed money in the form of a planning grant of \$10,000 (for 18 months) and an initial five-year award of up to \$70,000 annually, renewable for a second five-year period for \$35,000 annually. Each center, however, must have at least six business partners that provide at least \$300,000 in membership dues. This program is a prime example of federal programs acting as facilitators for more broad-based, multi-stakeholder investment.

In general, these NSF programs, like the NIST work discussed in the next section, make respectable contributions to the creation of regional innovation clusters, encouraging the development of a 21st high-tech U.S. economy focused on meeting the challenges of global competition, creating high-paying jobs, and promoting the innovations that power our economic growth. But these programs are sorely underfunded, poorly marketed and mostly uncoordinated with each other. A more comprehensive and substantive economic development policy and innovation cluster creation effort will make these programs more efficient, focused, and united in common goals. Federal cluster policy can be the glue that holds these programs together and the binoculars that give them vision.

National Institute of Standards and Technology external programs

In addition to operating the only federal laboratories expressly focused on boosting private-sector competitiveness, NIST operates so-called “external” programs that fit naturally with the strengths of regional innovation clusters.

The precursor to the Manufacturing Extension Partnership program, or MEP, was created by the Omnibus Trade and Competitiveness Act in 1982, with the MEP as we currently know it coming into existence in 1988. A program with a FY2010 proposed budget of \$125 million, MEP is a network of 59 centers in 393 locations in every state and in Puerto Rico that employs over 1,600 specialists in business and manufacturing, and assists small- and medium-sized businesses embrace the process improvements and growth strategies that increase their competitiveness and profitability. MEP centers are non-profit organizations receiving one-third of their funding from NIST and two-thirds from state or other regional funds, including fees paid by manufacturers.

A study of the program’s fiscal year 2007 efforts found that with relatively little resources, the MEP improved productivity among 8 in 10 MEP clients, created or retained 57,000 jobs, created or retained \$10.5 billion in sales, spurred \$2.2

billion in new private investment, and saved over \$1.4 billion in costs.⁵⁶ These figures suggest that the program has played an important role in assisting small- and medium-sized manufacturers that are the bedrock of this nation's economy, though it is clear that the program could be improved.

The Technology Innovation Program, which is a successor to the Advanced Technology Program, was created by the America COMPETES Act of 2007,⁵⁷ for the purpose of assisting small businesses, academic institutions and consortia to accelerate innovation through high-risk, high-reward private sector research that supports national challenges. The explicit focus is on private-sector innovation that may be too novel or too multi-disciplinary to fit without traditional innovation programs. Thus, the new TIP mission focuses on developing technologies that address areas of critical national need.

TIP is operating under a \$69 million budget for fiscal year 2009, which ends in September this year, to spend on competitive, cost-shared grants to businesses, universities, and nonprofit institutions—or collaborative ventures—to promote and enable innovation that solves pressing national problems. The 2009 competition is currently underway; NIST has announced that it is seeking proposals that focus on manufacturing through the improved use of advanced materials, such as superalloys and nanomaterials, and civil infrastructure through the creation of tools, such as sensor devices, that boost the ability of local governments to manage the structural integrity of infrastructure, such as dams, bridges and highways, as well as better methods of repairing existing infrastructure.⁵⁸ The Obama administration has sought a budget of \$70 million for FY 2010.

Increased, sustained support for the MEP and TIP would provide a stronger support for the commercialization of innovation technologies. And NIST already has experience with successful cluster strategy, for example, through work with the Albany nanotechnology cluster.⁵⁹ But both MEP and TIP are natural candidates for work to strengthen clusters—the MEP because it focuses on the needs of local manufacturers and the TIP because of its new ability to work with academic institutions and consortia on issues that combine national challenges with regional expertise. Indeed, Vice President Biden and Secretary of Commerce Gary Locke recently announced a NIST effort, through the MEP program, of just this kind to support automobile industry supply-chain competitiveness in the Midwest.⁶⁰

Department of Labor workforce development programs

Workforce development programs, housed in numerous government agencies and departments, have been moderately effective but are essential to the development of innovation clusters for the high-tech 21st century economy. The Department of Labor's Workforce in Regional Economic Development, or WIRED program and its Community-Based Job Training program are the most prominent of these programs, but both have seen only modest success.

WIRED is a Department of Labor program that makes focused, strategic investments in the development of workers with skills to staff the high-tech companies that are the foundation of innovation clusters, as well as investments in the development of workers that can compete with the increasingly skilled international workforce. In general, the program focuses on building the workforce in struggling regions, such as those affected by global trade shifts, dependent on a single industry, or recovering from natural disasters.

In three rounds of grants and in dozens of specific regions across the country, WIRED has spent about \$326 million since its inception in 2005. WIRED follows a six-step plan to economic and workforce transformation that includes identifying the regional economy, forming the core leadership group, performing a SWOT analysis (strengths, weaknesses, opportunities and threats in a region), creating a shared regional identity and vision for the local economy, devising strategies, and leveraging resources and implementing the program.⁶¹

The Community-Based Job Training program, a \$125 million annual enterprise, was created in order to develop partnerships between the workforce system and the community college-vocational education network, increasing the ability of community colleges and other vocational schools to meet the needs of employers in the 21st century. The program makes grants for two central purposes:

To increase the capacity of community colleges to provide training in a local high-growth, high-demand industry through activities such as the development of training curricula with local industry, hiring qualified faculty, arranging on-the-job experiences with industry, and using up-to-date equipment; and to train new and experienced workers in identified high-growth, high-demand industries, with the aim of employing and/or increasing the retention and earnings of trained workers, while meeting the skill needs of businesses within targeted industries.⁶²

A number of observers have written on the importance of workforce development programs in spurring the development of regional innovation clusters, but they have evaluated these Department of Labor programs as moderately successful at best. A recent report on clusters and competitiveness called the WIRED program “too small and too short-lived to do the necessary [cluster-creation] work on its own.”⁶³ Critics of WIRED have also highlighted the fact that it is sorely underfunded and far too ad hoc in its structure to build the collaborative stakeholder network that is one of its central goals.

In general, the jury is still out on the effectiveness of WIRED and the Community-Based Job Training program, and their validity as cultivators of highly-skilled workers and multi-stakeholder innovation networks. For this reason, many feel that these programs, especially WIRED, might not have such a long future.⁶⁴ But the goals of these programs should be included in a nationwide innovation clusters strategy.

Department of Energy

The Department of Energy’s 2010 budget request features \$280 million for Energy Innovation Hubs designed to “support cross-disciplinary research and development focused on the barriers to transforming energy technologies into commercially deployable materials, devices and systems.”⁶⁵ While it is not clear how much of this request will be appropriated, these energy hubs are forward-thinking proposals that will spur the development of the innovation clusters that will help solve our national energy challenges, create jobs, and promote widespread economic growth.

Endnotes

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- 18 The data for the Employment by Industry statistics for the 2007 national distribution were retrieved from the U.S. Census data, specifically through the Economic Fact Sheet in the Business and Government section (<http://factfinder.census.gov/>). The U.S. Census provides information on 18 industrial sectors—mining, quarrying, and oil and gas extraction; information; administrative and support and waste management and remediation services; construction; finance and insurance; real estate and rental and leasing; manufacturing; arts, entertainment, and recreation; accommodation and food services; other services (except public administration); professional, scientific, and technical services; management of companies and enterprises; educational services; health care and social assistance; utilities; transportation and warehousing; wholesale trade; and retail trade. These 18 categories were matched to the 11 categories used with the SOCDs data using NAICS codes (with the exception of public administration). The 2007 public administration data was not available via U.S. Census Economic Fact Sheet. In light of this, the research team computed the average of the public administration employment data from the SOCDs database for the years 1970 and 2000. Specifically, the research team estimated the proportional average of the public administration by employment to compute the proportion (5 percent) for 2007.

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- 22 This data was retrieved from the City-Data Forum (<http://www.city-data.com/>). The municipalities for the four metropolitan areas—Akron, Cleveland, Pittsburgh, and Youngstown—include cities with more than 6,000 residents; smaller cities, towns, and villages with 1,000 to 6,000 residents; and very small towns and villages with less than 1,000 residents.
- 23 The need to rationalize redundant and competing government services was repeatedly mentioned as a problem in interviews and surveys.
- 24 This information was provided to the CAP research team by each of the economic development agencies—Innovation Works, PLSG, JumpStart, and BioEnterprise.
- 25 This information was provided for the CAP research team by NorTech.
- 26 Information retrieved from <http://www.techbelt.org/>.
- 27 The patent data was retrieved from the Delphion patent database (<http://www.delphion.com/>). The research team pulled U.S. patent and application data for the contiguous region of interest spanning Cleveland to Akron to Youngstown to Pittsburgh; the team pulled data on U.S. patents and applications between January 1, 2006 and May 20, 2010. For Table 2, we report the patent and application data only for the Akron, Cleveland, Pittsburgh, and Youngstown city municipalities. On a final note, we only report data on patent assignees. As defined by the U.S. Patent and Trade Office, the patent assignee is the individual entity who “becomes the owner of the patents and has the same rights that the original patentee had” (<http://www.uspto.gov/web/offices/pac/doc/general/#assignments>).
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- 33 The data used for this column was taken from another question in the survey—“For the years 2007 to present (or when your organization ceased operations), did you apply for or receive any funding from federal agencies or programs?” Therefore, the subsample of firms who responded to this question is slightly different than the other question—“What are your plans for working with these agencies in the future?”
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