

Intermediate Steel-Industry Suppliers in the Pittsburgh Region:
A Cluster-based Analysis of Regional Economic Resilience

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ABSTRACT: As their signature industry contracted or relocated, many traditional industrial regions have had to transition from a single-industry economy to a diversified economy in recent years. Although a "diversified" economy is often assumed to indicate the introduction of "new" industries to a region, industrial diversity can also arise from traditional economic strengths. The experience of intermediate steel-industry suppliers in the Pittsburgh region offers valuable insight for regional analysts into how traditional cluster formations can serve as a source of economic resilience. Survey findings reported in this study identify intermediate steel-industry suppliers in the Pittsburgh region that have successfully networked and shared expertise across product lines in order to serve national and global steel markets. The resulting collaborations have enabled these suppliers to form an industrial cluster that has contributed significantly to the region's vitality. Indeed, the decline of steel-making capacity in Pittsburgh may not have signaled the end of the region's affiliation with steel so much as the beginning of a new status in the global steel value chain as a key location for intermediate steel-industry suppliers. *Key words: industry cluster, steel industry, regional economic resilience, regional economic development. JEL Classifications: R11, R58.*

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1. Introduction

The connection between regional economic development and the structure of a signature industry has vexed traditional manufacturing regions of North America and Europe for decades. During the past thirty years, these regions have experienced significant declines in manufacturing employment and capacity from a combination of technological change, global competition, and geographic shifts in economic activity. Indeed, the traditional manufacturing region that stretches across Pennsylvania, Ohio, Michigan, and Indiana is now commonly referred to as “the rust belt” to indicate the perception of its economic development potential. However, our research into the state of the steel industry, a signature industry for the Pittsburgh region, has indicated that this perception may be inaccurate and premature.¹ Although, the size of its steel-making industry has shrunk in recent decades, Pittsburgh maintains important ties to the global steel industry through the continuing presence of a thriving community of intermediate suppliers to the steel industry.

This study reports survey-based findings about intermediate steel-industry suppliers in the Pittsburgh region, drawing information from firms who have remained in the region despite the precipitous decline of their local steel-making customer base. Our findings offer valuable insight for regional analysts and regional development practitioners into how intermediate suppliers can serve as a source of economic resilience in regions, like Pittsburgh, where the decline of a signature industry has been substantial and a transition is being made from a single-industry economy to one of diversified economic activity. Although a “diversified” economy is often assumed to indicate the introduction of “new” industries to a region, our research into the steel-

industry suppliers of Pittsburgh indicates that industrial diversity also can arise from traditional economic strengths. In the following sections, we describe the characteristics of these suppliers as well as some of the strategies that have contributed to their continued ties to Pittsburgh.

2. Steel and the Steel City

The late 1970s represented the beginning of the end of Pittsburgh's status as one of the dominant steel-producing regions in the United States. In 1978, Pittsburgh's steel-making capacity was nearly 17 million tons annually, representing 12 percent of the nation's total capacity (Center for Industry Studies, 2003). That same year, over 90,000 people were directly employed by the primary metals industry in the Pittsburgh region, representing one-third of all manufacturing workers in the region and ten percent of total regional employment (County Business Patterns, 1978).

Pittsburgh's decline from steel pre-eminence was swift and painful. Over the next ten years, primary metals employment dropped by 74 percent in the Pittsburgh region, while declining by only 38 percent nationally (County Business Patterns, 1978 and 1988). By the year 2000, employment in primary metals manufacturing had dropped to less than 2 percent of Pittsburgh's regional employment.²

Not surprisingly, as a result of this dramatic shrinkage, a common perception developed in Pittsburgh that steel was no longer an important factor in the regional economy. In contrast to this image, however, our research concerning emerging steel technologies (Giarratani, Gruver, and Jackson, 2006 and 2007) brought us into direct contact with steel producers far removed from Pittsburgh who would refer to the importance of Pittsburgh's intermediate suppliers in terms of materials, equipment,

process controls, or other aspects of steel production. These comments indicated a possible role for intermediate steel-industry suppliers as part of Pittsburgh's export base and stimulated our interest in learning more about this aspect of Pittsburgh's economic transition.

Scholars have long been concerned with the ability of intermediate suppliers to survive after the departure or decline of their downstream industry. Forty-five years ago, Chinitz (1961) drew attention to the regional implications of the linkages between large, integrated steel producers and their suppliers. He reasoned that the nature of these linkages might limit the creation of an independent supplier community, in effect relegating the fortunes of local suppliers to being dependent on the fortunes of their local customer base. In turn, the ability of the supplier community to trigger development and promote industrial diversity also would be limited (Chinitz, 1961 and Pittsburgh Regional Planning Association, 1963a).

In recent years, related concerns have been expressed by scholars studying other traditional manufacturing regions such as the Ruhr Valley in Germany (Grabher, 1991), Cleveland and Northeast Ohio in the United States (Hill and Brennan, 2000), the Teeside region of England (Sadler, 2004), and the Styria region of Austria (Todtling and Trippel, 2004). Like Chinitz, these analysts have found that a key dimension of a region's resilience in the face of a dramatic industrial change derives from the response of each region's community of intermediate suppliers.

In light of the concerns expressed in this literature, we decided to survey the intermediate steel-industry suppliers in the Pittsburgh region in order to better understand the nature of this industry cluster and its centrality to the modern steel

industry. Intermediate suppliers, by their nature, represent a diverse group of firms that do not fall into a single, or even small number of, statistical codes. Although this diversity provides a source of strength to the industry cluster, it also makes the cluster difficult to identify from statistical analysis alone. In order to overcome this statistical limitation, we developed a survey instrument for distribution to a list of self-described steel-industry suppliers provided by the Association of Iron and Steel Technology (AIST).

A leading industry association the AIST publishes an annual directory of steel plants that is the most widely used directory in the industry. In addition to listing steel plants, the *AIST Directory Iron and Steel Plants* includes over 400 pages of listings for suppliers to the steel industry. Because of the directory's status in the industry, suppliers are highly motivated to participate in the directory's listings. Of the listed suppliers in 2003, 289 were located in the Pittsburgh Metropolitan Statistical Area (MSA), and 77 of these completed our survey.

The surveyed firms offer a wide variety of products and services—including raw materials, machinery and equipment, operating services and supplies, and engineering and consulting services. Despite this variety of products and services, subsets of firms in the cluster report that “key” suppliers, partners, networks, and other collaborators are found within the Pittsburgh region. In this sense, it appears that some of the important linkages within the cluster cut across product lines, rather than falling within a single product area, as in traditional cluster definitions.³

Our analysis first discusses the definition of a cluster in the context of the intermediate steel-industry suppliers. We then provide additional motivation for the survey before proceeding on to describe its structure and our findings.

3. Defining the Cluster

Many methods have been used to define and describe the boundaries of industry clusters. Martin and Sunley (2003) provide an excellent review of the variety of cluster definitions and attributes as well as a review of the debate concerning the theoretical usefulness of the cluster concept. The conventional representation of a cluster, however, derives from the work of Porter (1990) and is depicted graphically by the Porter diamond, which links together factor inputs, supporting industries, competitive environment, and demand conditions in order to form the regional and economic context of a cluster.

In Porter's view, clusters are "geographic concentrations of interconnected companies" (Porter, 2000, p. 15) that include suppliers and service providers from across industrial boundaries as well as related institutions, such as universities, governmental agencies, and trade associations. For Porter, clusters include dialogue and cooperation, as well as competition. He points to the importance of this cooperation and dialogue in promoting regional economic prosperity, but also highlights one of the major problems in identifying these clusters: "cluster boundaries rarely conform to standard industrial classification systems" (Porter, 2000, p. 18).

This problem is exacerbated in the case of the Pittsburgh cluster of intermediate steel-industry suppliers in that a main element in the Porter diamond—local demand conditions—offers an insufficient basis for cluster definition. The cluster of

intermediate steel-industry suppliers that exists in the region today is geographically separated from its demand industry to a significant extent. Yet, some of these suppliers have found a source of economic competitiveness and renewal by creating linkages with each other, separate from the typical upstream and downstream linkages of industrial activity. Their linkages have become the basis for clustering that is based in shared “projects,” such as a marketing plan or product development effort, rather than from a shared product, such as steel production.

Cross-product clusters of this kind have gained significant attention in regional development literature, particularly in research that focuses on the traditional industrial regions of Europe and North America. Several authors (Grabher, 1991; Storper, 1992; and Sadler, 2004) focus on intermediate steel-industry suppliers, in particular, and find that the development of a supplier-based cluster in traditional steel areas can help to rescue a region from decline and guide it on a path of economic renewal.

On the basis of his analysis of the steel industry in the Ruhr Valley of Germany, Grabher (1991) identifies a phenomenon that he calls “cathedrals in the desert.” This phenomenon arises from the establishment of signature industries with high entry barriers, such as steel, in locations that did not have a pre-existing industrial presence. As a result, the regions do not develop the diverse industrial infrastructure or experience necessary to adapt to changing conditions. The resulting feudal dependency of small suppliers on the signature industry leads to rigid regional specialization that locks suppliers into an inflexible industrial path. Concerns over this type of “lock in” are also prevalent in the steel regions of the United States and contribute to the assumption that

the decline of steel-making will also precipitate the decline of its affiliated supplier community.

Grabher's solution to the problem of regional lock-in is to promote active versatility (Grabher, 1991, p. 65) among supplier firms, enabling these smaller firms to leverage their market flexibility to maintain steel revenue sources as well as to enter new markets. Storper (1992) expands on this concept in his analysis of Product Based Technological Learning (PBTL) as a source of economic vitality in traditional industrial regions of the United States, France, and Italy. He finds that production networks among firms reduce the risk of technology lock-in and enable firms within the network to use "relation-specific skills" and cooperation to realize technological rents. Technological change, particularly rapid change, can force supplier firms to replace cost-minimizing behavior, which tends to link them tightly to a large customer, with technological know-how that is more easily transferable across product-lines and across markets (Storper, 1992).

In comparing the automotive and metals firms of the Austrian region of Styria, Todtling and Trippel (2003) interviewed 58 firms over 3 years and found that technological collaboration and knowledge sharing can make the difference between regional decline and successful renewal. They warn against both the "fragmentation trap" (p. 1183) of firms that are geographically agglomerated, but disconnected, and the "integration trap" (p. 1187) of firms that are connected, but overly focused on a single industry. Clustered firms that avoid both of these traps are able to realize the economic efficiency of scale economies and innovation. Maskell and Lorenzen (2004, p. 1002)

describe how clusters engaged in collaborative efforts become “markets where commodities, services, and knowledge are traded in a notably efficient way.”

Sadler (2004) also discusses the importance of collaboration among former intermediate steel-industry suppliers in a traditional industrial district. In a survey of supplier firms related to the steel industry in the Teeside region of England, Sadler finds that technology-based and market-based groups are a more appropriate unit of analysis than product-based groups. He cautions that government cluster analysis is too often product-based, missing the economic importance of other types of clusters.

In keeping with this literature, our analysis of the Pittsburgh cluster of intermediate steel-industry suppliers provides a concrete example of how intermediate suppliers in a mature industrial area are able to use collaboration with each other in order to form the type cluster that Porter identifies as critical to regional economic productivity and prosperity. However, unlike the clusters in Porter’s analysis, the Pittsburgh supplier cluster has emerged in response to the decline in local demand conditions rather than in concert with growing local demand. Our survey findings indicate that the Pittsburgh supplier cluster includes the type of cross-product linkages and market interactions identified by Maskell and Lorenzen (2004) and Sadler (2004). In this way, the Pittsburgh supplier cluster appears to have avoided the problems of lock-in identified by Grabher (1991), Storper (1992) and Todtling and Trippel (2004). Through cluster participation, Pittsburgh area suppliers are managing to both maintain their steel-based revenue and to diversify into new markets—both of which contribute the resilience of the Pittsburgh regional economy.

4. Motivating the Survey

As Table 1 illustrates, Pennsylvania represented the largest national concentration of steel production in 1980, just following the period of peak U.S. steel production.

Several geographic, economic, and historic factors contributed to this concentration of production. Traditional ore-based, or “integrated,” steel-making requires the use of bituminous coal and iron ore as primary inputs. Both products are geographically limited and difficult to ship. Pittsburgh is located on the edge of the Appalachian regions that produce significant quantities of coal and along side several waterway connections for easy shipping of iron ore from the northern regions of Michigan and Minnesota, where 99 percent of iron ore in the United States is located.⁴ Proximity to the auto factories of Michigan and Ohio, major steel customers, also contributed to Pittsburgh’s geographic advantage. This advantage was further supported in the early 20th century by a basing-point pricing system that standardized shipping rates nationwide as though the shipment had originated in Pittsburgh.⁵

Pittsburgh’s many advantages as a center of steel-making began to erode in the 1970s. Recession and growing automotive imports lessened Detroit’s demand for steel. Technological advances in steel-making lessened the industry’s reliance on coal and iron as “minimills” grew adept at making high quality steel by recycling scrap metal. Global competition and environmental pressures also contributed to the decline of several large, integrated mills in the Pittsburgh region. As a result, by 1990, only 7 percent of U.S. steel production remained in the region (see Table 1). In the ten years between 1980 and 1990, Pittsburgh had dropped from 22.5 million tons of operational,

steel-making capacity to 7.4 million tons—a decline of nearly 70 percent (Center for Industry Studies, 2003).

If Pittsburgh's intermediate steel-industry suppliers had remained locked into their relationship with regional steel mills, the presence of these suppliers in the region would have certainly followed the same pattern of precipitous decline. However, the data we collected from the AIST directory (AIST, 2003) indicates that the Pittsburgh region remains a central location for obtaining a variety of products and services needed by both national and international steel producers. The 289 suppliers listed in the 2003 AIST directory accounted for twenty percent of the national steel-industry supplier listings and nearly fifty percent of the listings for machinery and equipment suppliers and for raw materials suppliers (AIST, 2003). Given the relative and absolute decline of steel making in the region, these numbers suggest that Pittsburgh's intermediate steel-industry suppliers have retained a presence and importance that is independent of steel making in the region, *per se*. Moreover, whatever the original basis for steel industry agglomeration in the region, this supplier cluster now serves as a source of exports beyond the region.

5. Survey Description

In surveying Pittsburgh's intermediate steel-industry suppliers, we set out to determine if a cluster of the intermediate suppliers could survive and even thrive in a region after the dramatic decline of that region's end-user. We identified the population of interest as the 289 firms listed in the 2003 AIST directory as Pittsburgh area suppliers to the steel industry. Using establishment-level data from the U. S. Census, we estimate that total employment for this group of intermediate steel-industry suppliers

was in excess of 12,000 in 2003, with a total payroll of \$687 million. The estimated average annual wage for the group was nearly \$56,000, considerably higher than the 2003 regional average of \$36,000.⁶

In the spring of 2005, we contacted each of the 289 supplier firms with an invitation to participate in our study of the Pittsburgh cluster of steel industry suppliers. The invitation included letters of endorsement from the AIST as well as from Mr. John Surma, President and CEO of the U.S. Steel Corporation. Participation involved the completion of an online survey that offered password-protected confidentiality and a four month window in which to complete the survey. Seventy-seven respondents, representing over one-quarter of the invited participants, completed the survey. The respondents represent a large and diverse group of intermediate steel-industry suppliers, and their completed surveys offer a wealth of information with which to investigate the status of their related regional industry cluster.

As mentioned previously, the diversity of industries represented by the steel-industry suppliers creates a barrier to defining the group with standard statistical codes. This barrier also makes it difficult to identify whether the respondent group is representative of the population of steel-industry suppliers. In order to address this problem, we have assumed that the surveyed group of suppliers represents the known population of steel-industry suppliers in the Pittsburgh region. We then matched as many of these suppliers as possible to the establishment data in the 2003 Quarterly Census of Employment and Wages of the U.S. Census Bureau, identifying 259 of the 289 suppliers and 66 of the 77 respondents. The comparative statistics for the assumed population and respondent groups are included in Table 2. These statistics include the

average wage, employment size and distribution, and industry participation levels as well as, where possible, the standard deviation and estimated t-statistic from a difference of means test.⁷

On the basis of the comparison shown in Table 2, we assume that the structure of the respondent group is representative of the population as a whole. Although the average wage per establishment shows a statistical difference between the respondent and population group, the average wage per employee appears to be numerically similar. Unfortunately, a statistical test of significance was not available for this figure. Similarly, the distribution of the survey respondents across the establishment size and industry categories is reasonably similar to the distribution of the identified population group, but is not associated with a statistical test for significance. The average employment within those categories was tested, with most categories showing no statistically significant difference between the average employment size within the category. The strongest difference between the means is found in the average employment size for those suppliers in the information industry sector, but the distribution of suppliers in this category is fairly similar across groups (26 percent of the population and 28% of the sample).

The survey, attached in Appendix A, is divided into three major parts: (1) Firm Location and History, (2) Firm Products and Markets, and (3) Relationship with the Pittsburgh Region. Part 1, Firm Location and History, asked the respondent to provide basic information about the firm's organization structure, locations, employment size, and start date. Part 2, Firm Products and Markets, included more specific questions about the product categories produced by the firm as well as the market sectors and

market locations served by the firm. Finally, Part 3, Relationship with the Pittsburgh Region, asked the respondents to describe their firm's regional linkages in terms of the Pittsburgh labor market, business relationships, and the more general Pittsburgh business climate.

6. Survey Results

The survey respondents reported a strong and current involvement in selling to the steel industry. Nearly all of the respondents had made a sale to a steel producer within the last year, and 92 percent of the respondents had made such a sale in the last 3 months. Over two-thirds of the respondents indicated that the majority of their sales efforts were focused on the steel industry.

Although the respondents share an interest in selling to the steel industry, they exhibit substantial variety in the goods and services that they offer to the steel industry, ranging from basic materials and simple operating supplies to high-tech equipment and sophisticated engineering designs. The variety of the main sales categories of the survey respondents, illustrated in Figure 1, is the first indication that the clustering activity within this group of suppliers would most likely be across product lines rather than within a shared product line.

Several questions in the survey asked the respondents to characterize their linkages with other regional suppliers. Specifically, they were asked to identify the geographic location from which they found most of their "key contacts," including key suppliers, partners, and business networks (see questions 36-38). In addition, they were asked whether or not they collaborated with regional firms on either product development or marketing (see questions 49 and 51). Of the 77 respondents, 53 (or 69 percent)

indicated that they either had key contacts centered in Pittsburgh or collaborated with regional firms or both. We label this subset, which is characterized by the relative strength and importance of inter-industry linkages within the region, as “strongly-linked” suppliers. As indicated in Table 3, of the 53 strongly-linked suppliers, just over half indicated that key contacts were mainly located within the Pittsburgh region, and eighty-five percent collaborate on product development or marketing.

As a group, these intermediate steel-industry suppliers represent the heart of the region’s cluster of steel-industry suppliers. The remaining 24 firms do not report networking or collaborative interactions within the Pittsburgh region, and on this basis we describe them as “weakly-linked.” We want to emphasize that firms labeled “strongly-linked” are not necessarily more profitable or successful in any way. Similarly, the firms that we label “weakly-linked” are not necessarily less or more important to Pittsburgh. These labels do, however, reflect self-reported information about the existence of “key” Pittsburgh-based suppliers, partners, networks, and other collaborators for the strongly-linked respondents.

Distinctions between the strongly-linked and weakly-linked supplier groups offer valuable insight into the nature of the cluster formed by intermediate suppliers. The characteristics of the survey respondents and the implications of these characteristics for the steel supplier cluster are detailed in the sections that follow.

Firm Age and Structure

The survey respondents range from small, recently-formed suppliers to large multinational enterprises. About two-thirds of all survey respondents are single-plant firms, with just over half of those plants smaller than 20 employees. The year that each respondent firm first established a location in Pittsburgh ranges over 100 years, from 1873 to 2004, with 1974 as the median start year. Although the 1980s witnessed the decline of the Pittsburgh steel-making industry, one-third of the survey respondents started operations in the Pittsburgh region after 1990, and nearly one-half of the smallest firms (less than 20 employees) have start dates after 1990.

Three-quarters of the respondents reported that their firm first entered the Pittsburgh region as a start up. Another twenty percent entered as a new division of an existing company or as a spin-off from an existing company. Survey respondents also report a considerable amount of merger and acquisition activity. One-quarter of all respondents have merged with or been part of an acquisition by another firm. Moreover, three-fourths of the mergers and acquisitions have occurred since 1990. If we combine the merger and acquisition dates with the start-up date of firms that have not participated in merger and acquisition activity, we find that nearly half of all respondents have chosen to enter the Pittsburgh steel supplier market after 1990, either through start-up, merger, or acquisition activity.

Along with their small size, the recent start dates for many of the suppliers indicate a significant dynamic element of entrepreneurial start-ups among the regional intermediate steel industry suppliers. This information provides a contrast to the typical image of steel-related activity in the region as being comprised of older, more

established firms. Given the steep decline in its steel-making capacity and production during the 1980s, the ability of the Pittsburgh region to attract new steel-industry supplier firms and generate merger and acquisition activity after 1990 is an indication of the vitality of the supplier cluster.

About two-thirds of the survey respondents are single location firms with less than 50 employees in the Pittsburgh region. Size distribution does not vary much between respondents with and without key local linkages. Firm age, however, does vary between the groups. Older, more established firms appear to be more likely to report key local linkages. In fact, 60 percent of strongly-linked firms have a start year *before* 1980, while 67 percent of weakly-linked firms have a start year *after* 1980.⁸ Perhaps a longer history within the region provides greater opportunity to network locally. As one engineering service firm explained, “Having been in this business for thirty-five years, I know most of the key players/firms in the area and can use that network to obtain information.”

Although most respondents are relatively small, single-location firms, about 35 percent of the respondents are large, multiple-location firms. Of these firms, over 90 percent report additional U.S. locations outside of the Pittsburgh region, and 44 percent reported additional locations outside of the United States. In addition, the Pittsburgh region was identified as the U.S. headquarters for 17 respondents, of which 7 also listed their international headquarters as in the Pittsburgh region. Multiple-location respondents were just as likely as single plant respondents to report key linkages in the Pittsburgh area.⁹ Interestingly, respondents with headquarters outside of the Pittsburgh

region also reported key local linkages. In fact, eight of the nine respondents with international headquarters outside the Pittsburgh region reported a key regional linkage.

Product Categories

As indicated in Figure 1, the products and services provided by the survey respondents are distributed across five main categories: (1) operating services, (2) operating supplies, (3) engineering and consulting services; (4) machinery and equipment; and (5) raw materials. Examples of the products and services that constitute each category are provided in Table 4.

Although Figure 1 indicates the central product or service focus for each respondent, the respondents were also asked to indicate all categories in which their firm participated. Those responses are detailed in Table 5, which illustrates that the respondents often provide products and services in more than one category. The majority of respondents offer some type of engineering or consulting service, while a relatively small fraction of respondents provide raw materials.

Table 5 also illustrates the participation rates in each sales category for the strongly-linked and weakly-linked suppliers. As indicated by the t-statistics reported in the table, the participation rates do not change substantially when the respondents are separated into these groups. Thus, the key linkages reported by the suppliers do not appear to be limited to or driven by particular type of product or service, but rather are spread across all sales categories.

Marketing by Industry

Not only do the survey respondents represent a broad cross-section of steel supplier categories, they also represent a group of suppliers that has maintained consistent contact with the steel industry. More than 95 percent of all respondents report making a sale to the steel industry in the last 6 months. All of the respondents indicated that some share of their marketing and sales effort is focused on the steel industry, with nearly two-thirds of the respondents indicating that steel sales represent the majority of their marketing and sales efforts.

However, we identified some differences in marketing strategy and customer focus between the strongly-linked and weakly-linked respondents. As Table 6 indicates, the weakly-linked respondents are disproportionately represented among the firms that focus the majority of their sales and marketing on steel customers and among the firms that reported shifting more sales toward the steel industry. In addition, a larger proportion of weakly-linked suppliers reported rising steel sales in absolute terms. In contrast, one of the strongly-linked respondents described their changing customer base as follows:

Our business used to be heavily involved in the steel industry. As the industry moved away from Pittsburgh, it was important to develop other areas of business. We now deal in the automotive industry, aerospace industry, heavy equipment industry and the defense industry. Steel plants are still a part of our business, but not nearly as important as they used to be.

By combining information on changes in absolute and relative steel sales, we were able to identify the firms for which steel customers represent a growing or shrinking share of revenue. As indicated in the lower portion of Table 6, the dominant trend among the weakly-linked suppliers was for steel customers to represent a growing share

of their revenue base, while the dominant trend among the strongly-linked suppliers was for steel to represent a shrinking share of their revenue base. That is, 46 percent of the weakly-linked suppliers appear to be shifting their sales toward steel in comparison to only 27 percent of the strongly-linked suppliers; whereas, only 21 percent of the weakly-linked suppliers appear to be shifting away from steel sales, in comparison to 45 percent of the strongly-linked suppliers.¹⁰ The steel focus of the remaining proportion of suppliers is either static or ambiguous because of concurrently changing company size.

Marketing by Region

Less than 10 percent of the respondents indicated that the Pittsburgh region was the main focus of their overall marketing efforts. Nearly 56 percent focused on other national markets and another 35 percent on global markets. A similar pattern was reported by the survey respondents for their steel marketing efforts, with roughly two-thirds of all survey respondents focusing on U.S. markets (including Pittsburgh) and approximately one-third on global markets. Although local steel customer demand has undoubtedly decreased in recent years, the ability of the steel-industry supplier cluster to market to regions outside of the Pittsburgh is a strength of the cluster and a potentially valuable source of income for the regional economy. One supplier of raw materials put it this way: “We simply had to go from an initial marketing plan of local supplier to a national plan to survive and grow.”

Although the broad geographic marketing structure is similar between the strongly-linked and weakly-linked supplier groups, the focus within the U.S. markets varied

somewhat. Over 60 percent of the weakly-linked suppliers that focused on U.S. steel markets reported that their main markets were either in Pittsburgh or in the traditional steel region stretching from Pittsburgh to Chicago (see Table 7). In contrast, about 60 percent of the U.S-focused, but strongly-linked, suppliers reported that their main markets were in other national areas outside of those traditional steel areas.¹¹

This difference indicates that strongly-linked suppliers may be more focused on exports outside the region than the weakly-linked suppliers. A second difference in survey responses that supports this possibility is the illustrated in the bottom half of Table 7. Nearly three-quarters of the strongly-linked suppliers reported a decline in their Pittsburgh customer base, whereas less than 60 percent of the weakly-linked suppliers reported such a decline. Thus, strongly-linked suppliers were both more likely to report extra-regional marketing efforts and more likely to report a decreasing customer base in the Pittsburgh region.

Regional Assets

In Storper's analysis (1992), firms that network in order to achieve technological rents in new markets also tend to be more dependent on regional assets and agglomeration. Our survey results support this finding. The strongly-linked steel industry suppliers reported less dependence on local steel customers than the weakly-linked suppliers, but greater dependence on regional resources, such as labor markets and universities.

As Table 8 illustrates, in every labor category (unskilled, skilled, and professional/technical), the strongly-linked suppliers report a greater dependence on the

Pittsburgh region when searching for new hires. Although this difference was statistically significant only in the unskilled labor category ($t = -2.71$), there was also a statistically significant difference in the percentage of the respondents' entire labor force that was hired locally. Over 80 percent of the strongly-linked suppliers reported that a majority of their workforce was hired from the Pittsburgh population ($t = 2.38$). In fact, 44 percent of the strongly-linked suppliers report that their entire staff was hired locally, in comparison with only 25 percent of the weakly-linked suppliers ($t = -1.70$).

The respondents generally found the Pittsburgh region to be an asset in retaining their workforce, with 60 percent of the respondents choosing Pittsburgh as a positive or critical factor in retention and only 5 percent identifying Pittsburgh as a negative factor. The respondents also reported considerable employee mining among the steel-industry suppliers. Over two-thirds of the respondents indicated that they had either recruited employees from or lost employees to another steel-industry supplier in the Pittsburgh area.

Much of the literature on the role of universities in economic development focuses on universities as a source of skilled labor or technology transfer (see Varga, 2002, for a review of the literature). However, analysts of regional industry clusters (Drabenstott, 2005; Todtling and Trippel, 2004; and Sadler, 2004) have begun highlighting the additional importance of universities as a cluster participant, and thus as a critical factor in the success of regional clusters, rather than just as a labor or patent resource.

Although Pittsburgh has several strong research universities, they do not appear to be adequately leveraged by steel industry suppliers. Over half of all respondents (both strongly-linked and weakly-linked suppliers), reported that the universities were "not at

all important” in providing either product development or technical support. Less than 20 percent found the university community to be moderately or very important. Slightly more respondents (29 percent) found the universities to be a valuable source of professional and technical hires, but this is still a surprisingly low figure.

The other important regional assets—such as suppliers, partners, networks, and other collaborators—were identified as “key” contacts in the previous sections. By definition, the weakly-linked suppliers in our survey do not report finding any of these key contacts within the Pittsburgh region. Their key contacts, instead, are distributed nationally and globally. Interestingly, nearly half of the weakly-linked suppliers indicated that one or more of these key contacts were mainly sourced globally rather than nationally. Only 22 percent of the strongly-linked suppliers had a key contact that was sourced globally.

We also asked the weakly-linked suppliers, to identify factors that prohibited them from regional collaborations. Their responses to questions 50 and 52 are provided in rank order in Table 9. A majority of the weakly-linked suppliers do not believe that collaboration is relevant to their business for either product development or marketing purposes. The second most common reason was that collaboration could raise competition concerns. Less than 20 percent of the weakly-linked suppliers were not collaborating with firms in the region because they had established collaborations outside of the Pittsburgh region. Thus, for the most part, the weakly-linked suppliers in the survey were choosing not to collaborate with other firms for internal business reasons rather than because Pittsburgh did not offer sufficient collaborative possibilities.

Interestingly, both categories of suppliers seem committed to maintaining their Pittsburgh presence. Only one respondent from each subset of suppliers indicated that Pittsburgh operations were planned to decrease in the next five years, and none of the respondents indicated that they planned to relocate away from Pittsburgh within that time frame. Despite their different approaches to collaboration and regional resources, both types of intermediate steel-industry suppliers appear to find concrete benefits from locating in the Pittsburgh region and can thus be expected to remain a part of the region's economic base.

7. Analysis and Implications

The steel-industry supplier cluster described in this article represents a thriving, but diverse group of firms—a fact that belies the public image of “steel” in the Pittsburgh region. The firms in this cluster include not only a wide range of industry affiliations, but also a range of size and establishment types from small, single plant firms to international corporations. Some of the respondent firms have been in the Pittsburgh region for well over 100 years and some are almost brand new. Their products and services are distributed locally and across the globe.

Despite this diversity, or perhaps because of it, a subset of the regional steel-industry suppliers has found ways to collaborate with each other in order to serve both steel and non-steel markets. Interestingly, the subset of suppliers with the strongest regional linkages includes the suppliers who are most likely to be gaining ground in non-Pittsburgh and non-steel markets. Perhaps this is an economic response to the reduced size of the local steel market, or perhaps suppliers with weaker regional

linkages have simply had more success marketing to the steel industry and thus do not need to seek out collaboration with other suppliers.

Either way, the survey results highlight two distinct strategies that underlie the contribution of the steel-industry supplier cluster to Pittsburgh's economic resilience. The first strategy is based on expanding product markets, and the second is based on expanding geographic markets. In this way, steel, per se, has remained important to the cluster, but not solely so, and the Pittsburgh regional market has remained important to the cluster, but also not solely so.

Because of these strategies in response to national steel industry dynamics, the survey results indicate that the steel-industry suppliers in the Pittsburgh region are successfully avoiding the integration trap and pitfalls of lock-in that Grabher (1991) found occurring in the steel region of the Ruhr Valley. Of special interest in this respect is our finding related to the ability of strongly-linked suppliers to transfer technological knowledge across different product lines, as suggested by Storper (1992), thereby diversifying their customer base and realizing the economic rents of active versatility. Further study of this important finding is warranted to better understand the contribution of inter-firm linkages to the success of the supplier cluster.

Unfortunately, clusters characterized by this type of market diversity are also difficult to identify as a cluster because they can not be captured easily by government industrial codes (Sadler, 2004). This simple finding may be a large part of the explanation for why this dynamic, high-wage, and high-tech group of collaborating firms has not captured the attention of Pittsburgh's economic development professionals. Although the steel-industry supplier cluster has a relatively low-profile,

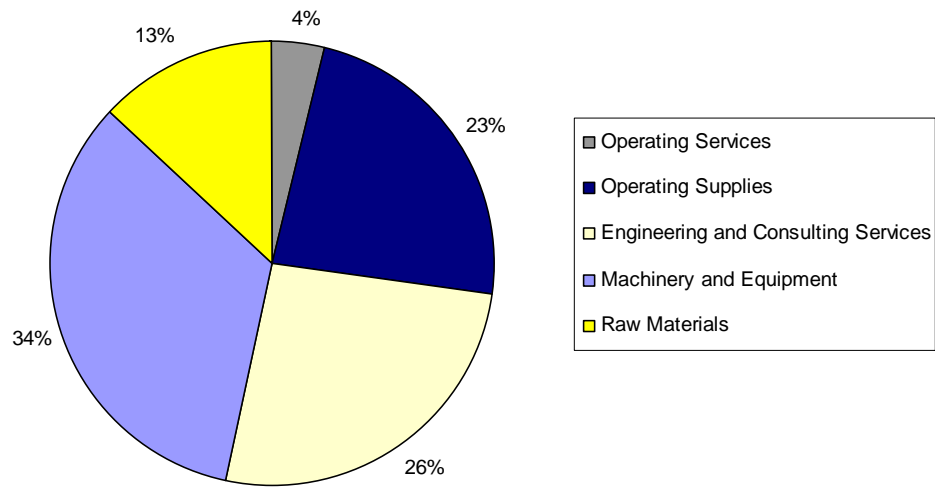
it has still managed to attract new entrants and expand into national and global markets. Thus, the decline of steel-making capacity in Pittsburgh may not have signaled the end of the region's affiliation with steel so much as the beginning of a new status in the global steel value chain as a key location for intermediate steel-industry suppliers.

8. Conclusion

A significant consequence of the product diversity among the intermediate steel-industry suppliers is that these suppliers do not represent a conventional cluster system that links upstream and downstream industries together around a single product. Rather, they are part of a cluster that is structured as a more complex matrix of linkages among the suppliers themselves. Steel continues to be a binding force for this cluster, but not through vertical linkages alone. The horizontal linkages binding firms to each other in this cluster are a critical element that needs to be recognized in regional economic development policy. Forty-five years after Chinitz (1961) first raised his concerns about the possible limitations of intermediate steel-industry suppliers to serve as an independent basis for economic development in the Pittsburgh region, we have identified a cluster of suppliers in the region who have succeeded despite daunting competitive circumstances. By leveraging steel-making expertise as well as regional assets, the cluster has achieved its own place in national and global markets.

9. Figures

Figure 1: Main Sales Categories of the Survey Respondents



Source: Center for Industry Studies, 2005 Survey of Intermediate Steel-Industry Suppliers in the Pittsburgh Region.

10. Tables

Table 1: Production Share for U.S. States and Regions 1980-2000

Region	1980	1990	2000
Pennsylvania	21%	7%	7%
Indiana	18%	21%	23%
Ohio	14%	17%	16%
Illinois	8%	8%	6%
Michigan	7%	8%	6%
Central North	8%	7%	7%
North East	7%	5%	5%
West Half	7%	5%	6%
South East	5%	7%	9%
Central South	5%	12%	14%

Source: American Iron and Steel Institute, Annual Statistical Report

Table 2: Comparison of Survey Respondents and Surveyed Population

	Identified Population of Steel-Industry Suppliers			Identified Survey Respondents			Difference of Means	
	N	Category Share	Mean Employees or Wage	N	Category Share	Mean Employees or Wage	Standard Deviation	t-statistic
Average Wage								
Wages per Establishment (Q1 2003)	259		\$662,983	66		\$512,792	\$704,864	1.73**
Annual Wage/Employee			\$55,767			\$52,478		
Average Employment (January 2003)								
All Categories	259	100%	48.1	66	100%	39.5	54.9	1.26
By Establishment Size								
Less than 10	82	32%	4.45	20	30%	4.1	2.7	(0.61)
10-49	109	42%	23.16	26	39%	24.2	12.2	0.53
50-99	32	12%	67.66	15	23%	60.3	8.0	(1.62)*
100-499	34	13%	178.97	5	8%	199.0	80.7	0.56
Over 500	2	1%	656.50	0	0%	n/a	n/a	n/a
By Industry								
Mining/Construction	16	6%	98.31	2	3%	100.5	142.1	0.02
Manufacturing	109	42%	64.60	25	38%	62.4	70.6	(0.15)
Wholesale Trade	64	25%	15.23	20	31%	23.7	26.9	1.41*
Information	68	26%	41.57	18	28%	19.7	23.0	(4.04)**

Note: Comparison test for difference of means is significant at the 0.10 level where indicated by (*) and at the 0.05 level where indicated by (**).

Source: ES202 Data from the U.S. Census Bureau prepared by the University Center for Social and Urban Research of the University of Pittsburgh

Table 3: Key Contacts and Collaborations of Strongly-linked Suppliers

Key Linkages in Pittsburgh Region	Number of Respondents	Share of Strongly-linked Suppliers
Key Suppliers	12	23%
Key Partners	17	32%
Key Networks	13	25%
One or More Key Contacts	29	55%
Product Collaboration	29	55%
Marketing Collaboration	37	70%
Total in Collaboration	45	85%
<i>All Strongly-linked Suppliers</i>	<i>53</i>	<i>100%</i>

Source: Center for Industry Studies, 2005 Survey

Table 4: Examples of Sales Categories

Sales Category	Examples
Operating Services	Lab testing, rental equipment, equipment repair
Operating Supplies	Injection lances, valves, bearings, gaskets, seals, welding rods
Engineering and Consulting Services	Computer modeling, personnel training, quality optimization studies, market research, facility design studies, safety audits
Machinery and Equipment	Furnaces, rolling mill equipment, pollution control equipment, ventilation systems, pickling tanks, vacuum degassing systems
Raw Materials	Coal, coke, iron ore, magnesium oxide, metallurgical powder, scrap metal

Source: Center for Industry Studies, 2005 Survey

Table 5: Share of Respondents Participating in Each Sales Category

Sales Category	All Respondents	Strongly-linked Suppliers	Weakly-linked Suppliers	t-statistic
All Areas	77	53	24	
Operating Services	38%	38%	38%	-0.02
Operating Supplies	40%	38%	42%	-0.33
Engineering & Consulting	62%	58%	64%	-0.48
Machinery & Equipment	49%	58%	45%	1.05
Raw Materials	14%	13%	15%	-0.30

Note: The t-statistic reports the difference of means test between the strongly-linked and weakly-linked supplier groups. None of the reported t-statistics are significant enough to reject the hypothesis of no difference.

Source: Center for Industry Studies, 2005 Survey

Table 6: Trends in Sales to the Steel Industry

Steel Sales Trends	All Suppliers	Strongly-Linked Suppliers	Weakly-Linked Suppliers	ANOVA	
				F	p
Majority of Sales to the Steel Industry	65%	61%	75%	1.45	0.233
Rising Absolute Share	49%	43%	63%	2.43	0.124
Rising Relative Share	30%	30%	29%	0.09	0.762
Trend					
Shrinking Steel Share	37%	45%	21%		
Growing Steel Share	33%	27%	46%		

Note: The F-statistic (and related p-value) reports the results of the ANOVA test for no difference between the means of the strongly and weakly linked respondents. Because the trend data combines several variables, standard deviations are not available.

Source: Center for Industry Studies, 2005 Survey

Table 7: Geographic Marketing Trends

	All Suppliers	Strongly-Linked Suppliers	Weakly-Linked Suppliers	Wilcoxon Rank Sum Test z (p-values)
Geographic Focus of Steel Marketing Efforts				
National Focus	52	36	16	
Traditional Steel Areas (Pittsburgh – Chicago)	48%	42%	62%	1.37 (0.169)
Global Focus	25	17	8	
Changes in Pittsburgh Customer Base				
Decreased	68%	73%	58%	1.323 (0.186)
Stayed the Same	17%	15%	21%	
Increased	14%	12%	21%	

Note: The Wilcoxon-Mann-Whitney tests reported in the last column compare differences between the two supplier groups on questions concerning (1) the marketing focus within U.S. markets and (2) changes in the size of the Pittsburgh customer base. Both differences have significance at the 20 percent level.

Source: Center for Industry Studies, 2005 Survey

Table 8: Relationship between Suppliers and the Pittsburgh Labor Market

Labor Category	All Suppliers	Strongly-Linked Suppliers	Weakly-Linked Suppliers	t-statistic (p value)
Pittsburgh is the Focus of the Search for:				
Unskilled Labor	29 (38%)	22 (42%)	7 (29%)	-2.71 (0.01)
Skilled Labor	34 (44%)	25 (47%)	9 (37%)	-1.07 (0.29)
Professional/Technical Labor	29 (38%)	23 (43%)	6 (26%)	-1.22 (0.23)
Over 60% of Workforce Hired from Pittsburgh	57 (75%)	43 (83%)	14 (58%)	-2.38 (0.02)

Note: The t-statistic reports tests of no difference in the means of the two supplier groups for each variable.

Source: Center for Industry Studies, 2005 Survey

Table 9: Weakly-Linked Suppliers' Reasons for Non-collaboration on Product Development and on Marketing

	Product Development	Marketing
Not relevant to business	52%	58%
Raises competition concerns	30%	21%
Collaborate with non-Pittsburgh firms	17%	17%
No time for collaboration	0%	4%

Source: Center for Industry Studies, 2005 Survey

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Appendix A

Steel Industry Survey

<http://surveyweb2.ucsur.pitt.edu/steelsurvey/survey2.php>

Firm Location and History

Please refrain from using the BACK or FORWARD buttons in your browser menu. Please click on the "NEXT PAGE" button BELOW when you are finished answering the questions in this page.

Q1. Is your company a single plant or multiplant operation?

- Single plant
- Multiplant

Q2. What is your employment size? *(if single plant only)*

- Under 20 employees
 - 20 - 50
 - 51 - 100
 - 101 - 250
 - 251 - 500
 - Over 500
-

Definition of Pittsburgh area/region: The Pittsburgh region includes the seven counties of the Pittsburgh metropolitan statistical area (as defined by the Census), including Allegheny, Armstrong, Beaver, Butler, Fayette, Washington, and Westmoreland counties.

Q3. Please provide the following information

Number of Pittsburgh area Locations:

Number of other US locations:

Number of non-US locations:

Location of international headquarters:

Location of US Headquarters:

Q4. What is your Pittsburgh area employment size?

- Under 20 employees
- 20 - 50
- 51 - 100
- 101 - 250
- 251 - 500
- Over 500

Q5. What is your global area employment size?

- Under 20 employees
 - 20 - 50
 - 51 - 100
 - 101 - 250
 - 251 - 500
 - Over 500
-

Q6. What year was your first location in the Pittsburgh region established?

Q7. How did your firm first enter the Pittsburgh region??

- Startup firm
- Relocated firm
- New division of an existing firm
- Spin-off from a larger organization (if so, please answer Q8)
- Other (describe):

Q8. If your firm was a spin-off from a larger organization, was it a steel maker?

- Yes
 - No
-

Q9. Has your Pittsburgh location merged with another firm?

- Yes (if Yes, please provide information below)
- No

Q10. If answered Yes to Q9, please provide the following information

Name of company merged with:

Year of merger:

Q11. Has your Pittsburgh location been acquired by another firm?

- Yes (if Yes, please provide information below)
- No

Q12. If answered Yes to Q9, please provide the following information

Name of acquiring company :

Year of acquisition :

Firm Products and Markets

Please refrain from using the BACK or FORWARD buttons in your browser menu. Please click on the "NEXT PAGE" button BELOW when you are finished answering the questions in this page. You can use the "PREVIOUS PAGE" button BELOW to go to the previous page if needed.

Q13. Please describe the main product line at your Pittsburgh location(s):

XXXXXXXXXXXXXX

Q14. Please check all product categories that apply to the sales at your Pittsburgh location(s):

Operating Services (<i>such as repair, maintenance, chemical treatment, lab analysis, or measurement and testing that maintain the regular operations of the steel plant</i>)	<input checked="" type="checkbox"/>
Operating Supplies (<i>such as coatings, chemicals, valves, gears, or spare parts that are required by the regular operations of the steel plant</i>)	<input checked="" type="checkbox"/>
Consulting/Engineering (<i>such as engineering design, turnkey installation, environmental planning, or market research</i>)	<input checked="" type="checkbox"/>
Machinery and Equipment	<input checked="" type="checkbox"/>
Raw Materials (<i>such as iron ore, pig iron, scrap, or alternative irons</i>)	<input checked="" type="checkbox"/>

Q15. In you selected more than one category in Q14, which of these categories is the focus of your firm's current sales efforts?

- Operating Services
- Operating Supplies
- Consulting/Engineering
- Machinery and Equipment
- Raw Materials

Q16. When was the last time you made any sales to the steel industry?

- Within the last 3 months
- 3 – 6 months ago
- 6 - 12 months ago
- During 2003
- During 2002
- Prior to 2002
- Never

Definition of Steel Industry: The steel industry includes those companies that make steel from raw materials, such as iron ore, pig iron, scrap metal, or scrap substitutes such as DRI or HBI.

Q18. What product and/or service do you provide or market to the steel industry?

xxxxxxxxxx

Q19. Approximately what portion of your sales effort is focused on providing a product or service to the steel industry and/or marketing to the steel industry?

- Not currently a steel supplier
- Under 10%
- 10 – 25%
- 26 – 50%
- 51 – 75%
- 76 – 100%

Q20. In the past ten years, would you say that your sales to the steel industry in absolute terms have:

- Declined
- Stayed the same
- Increased

Q21. In the past ten years, would you say that your sales to the steel industry as a percentage of your overall sales have:

- Declined
- Stayed the same
- Increased

Q22. Did your firm contribute in any way to the design, building, equipment, or supplies of one or more of the new flat-product minimills (Beta Steel in Portage; Gallatin in Ghent; Ipsco in Montpelier and Mobile; North Star Bluescope in Delta; Nucor in Berkeley, Crawfordsville, Decatur, Hickman, and Hertford; and Steel Dynamics in Butler)?

- Yes (if Yes, please answer Q23)
- No

Q23. If you answered Yes to Q22, please describe the product/service provided and the name(s) of the flat-product minimills that have been your customers

xxxxxxxxxxxxxxxx

Q24. Does your firm have ongoing contracts or sales to one or more of the new flat-product minimills?

- Yes (if Yes, please answer Q25)
- No

Q25. If you answered Yes to Q24, for what product/service at which mill(s) does your firm have ongoing contracts or sales?

XXXXXXXXXXXXXXXXXX

Q26. What is the main geographic focus of your overall marketing efforts?

- Local (Pittsburgh region)
- National
- Global

Q27. What is the main geographic focus of your marketing efforts to the steel industry?

- Local (Pittsburgh region)
- Traditional steel markets (Pittsburgh , Cleveland , Gary , Chicago)
- National
- Global

Q28. How has the size of your customer base in the Pittsburgh region changed over time?

- Decreased
 - Stayed the same
 - Increased
-

Relationship with Pittsburgh Region

Please refrain from using the BACK or FORWARD buttons in your browser menu. Please click on the "NEXT PAGE" button BELOW when you are finished answering the questions in this page. You can use the "PREVIOUS PAGE" button BELOW to go to the previous page if needed.

Human Resources

Q29. When you hire unskilled labor, which of the following is the focus of your search effort?

- The Pittsburgh region
- The state
- The tri-state area (Ohio , West Virginia , Pennsylvania)
- National focus
- Not applicable

Q30. When you hire skilled labor, which of the following is the focus of your search effort?

- The Pittsburgh region
- The state
- The tri-state area (Ohio , West Virginia , Pennsylvania)
- National focus
- Not applicable

Q31. When you hire professional or technical staff, which of the following is the focus of your search effort?

- The Pittsburgh region
 - The state
 - The tri-state area (Ohio , West Virginia , Pennsylvania)
 - National focus
 - Not applicable
-

Definition of Pittsburgh area/region: The Pittsburgh region includes the seven counties of the Pittsburgh metropolitan statistical area (as defined by the Census), including Allegheny, Armstrong, Beaver, Butler, Fayette, Washington, and Westmoreland counties.

Definition of Steel Industry: The steel industry includes those companies that make steel from raw materials, such as iron ore, pig iron, scrap metal, or scrap substitutes such as DRI or HBI.

Q32. What proportion of your workforce are you generally able to hire from the Pittsburgh region?

- None
- Under 40%
- 40 – 60%
- 61 – 99%
- All

Q33. Have you ever recruited employees away from other Pittsburgh region suppliers to the steel industry?

- Yes
- No

Q34. Have you ever lost employees to other Pittsburgh region suppliers to the steel industry?

- Yes
- No

Q35. How does your location in the Pittsburgh region affect your ability to retain the necessary workforce for your company?

- Pittsburgh region is not a factor
 - Pittsburgh region is a generally negative factor
 - Pittsburgh region is a generally positive factor
 - Pittsburgh region is a critical factor
-

Business Climate

Q36. Are key suppliers to your firm:

- Mainly based in the Pittsburgh region
- Mainly based in the traditional steel area between Chicago and Pittsburgh
- Distributed throughout the nation
- Distributed globally

Q37. Are key partners in the product development process:

- Mainly based in the Pittsburgh region
- Mainly based in the traditional steel area between Chicago and Pittsburgh
- Distributed throughout the nation
- Distributed globally

Q38. Are key industry networks and professional associations:

- Mainly based in the Pittsburgh region
- Mainly based in the traditional steel area between Chicago and Pittsburgh
- Distributed throughout the nation
- Distributed globally

Q39. How important are regional universities or research organizations to your company's product development?

- Very important
- Moderately important
- Somewhat important
- Not at all important

Q40. How important are regional universities or research organizations to your company's technical support?

- Very important
- Moderately important
- Somewhat important
- Not at all important

Q41. How important are regional universities or research organizations to your company's professional/technical hires?

- Very important
 - Moderately important
 - Somewhat important
 - Not at all important
-

Q42. Please check the three most important benefits of maintaining a location in Pittsburgh.

Hiring labor	<input checked="" type="checkbox"/>
Labor retention	<input checked="" type="checkbox"/>
Non-steel customer relationships	<input checked="" type="checkbox"/>
Steel customer relationships	<input checked="" type="checkbox"/>
Supplier relationships	<input checked="" type="checkbox"/>
Relationships with partners or collaborators	<input checked="" type="checkbox"/>
Access to technical assistance or a technical community	<input checked="" type="checkbox"/>
Quality of universities	<input type="checkbox"/>
Regional infrastructure	<input type="checkbox"/>
Regional business taxes	<input type="checkbox"/>
Regional cost of living	<input type="checkbox"/>
Regional business costs	<input type="checkbox"/>
Network of other firms in your business	<input type="checkbox"/>
Access to professional association	<input type="checkbox"/>
Other (specify): <input type="text"/>	<input checked="" type="checkbox"/>

Q43. What are the driving factors for your answers to question 42 above?

Q44. Please check the three factors that you find to be most lacking in the Pittsburgh region and that might possibly encourage your firm to relocate away from the Pittsburgh region.

Hiring labor	<input type="checkbox"/>
Labor retention	<input type="checkbox"/>
Non-steel customer relationships	<input type="checkbox"/>
Steel customer relationships	<input type="checkbox"/>
Supplier relationships	<input type="checkbox"/>
Relationships with partners or collaborators	<input type="checkbox"/>
Access to technical assistance or a technical community	<input type="checkbox"/>
Quality of universities	<input type="checkbox"/>
Regional infrastructure	<input type="checkbox"/>
Regional business taxes	<input type="checkbox"/>
Regional cost of living	<input type="checkbox"/>
Regional business costs	<input type="checkbox"/>
Network of other firms in your business	<input type="checkbox"/>
Access to professional association	<input type="checkbox"/>
Other (specify): <input type="text"/>	<input type="checkbox"/>

Q45. What are your firm's plans for its Pittsburgh area location(s) in the next five years?

- Maintain current operations
- Increase current operations
- Decrease current operations
- Relocate

Q46. Do you participate in a regional professional association (such as the Pittsburgh Chamber of Commerce, IEEE, AIST, Pittsburgh Technology Council)?

- Yes (please name assoc.:)
- No (if No, please answer Q47 below)

Q47. If you answered No to Q46, why have you decided not to participate in a regional professional association?

- No relevant regional professional association exists locally
- Regional professional association exists, but no time to participate
- Regional professional association exists, but participation raises competition concerns
-

Q48. Has your participation in a professional association assisted in your efforts to market to the steel industry?

- Yes (please name assoc.:)
- No

Q49. Do you collaborate with regional firms on product development?

- Yes
- No (if No, please answer Q50 below)

Q50. If you answered No to Q49, why have you decided not to collaborate with regional firms on product development?

- Collaborative product development is not relevant to my business
- Collaborative product development raises competition concerns
- Collaborate on product development with firms outside of Pittsburgh region
- Do not have time to pursue collaboration
-

Q51. Do you collaborate with regional firms on marketing/sales?



Yes



No (if No, please answer Q52)

Q52. Why have you decided not to collaborate with regional firms on marketing/sales?



Collaborative marketing/sales is not relevant to my business



Collaborative marketing/sales raises competition concerns

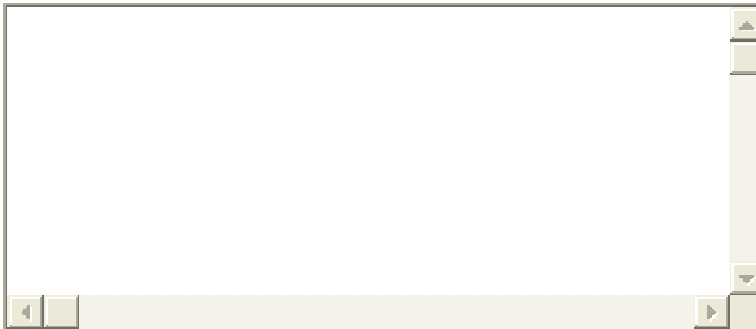


Collaborate on marketing/sales with firms outside of Pittsburgh region



Do not have time to pursue collaboration

Q53. Please share with us any other comments that you have on the history, current status, and future of the Pittsburgh cluster of suppliers to the steel industry:



¹ The Pittsburgh region is defined in this article as the seven county region that constitutes the Pittsburgh metropolitan statistical area (MSA), including Allegheny, Armstrong, Beaver, Butler, Washington, and Westmoreland counties.

² In comparison, employment in the transportation equipment industry represented 11 percent of all employment in Wayne County, Michigan (the central county of the Detroit area) in 1978 and still makes up 7 percent of employment there in 2004 (County Business Patterns, 1978 and 2004).

³ See Sadler (2004) for a more thorough discussion of this distinction.

⁴ William S. Kirk, "Iron Ore," in the United States Geological Survey, *Minerals Yearbook 1998*, p. 1.

⁵ This system was revised in 1924 to include Cleveland and Chicago as additional basing points and was finally abolished in 1948. See Heckman, 1978, p. 127.

⁶ Regional wage and employment data has been extracted from the 2003 Quarterly Census of Employment and Wages (ES202) of the Census Bureau of the U.S. Department of Commerce by the University Center for Social and Urban Research of the University of Pittsburgh.

⁷ Non-parametric tests comparing categorical distributions were not available from the Census data. In addition, a standard deviation was not available for the average wage per employee.

⁸ The test for no difference between the means resulted in a t-statistic of -1.88 and a p value of 0.064.

⁹ The ratio of strongly-linked respondents among the single plant and multiple location respondents was close to .68, the ratio for all respondents. The t-statistic for difference of means was -0.2115, insufficient to reject the hypothesis of no difference.

¹⁰ Because this trend data combines several variables, standard deviations are not available.

¹¹ Significance test reported in Table 7 indicates that this difference is significant at the 80 percent level.