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Power in Firm Networks:
What it Means for Regional Innovation Systems

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WHAT IT MEANS FOR REGIONAL INNOVATION SYSTEMS

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ABSTRACT

The role of power within regional firm networks is noted in empirical studies but insufficiently theorized. We suggest that network functioning is conflictual and that more powerful network members, particularly transnational corporations (TNCs), leverage regional resources to advance their sustainable competitive advantage.

The agendas and power exercised by TNCs within regionalized firm networks have significant implications for regional policy and the uneven allocation of resources and capacities within and among regions.

Our findings indicate that transnational firm access to resources critical to innovation, including university research and skilled labor, negatively affects the potential for innovation by small and medium-size firms.

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Regions

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R11 - Analysis of Regional Growth, Development, and Changes

R12 - Size and Spatial Distributions of Regional Economic Activity

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CHARTS

Research on how firms actually behave in territorial innovation systems has raised questions about some taken-for-granted premises in policy-oriented regional development studies (Diez & Kiese, 2006; Hendry & Brown, 2006; Kristensen & Zeitlin, 2005; Malmberg & Power, 2005; Martin & Sunley, 2001). One taken–for-granted premise is that co-located transnational and small and medium-size firms exist in a cooperative relationship that enables the small and medium size enterprises (SMEs) to introduce innovations and reach global markets. Kristensen and Zeitlin (2005) and Dicken (1998) describe how the assumed symbiotic relationship between large and small firms is rooted in the "lead agent" role played by transnational corporations (TNCs). Within this theoretical frame, TNCs locate in regional innovation systems to tap the specialized innovative capacity of small firms. In return, because they have more favorable access to capital and information, TNCs enable regionalized SMEs to access innovation -relevant information and reduce risk in volatile financial markets.

Kristensen and Zeitlin's (2005) case study of a transnational firm and its relationships with its regional subsidiaries in several countries, suggests that this potential is not reached. Instead, association with the TNC network "led to the creation of volatility, destruction of skills, loss of strategic assets, and additional needs for liquid capital, while very few of the potential benefits seemed to have been achieved" (p.7). They attribute this failure to the "diversity of evolutionary logics" that emerge as transnational firms expand (p.17) and to the consequent constraints on the ability of the TNC to tap the specialized knowledge of regional innovation systems, to absorb knowledge from global markets, and to transfer that knowledge to local firm networks.

While acknowledging the importance of this account of the capabilities of TNCs as lead firms, we focus on another factor that limits innovative capacity in regional economies that include innovative small and medium size enterprises (SMEs) and "lead" TNCs. This factor is TNC power relative to regionalized SMEs. It is manifested in TNC ability to use its political power to manage access to and the orientation of key regional production resources. The goal of this strategy is to maintain TNC sustainable competitive advantage in global markets and attain profit goals. Our research on regionalized innovative SMEs in "advanced" manufacturing, combined with evidence from other recent case studies of regional innovation systems, indicates three ways in which TNC power can affect innovative capacity.

First, TNCs use political power to influence regulatory policy, affecting which innovations are commercialized and how knowledge is diffused, to whom, and under what conditions. Second, TNCs drive the innovation agenda within publicly supported research centers, including those at universities. Finally, TNCs dominate the regional labor market, using management resources to organize skill development programs around their specific needs, and competing with SMEs for the most valued segment of the skilled workforce – experienced technically-trained workers who combine technical and managerial skills. Since the TNC agenda diverges from and competes with that of innovative small firms, it can limit or even squelch SME ability to reach their innovative potential.

A closer look at power in territorial firm networks provides a different vision of how TNC-led regional innovation systems function. In particular, a power-oriented analysis begins to answer questions about why regionally co-located firms do not

produce market-disrupting innovations or lead to unique regional competencies and regional competitive advantage (Asheim & Coenen, 2006; Moulaert & Sekia, 2003; Simmie, 2005). More generally this type of analysis can contribute to a broad set of theoretical debates concerned with the role of power in processes with spatial and territorial dimensions (Allen, 2003, 2004).

To set the stage for looking at how TNCs exercise network power by leveraging regional resources, we briefly examine current thinking about the role of small firms in the innovation process and at the theories about why co-location should be associated with innovation.

The Missing Questions of Power and Conflict in Innovative Networks

Regional programs to develop sustainable innovation-based economies typically emphasize the role that small entrepreneurial firms (SMEs) play in the innovative capacity of regions. (Acs *et al.*, 1994; Audretsch & Feldman, 2003). The idea that small firms contribute to the innovative capacity of regions is a compelling one given empirical evidence that small firms "innovate" with greater alacrity than large firms (Hicks & Hegde, 2005). Measures such as patent activity, for example, establish a crucial role for small firms in the potential commercialization of new products.

The ability of small entrepreneurial firms to produce path breaking products and processes also has been linked to their participation in networks of interacting firms (Feldman *et al.*, 2005) . Case studies of regional innovation systems have focused on the importance of trust and cooperation in networks and the ways in which positive social

relations produce information sharing and knowledge spillovers, the critical factors underpinning sustainable innovation economies (Cooke, 2004, 2005).

This cooperation promotes a rapid and flexible response to changing and expanding global markets, and the capacity for innovation. Cooperation among co-located firms enables knowledge spillover from the learning and practice of firms in the co-located network. Knowledge spillover and the "untraded interdependencies" (Storper, 1997) produced via a cooperative network essentially make the whole greater than the sum of its parts and lead to a sustainable regional innovation system (Funke & Niebuhr, 2005). The second attribute is a skilled labor force, which is critical to both innovative capacity and the diffusion of knowledge within and across firms (Christopherson & Clark, 2007b; Malmberg & Power, 2005).

Within the policy literature, transnational corporations (TNCs) play a particular and fairly limited role in regional innovation systems. As "lead firms" they connect their fellow network members to global markets, enabling them to expand and specialize (Porter, 1998). TNCs seek competitive advantage by entering specialized regional industries in order to draw on their innovative capacities and benefit from their skilled labor (Cooke, 2004). The combination of small firm flexibility and innovative capacity, with large firm access to global markets theoretically enables regions to escape the dominant logic of convergence and price-based (or as it is sometimes called) "low road" competition.

Empirical studies have found, however, that trust or cooperation among co-located firms is limited (Angel, 2002; Freel & Harrison, 2006; Glasmeier, 1991; Hendry *et al.*, 2000; Lorenzen & Mahnke, 2002). Rather, there is evidence that, even under the

most favorable conditions, the relationships among co-located firms, and particularly those in supplier networks, are "close but adversarial" (Mudambi & Helper, 1998). One account describes "subversive" strategies in which the small innovative firm purposefully uses TNC resources but distances itself from the TNC because of the costs of integration into and dependence on the TNC agenda (Kristensen & Zeitlin, 2005). Together these accounts suggest a competing paradigm, one in which relations within innovation-based regional economies are infused with conflicts of interest and power relations.

Evidence to the contrary, the question of power relations has been missing from theories attempting to explain change in regional agglomeration economies and firm networks or failures in entrepreneurship and innovative capacity. To the extent it is recognized, the limits to regional innovative capacity have been explained with reference to endogenous characteristics of the region, such as inadequate supportive institutions or technological or political "lock-in" (Todtling & Trippl, 2005). These approaches, although providing significant insights, leave a model of cooperation and trust among large and small firms as the dominant paradigm. In its lack of attention to power relations, and emphasis on trust relations and "soft infrastructure", the literature on regions and firm networks is afflicted by some of the same theoretical problems as those which afflict the concept of social capital (DeFilippis, 2001; A. Markusen, 1999).

DeFilippis (2001) notes in his critique of social capital that networks of all kinds, (presumably including firm networks), are constructed around relative power relations. Networks encompass hierarchies of power or they wouldn't be networks. As Lin points out in an analysis of networks and individual investment in social capital, some positions in a network carry more valued resources and provide options for the exercise of greater

power (Lin *et al.*, 2001). There would be no incentive for the more powerful members to remain in the network if they didn't disproportionately gain the benefits of network participation. Just as people "network" in order to promote their individual interests (rather than those of the network as a whole), so do firms. Networks can and frequently do take the form of hierarchies with marginal benefit to the less powerful members. With respect to firm networks, regional firm clusters are important to the TNC only insofar as they support the international competitiveness of the TNC.

A second important characteristic of networks is their exclusivity. There is no purpose in belonging to a network if it does not keep people or firms outside its boundaries. In this instance, too, the rewards of exclusivity disproportionately go to the more powerful members of the network who can control who is in and who is out.

One demonstration of how power is used to set network boundaries is in the naming and identification of firm networks. For example, the choice to define a network as a biotechnology network rather than a pharmaceuticals or medical devices network prioritizes technology as the defining characteristic rather than end products. The "technology choice" makes the market goals and orientation of the network less visible and supports the background conception that change in markets is primarily driven by changes in technology rather than firm choices.

The observation that networks involve power is not a wholesale rejection of the role and importance of a regional social infrastructure. The idea that informal rules and norms aid coordination of economic actors under conditions of uncertainty is borne out by numerous empirical studies. Also unproblematic is the idea that this social infrastructure and its informal rules are differentiated by region, and function in

regionally specific ways. Again, comparisons among regionalized industries in the same nation, demonstrate considerable difference in industrial cultures across regions (A. Markusen, 1987; Saxenian, 1994).

What is missing from contemporary regional theory is an account of how the agendas of TNCs and SMEs can result in competition rather than cooperation and how TNCs have the upper hand in shaping the innovative potential of many regional innovation systems. In the next section we examine how research that refutes wholly cooperative conceptions of regional innovation systems explains sources of conflict.

SOURCES OF CONFLICT: TRAJECTORIES, CONTINGENCIES, AND GOVERNANCE IN INNOVATION SYSTEMS

The basic policy framework for regional innovation systems has stayed remarkably consistent over time. Michael Piore outlined an institutional framework for regional innovation in 1990 and that framework has been reiterated in subsequent research (Amin, 1999; Scott, 1992, 1998; Sengenberger *et al.*, 1990; Storper, 2002):

> Thus far, the literature seems basically to have identified a list of factors which are critical to success. The standard lists include: 1) a major research university, 2) an academic tradition, or ethos, which encourages researchers to engage in practical activities and which is not hostile to linkage between the academic and business community, 3) venture capital or, more precisely, a local financial community with both the resources and the willingness to provide funds for start-up enterprises; and 4) a local entrepreneurial tradition and a reservoir of expertise on the management of start-up business. The attempts to create new [high tech] regions have essentially tried to create the institutions on the list (Piore, 1990: 299).

Despite consistency in what constitute the key elements of success, concerns about the functioning of regional innovation systems have been a persistent part of the literature. A

series of case studies have raised questions about whether successful regional innovation systems can be sustained over time (Gertler, 2003). Among these case studies are a set which examines the trajectories of firm networks in the industrial districts that inspired the first work on regional innovation and its distinct advantages in global markets (Bianchi, 1994; Crevoisier, 1999; Sabel, 1983). These studies found evidence of deterioration in the innovative capacity of previously innovative firm networks. According to Boschma and Lambooy, "evidence suggests that in many industrial districts in Italy, there is a tendency for more market concentration (both horizontally and vertically), more market power (embodied by leader firms and business groups), fewer local inter-firm relationships (especially in the case of suppliers and subcontractors), less inter-active and inter-organizational learning, and some signs of institutional lock-in." (Boschma & Lambooy, 2002).

Two types of explanations are advanced for the failure of small firms in regional innovation systems to produce and commercialize new products. The first explanation attributes failure to the characteristics of the small firms and their interaction with one another. The second set of explanations takes a more dynamic (and trans-local) approach, examining how regional production systems built around small firms are affected by the changing agendas of lead firms in global production networks.

In the first, pattern-oriented, framework, the failed potential of small firm networks embedded in regional innovation systems has been noted by analysts of what are described as "entrepreneurial" regions. The "entrepreneurial regionalists" suggest that what prevents small firms from innovating is the absence of an entrepreneurial ethos, defined as the willingness to take risks in pursuit of big gains, and the ability to develop,

commodify, and commercialize the outputs of applied research (Audretsch, 2004). They attribute the absence of this ethos to market and governance failures that prevent cooperative competition among small firms and inhibit knowledge spillovers.

By contrast, there are a set of case studies whose questions and findings are underpinned by theories of firm and global production network path dependency. Regional innovation systems are affected by policy frameworks and economic conditions (in financial markets, for example) which change from one round of accumulation to the next (Massey, 1984). This dynamic orientation links these case studies of regional innovation systems to previous case studies of industry evolution and change (Christopherson & Storper, 1989; Dicken, 1988; Glasmeier, 1991, 2000; Markusen, 1985; Stone, 1973). They position questions about regional innovation systems within a theoretical tradition in economic geography that examines firms strategies in response to changing market conditions and government policies, in addition to new technologies.

Within this theoretical frame are studies of regional innovation systems emerging in old industrial regions. These studies have pointed to the contradictory processes affecting these regions by virtue of their connections to global markets through TNCs (Dawley, 2007f). These firms may be just as likely to be "removing resources from the region via rationalization and restructuring" as initiating new growth dynamics (Benneworth, 2006). For example, recent studies of the auto industry have recognized limits to innovation by small and medium size firms co-located with lead firms in the industry (Belzowski *et al.*, 2003; Rutherford & Holmes, 2006). These studies, too, focus on change over time and the way in which asymmetries in firm power and differential

access to global production and distribution networks affect the innovative potential of firm networks.

A basic premise of this approach is that hierarchy and power in regional innovation systems are affected by the changing role and market power of the TNC as it responds to market incentives. This power can be exercised in various ways, including in governance institutions and information diffusion -- "leader-firms and other organizations have sometimes become too dominant in the local institutional network" (Boschma and Lambooy, 2002: 302). A concern with power in inter-firm relations is a considerable departure from the conventional literature, which has tended to emphasize trust and cooperation and to imply, at least tacitly, symmetrical relations among firms (Asheim, 1992; Asheim & Isaksen, 2002) .

Finally, the "contrarian" case studies differ from the mainstream literature in how they understand governance relative to network functioning and innovative capacity. The mainstream research on entrepreneurial innovative regional economies has emphasized the ways in which regional institutions provide the glue that underpins trust and cooperation in firm networks. By extension, the case studies that identify the failures of regional innovation networks tend to tie those failures to the governance of the regional firm network and particularly the relationships among the small innovative firms. The failures are attributed either to lack of cooperation among innovative small firms or to industry specific dynamics that alter relations between large and small firms (Grabher, 1993; Rutherford & Holmes, 2006).

By contrast, the "contrarian" case studies suggest that the normative model of cooperative trust relations may, in fact, be the exception and that conflicts and power

relations are common in inter-firm networks. Our research adds a third dimension to the contrarian picture --- that of territorial governance and particularly sources of conflict over inputs critical to the innovation system. Another possible explanation for innovative firm network failure, then, is that the unequal power relations and the different strategic agendas of small innovative firms and dominant "flagship" TNCs hinder cooperation, foster information asymmetries, and reduce innovative potential.

Following on these insights, we examine how small innovative firms and transnational corporations use territorially–based governance institutions to leverage regional assets. In the conventional picture, large firms and SMEs appear to operate in parallel universes---the TNC in global markets and the SME in the region. At the same time their interests converge in the arena of innovation, where they play complementary roles (Scott, 1992). In reality, the universes of innovative SMEs and TNCs intersect at the scale of the region where they both rely on regional resources to achieve strategic objectives. TNCs and SMEs, however, have considerably different objectives with respect to the content and direction of the innovation process (Harrison, 1994; Storper & Harrison, 1991; Warrian & Mulhern, 2005). These differences are magnified if the TNC is publicly traded and subject to pressure for short term gains (Pike, 2005) . So, for example, the need for large markets combined with goals of double-digit percent annual growth in earnings per share prompt TNCs to focus on new products with large potential growth in the short term (West & DeCastro, 2001). And since the ultimate goal of publicly traded TNCs is the achievement of sustainable competitive advantage rather than innovation per se, its managers need to control the innovation process so that it complements their interests (Ernst et al., 2005).

Holmes and Rutherford describe how knowledge production and diffusion may be affected by the TNC agenda:

> Knowledge development within and between firms within North American automotive OEM supply chains is being shaped mainly by a short term focus on price reduction and the OEMS control of intellectual property. OEM demands for continuous price reductions from suppliers have cascaded down the supply chain and adversely impacted the automotive tooling manufacturers who sit at the bottom of the supplier base.
>
> Rutherford and Holmes (2006: 23).

They cite a case study of the automotive industry supply chain on the impact of short term goals of TNCS, (Belkowski et. al. 2002), who find that "suppliers believe that they transfer more knowledge to larger customers than they receive and too many firms are being forced to focus on short-term cost cutting, at the expense of knowledge-focused production." (Rutherford and Holmes 2006: 22).

In our research on innovation systems in U.S. regions, we also find that large firms that dominate local factor markets and global product markets, (TNCs), have different access to resources critical to innovation than do small and medium-size firms (SMEs) in regional agglomerations noted for their innovative potential. Our explanation, while recognizing the importance of differences in industry and firm paths, focuses on TNC power relative to governance institutions. Because of their influence over labor markets, government policy, and research and development institutions, the needs of large firms tend to take precedence over those of small firms.

In the next sections we present research on the photonics industry in Rochester that sheds light on the differing roles and goals of TNCs and small innovative firms in regional "clusters", and their relative access to information, labor and research capacity.

DIFFERENT AGENDAS IN A FIRM NETWORK: PHOTONICS IN ROCHESTER

Since the early 1900's, the Rochester, New York region has been the home of large, transnational corporations in two inter-related industries: optics and imaging and photographic equipment and supplies. The large firms in the region are prominent household names, including Kodak, Xerox, Corning, and Bausch and Lomb. All have restructured their operations since the 1980s to position themselves in global markets and utilize global production networks. For much of the workforce, this restructuring meant the end of a century of job security, and of a predictable employment system organized around internal labor markets (Jacoby, 1997; McKelvey, 1956)

The Rochester photographic equipment and optics and imaging industries have been organized historically around specialized suppliers. Even before the restructuring that accelerated in the in the 1980's, the industries in Rochester included a large number of small and medium sized firms, which were tied together through buyer and supplier relations with each other and the large firms in the region. In some cases, regionally-based suppliers were connected to a global network of optics and imaging end product producers (Sternberg, 1992). Since the 1990s, the regional network of small and medium sized firms has identified itself by technology---*photonics*---rather than by the traditional end products of the industry---*optical, imaging, and photographic equipment*. This identification with a shared technology rather than a shared end market illuminates the role the small and medium sized firms play in the transnational supply chain (Figure 1).

The Rochester region has remained competitive in optics, imaging, and photonics, but the contemporary industry has shifted its priorities to enter and develop products for new markets (Jacobs, 2002). While Rochester's large "lead" firms continue to concentrate on optics and imaging, consumer, and office products, the smaller firms have focused on photonics technologies and a wide array of intermediate markets.

The lead firms, most notably Kodak, are at the peak of global production networks producing new products, such as digital cameras, for mass markets. While the Rochester region is no longer the production center for Kodak, the company has maintained its research and development activities in the region. The innovative small and medium sized "photonics" firms supply the lead firms but also compete with them in the research and development phase of production. So, by contrast with the literature on global production networks, which portrays lead firms as playing a supportive role to regionalized innovative SMEs the small innovative Rochester photonics firms are in direct competition with the lead firms for key inputs, including specialized labor, research and development resources, and information on intellectual property. . These inputs are, to a large extent, provided by regional institutions, such as The University of Rochester and Rochester Institute of Technology or the product of long-term investments in industry specific skills and science-based knowledge.

In researching the regional industry between 2001 and 2004, we conducted a survey of small and medium size photonics firms in order to better understand their specific characteristics and their relationships with each other, lead firms located in the region (Kodak, Bausch and Lomb, Xerox, Corning); global production networks, and regional institutional resources. Our survey questions emerged from a series of focus

groups and key informant interviews with l actors engaged in the Rochester optics and imaging industry. The focus groups included representatives from firms, universities, civic organizations, trade associations, labor unions, community-based organizations, and public sector agencies. The survey questions were designed to examine how firms in the industry cooperate and interact with each other in the context of rapidly changing and technologically challenging markets.

The telephone survey was conducted during July and August of 2002. Of the 90 firms constituting the population of optics, imaging, and photonics firms, 57 responded fully to the survey as administered, a 63 percent response rate for the survey. Among the 57 firms responding, 51.2 percent of the firm representatives interviewed characterized themselves as the owner, CEO, or president of the firm. The firms were primarily small manufacturing firms (74 percent of respondents) with 76 percent employing between 1 and 50 people and none with more than 500 employees.

The survey results indicated that the small innovative photonics firms in the region remained connected to the lead firms and their global production networks. Seventy-four percent of firms responding had a past or existing subcontractor or supplier relationship with one or more of the four transnational firms in the region. The photonics SMEs reported that 59 percent had a present subcontractor/supplier relationship with the "Big Four." In a question aimed at the labor market for industry-specific skills, 42 percent of firms reported that a former or current staff member had previously worked for Corning, Kodak, Bausch and Lomb, or Xerox.

Because of the diverse applications of the photonics technology, however, the SMEs also supply widely diversified intermediate markets (Figure 2). Although they

identified themselves as manufacturing firms, they generally did not manufacture end products themselves but rather supplied optical, imaging, or photonics components to other firms.

The survey responses indicated that while most of the small firms were part of a regional supply chain---that is, they interacted with one another---their customers were distributed internationally (Figure 3). Rochester's optics, imaging, and photonics firms serve diverse markets including precision optics, calibration and measuring equipment, medical devices and biotechnology applications, and military and security devices. One firm owner described photonics as an "enabling industry," one that serves product markets based on the wide applicability of the underlying technology.

Interviews and focus groups indicated differences in the markets in which small and medium sized firms and lead firms operate. While both operate in global markets, the large lead firms are oriented toward end product markets while innovative SMEs serve intermediate input markets. Lead firms and SMEs are, however, in direct competition in input factor markets for skilled labor and research and development capacities within regions.

This competition in regional markets for labor and research and development resources places small and large firms in an adversarial position. Both types of firms need the same, regionally-embedded, factors of production. Many of these factors are publicly regulated or subsidized. The political and economic power of large firms, *vis a vis*, the state strongly influences public priorities regarding the allocation and use of these resources. In so far as the small and large firms share the same priorities (and there are situations in which they do) there is no disparate impact. However, empirical evidence

from the Rochester case and others, demonstrates that small and large firm interests diverge in some key respects and that the small innovative firm agenda and needs are likely to take second place to those of the large lead firm.

COMPETITION OVER KEY RESOURCES: SKILLED LABOR

One factor that is taken for granted in the regional innovation literature is the critical role of highly skilled labor with training in science and engineering. Our research indicates, however, that, because they are engaged in product commercialization and prototype construction as well as research, innovative SMEs need a labor force with a wide range of skills. In our survey, photonics firms in Rochester were asked two questions that related to the importance of labor skills: 1) what role did labor skills play in their decision to remain in the region, and 2) what resources were important to their ability to grow and expand in the region. The firm survey respondents identified the quality of the labor supply as the second most important reason for their presence in the Rochester region (Figure 5). In response to the second question the highest ranked answer was medium-skilled labor (Figure 6). In interviews, these medium-skilled workers included those with several years of experience and the ability to combine technical and managerial skills.

The answer to the second question is, perhaps, more telling than the first, which is consonant with evidence on the centrality of labor skills in regions oriented toward high value-added production. Although science and engineering workers are regularly considered a locational asset in attracting and retaining firms, the labor market needs of innovative industries include workers with a range of skill levels (Florida, 2002a, 2002b;

Gertler & Wolfe, 2002). In the Rochester regional labor market, however, SMEs find themselves in direct competition with transnational firms for medium skilled workers. This problem was consistently voiced in interviews with the CEOs of SMEs and with the public officials in the Industrial Development Association, charged with assisting the expanding group of innovative photonics firms. During the early period of our research, the supply of medium-skilled labor, particularly experienced operatives with machining skills, was extremely limited. In part, this resulted from the power of large firms in setting the prevailing wage in the region. Prospective employees looking at the Rochester region would decide against moving there because wages were consistently below the national average for their skills (Clark, 2004; Pendall at al, 2004). Our interviews indicated that TNCs actively lobbied public officials to prevent the entry into the labor market of competitor transnational firms that would raise the prevailing wage rate by competing for medium-skilled workers. When inward investment by other lead firms does occur, it serves to drive up wages for the experienced medium-skilled worker.

For example, a 2007 study of advanced manufacturing in the near-by Binghamton, New York city-region, based on interviews and focus groups with managers from SMEs and TNC lead firms suggested what can happen in more competitive conditions. Wages in the highly competitive computer and electronic sector rose almost 12 percent between 2000 and 2005 while wages in non-manufacturing sector in the region declined 4 percent during the same period (Christopherson *et al.*, 2007). In both regions, however, small firms are disadvantaged in the competition for medium skilled workers. In the Binghamton region, small specialized firms in the electronics packaging industry compete for experienced technically skilled workers with transnational

aerospace firms, Lockheed Martin and BAE, which have major facilities in the Binghamton region. One small software firm manager described the imbalance:

> We tried to advertise, and it was a disaster. Lockheed Martin has so swamped the local paper that your little ad doesn't even get seen. National ads yielded completely inappropriate resumes; we got zero interviews out of it. We do better talking with people we know.

In both the Rochester and Binghamton regions (and perhaps unexpectedly), competition is not as severe at the high end of the skill spectrum. Small innovative firms attract entrepreneurial skilled labor because they offer the alternative compensation that makes them competitive with corporate employment (e.g. stock options, co-ownership, leadership positions) and more opportunities for satisfying creative engineering work. High-skilled workers for the TNCs tend to follow firm contracts as they move from one location to another. Nineteen percent of the workforce in the two fastest growing Binghamton advanced manufacturing sectors migrated into the region to work (Ibid.).

The ability of the regional labor market to meet the needs of innovative SMEs is also affected in some U.S. states, including New York, by what are popularly called "non-compete agreements". Where they are enforced, non-compete agreements, between an employer and an employee regulate the movement of skilled workers among firms within a given geographic area and industry (Kauffman, 2007).

These state-level regulations prevent skilled workers from moving among firms or establishing new enterprises in their area of expertise.

TNCs essentially operate in a global labor market, able to attract engineers and scientists from all over the world, and thus could provide the regional skill base for technological innovation in existing and new firms. Instead, covenants not to compete

protect the recruitment and training investment of TNCs by limiting the mobility of workers. In places, such as the state of California where non-compete agreements are not enforced, entrepreneurship and innovation were encouraged by a free flow of skilled labor in the market (Gilson, 1999; Saxenian, 1994; Stone, 2004).

COMPETITION OVER KEY RESOURCES: RESEARCH CAPACITY

Our research in Rochester also pointed to another source of inequality and asymmetry between large TNCs and innovative SMEs: access to research infrastructure (Christopherson & Clark, 2007a). Again, there are differences in the objectives of TNCs and small potentially innovative firms within a regional innovation system. For example, TNCs want research institutes supported by universities or public funds to take on specific tasks in the development process. Because they cannot directly control university-sponsored research, they prefer that universities focus on generic technology, giving the TNC direction as to what research avenues are likely to be more profitable. They can then rely on in-house or captured research institutes to do the research that will result in commercial products and processes (Ernst et al., 2005). Increasingly those "captured research institutes" have emerged as partially publicly financed innovation centers or, as they are called in New York State, "Centers of Excellence" (Feller, 1999).

Transnational corporations are interested in "embedded labs" in part because they provide access to the emerging entrepreneurs and their ideas after a technology has been developed but before they spin off into competitors. In a related case, research on the implications of the innovation center agenda in the field of biotechnology indicates that spin-offs to SMEs are rare and that commercialization is limited to those products of

interest to large transnational firms, such as those in pharmaceuticals (Kenney & Patton, 2005). The large firm buyers are frequently not located in the region of the innovation center so investment in innovation doesn't contribute to the development of a dynamic regional agglomeration. In the context of the goals of these centers, small innovative firms are a means to an end, rather than a resource whose potential contributions to regional innovation need to be fostered.

TNCs are opposed to "the over involvement of universities in downstream product development activities" as a consequence of their mission to increase a capital flow from equity holdings in start-up firms and patents and licensing agreements (Feller, 1999). Small firms, however, lack the in-house commercialization capacity and need assistance in converting generic research into commercial properties (Ibid: 15). Since universities are critical venues for such support, TNC support for university research can serve to limit research focused on downstream applications that benefit smaller firms.

The way in which research is conducted in state-supported "innovation centers" represents another example of how power inequalities affect access to resources that foster innovation. is In the U.S., many states, along with their federal partners, have invested significant economic development resources in these industry or technology - specific centers aimed at research, training, and commercialization. A stated goal of these centers is to promote regional innovation capacity by nurturing nascent entrepreneurs (Bozeman, 2000).

Innovation center agendas are developed around explicit partnerships among universities, large firms, and state and local government, but heavily weighted toward the needs of the TNC "lead" firms. In the cases we have examined, the centers are managed

by staff seconded to the innovation center from transnational firms in the region and their advisory boards are dominated by large firm representatives. In order to benefit from the resources of the center, small innovative firms must be willing to compromise their independence and control of their intellectual property, allowing the large firms to learn about their innovative activities. The flow of information tends to be upward to the lead firm rather than diffused or horizontal, in ways that could benefit small firms.

The 2006 composition of the Board of Directors for the New York Infotonics Center of Excellence provides some insights into the differences in power and influence of transnational corporations and SMEs over regional innovation assets, including valuable information. The Infotonics Center lists 10 Board members, 7 of whom currently work for Kodak, Corning, or Xerox. The Board is rounded out by two directors of university research centers and one small firm representative. The CEO is a Kodak retiree. While innovation centers have become popular sites for regional economic development investment, their governance remains dominated by large corporate interests, calling into question their role in encouraging small firm growth and innovative capacity.

Far from fostering a regional entrepreneurial ethos, these centers provide opportunities for large firms to observe their (potential) small firm rivals. In some cases, large firms negotiate a “right of first refusal” for innovations developed under the center’s umbrella as a condition of their participation. These deals undercut the role centers could play in nurturing a regional entrepreneurial ethos.

CONCLUSIONS AND IMPLICATIONS

Because of their size, scale, and political as well as economic power, TNCs can shape the governance environment within which they operate at the regional, national and international scale. While TNC influence is well-documented, it is often portrayed as a result of individual influence rather than a systematic aspect of market governance.

As already noted, TNCs want to decrease the risk of disruptive innovations, prevent competitors from entering their product markets, and build innovations around the standard which they have established so as to add value to their product line and brand identity. To achieve these goals TNCs have to carefully manage the regional innovation process. This management may mitigate against rather than in favor of innovations that could lead to regional economic development.

Although research touts the advantages of small firms to the economy and job growth, evidence (from the US, at least) tells us that small firms are marginal players in the policy arena---at any scale. Their needs are poorly understood and the government programs intended to foster small firm innovation are minuscule when compared with subsidies and assistance to large firms (Feldman & Desrochers, 2003; Feldman *et al.*, 2002).

Theoretically, this shouldn't be a problem if the entrepreneurial activity of small firms is a spillover or by-product of industry agglomeration (Scott & Storper, 2003). Policies benefiting large firms in the agglomeration should not negatively impact small firms or their capacity for innovation. In fact, if it creates more capacity in the entire network of firms, there should be benefits to a large firm presence.

A look at real life policy making and how it engages and affects small and large firms in regional agglomerations presents a more complicated picture. First, it suggests that the interests, capacities, and strategies of large, transnational firms and SMEs in the same industry are considerably different from each other and may, in fact, conflict. Second, the power of the large transnational firm to set the innovation agenda and to insure that public policy supports that agenda is manifestly apparent. Large firms producing and distributing in international markets are able to influence policy because, despite down-sizing and out-sourcing, they continue to be major employers. They also have the resources to hire lobbyists, promote policy research, and contribute to officer holders who will give priority to their needs. Small firms, on the other hand, have little influence on policy because they lack political resources and influence.

With respect to the labor market, a key component of a dynamic regional innovation-oriented economy, the agendas of large firms and small firms diverge. Large firms shape the instructional programs of colleges and universities and have a disproportionate influence on prevailing wage rates for key personnel. Small firms in a growth phase may be starved of necessary workers both because of their inability to compete with the large firm for skilled labor and because they can't single-handedly attract skilled workers to come into the region. Although partnerships with universities may provide small firms with access to highly skilled workers in the development phase, this kind of support does not accommodate growth and production. When it comes to a critical segment of experienced, technically-skilled workers, small firms compete with TNCs, which offer not only higher wages but better health benefits, a key ingredient in the U.S. context because of the absence of national health protections.

Divergent interests are also evident in the territorial strategies of small and large firms. For example, large firms are eager to promote inter-regional competition because they hold significant regional investments and want to drive down costs. They are intrinsically more sensitive to sunk costs than small firms. Large firms are also more interested in replicating and embedding redundancies in their production networks both within and across regions. Small firms, by contrast, are more invested in the efficiencies and capacities of their own region.

These divergent interests are often glossed over in the presentation of a "regional vision" and a strategic plan for innovation-led development. In fact, the interests of the large firms may be used to represent the interests of the region as a whole (Lovering, 1999; MacLeod, 1996). What is perhaps more ironic is the large transnational firm agenda may, in fact, undermine the goals of policy-makers genuinely engaged in building innovative regions. The goal of regional innovation is a dynamic set of firms producing more jobs and opportunities. The goal of the TNC, by contrast, is to control any innovation not compatible with the firm's interests in sustainable competitive advantage. Certainly, TNCs have no incentive to promote the growth of small firms into regional producers and competitors who will challenge them for skilled labor and drive up the cost of other inputs.

From our perspective, market concentration, failure to cooperate, and knowledge asymmetry all indicate a power differential among firms and lead to another explanatory framework for failure and success in regional innovation systems.. While evidence indicates that skilled labor, coupled with institutional research and development capacities are central to successful regional innovation systems (Malmberg & Power,

2005), the power asymmetry between small and large firms means that TNC lead firms dominate in both realms, potentially undercutting regional innovative capacity. The remedy is policies that genuinely target small, innovative firms and recognize the current competitive landscape as a non-neutral space, a space of power and differential influence and access.

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Figure 1

Markets of Photonics Firms in Rochester	**Percent of Firms**
Imaging and Reproduction	19%
Other (aerospace, all of the above, etc...)	16%
Semiconductor	13%
Scientific Instruments	11%
Defense	11%
Telecommunications Equipment	11%
Medical Devices	8%
Consumer Products	6%
Barcoders/Encoders (Retail and Logistics)	3%
Biotechnology	2%

Figure 2

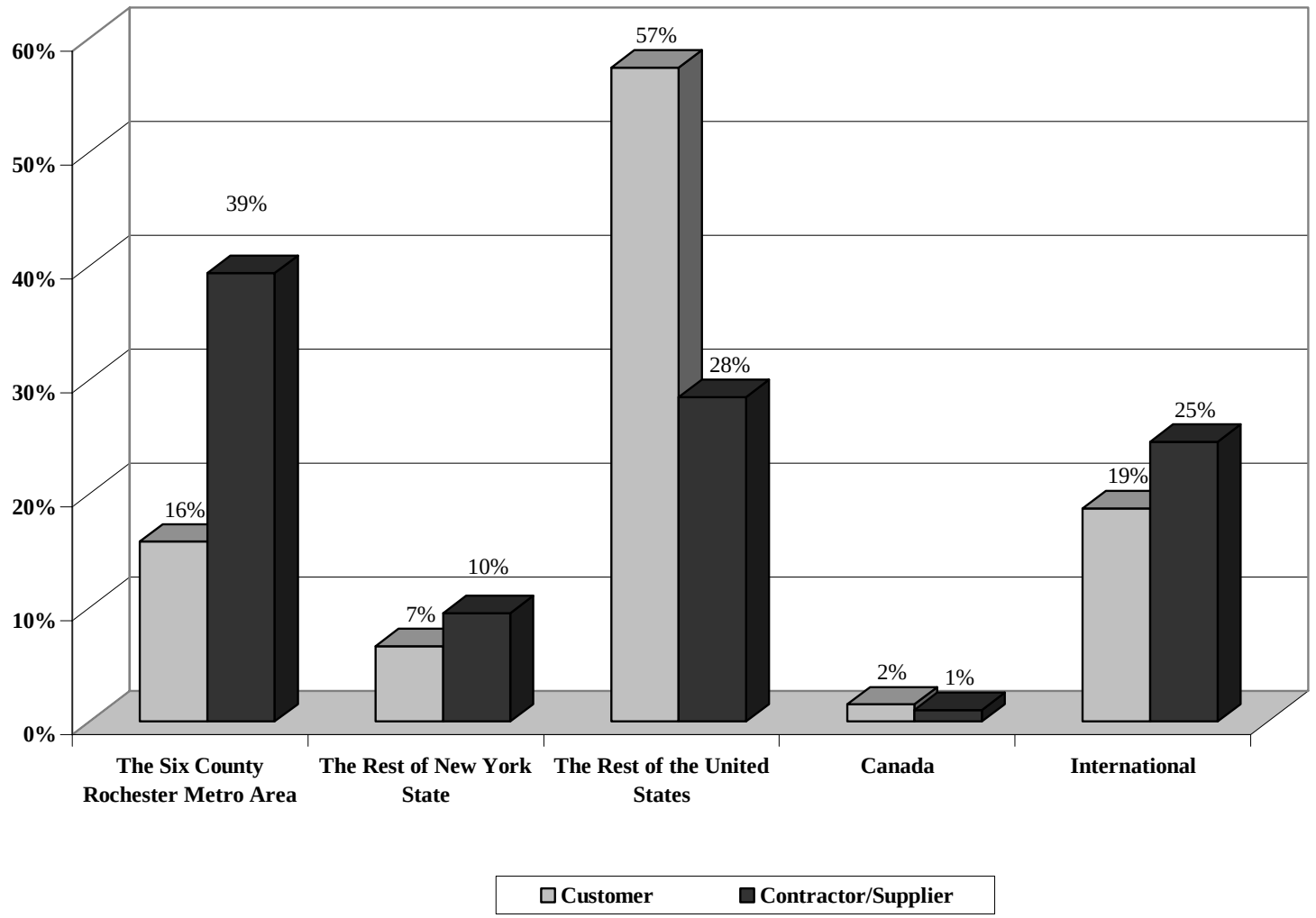

60%
50%
40%
30%
20%
10%
0%
16%
39%
7%
10%
57%
28%
2%
1%
19%
25%
The Six County Rochester Metro Area
The Rest of New York State
The Rest of the United States
Canada
International
Customer
Contractor/Supplier

Figure 3

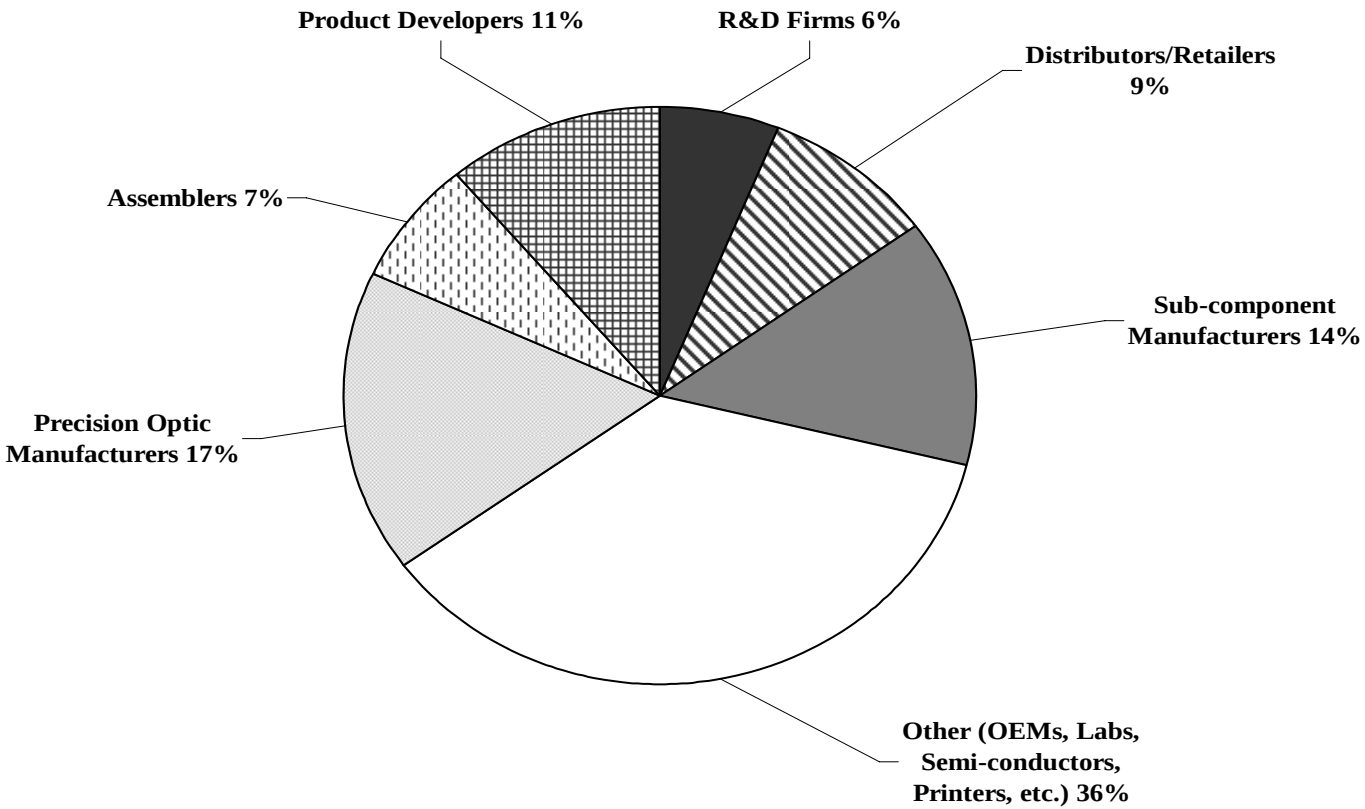
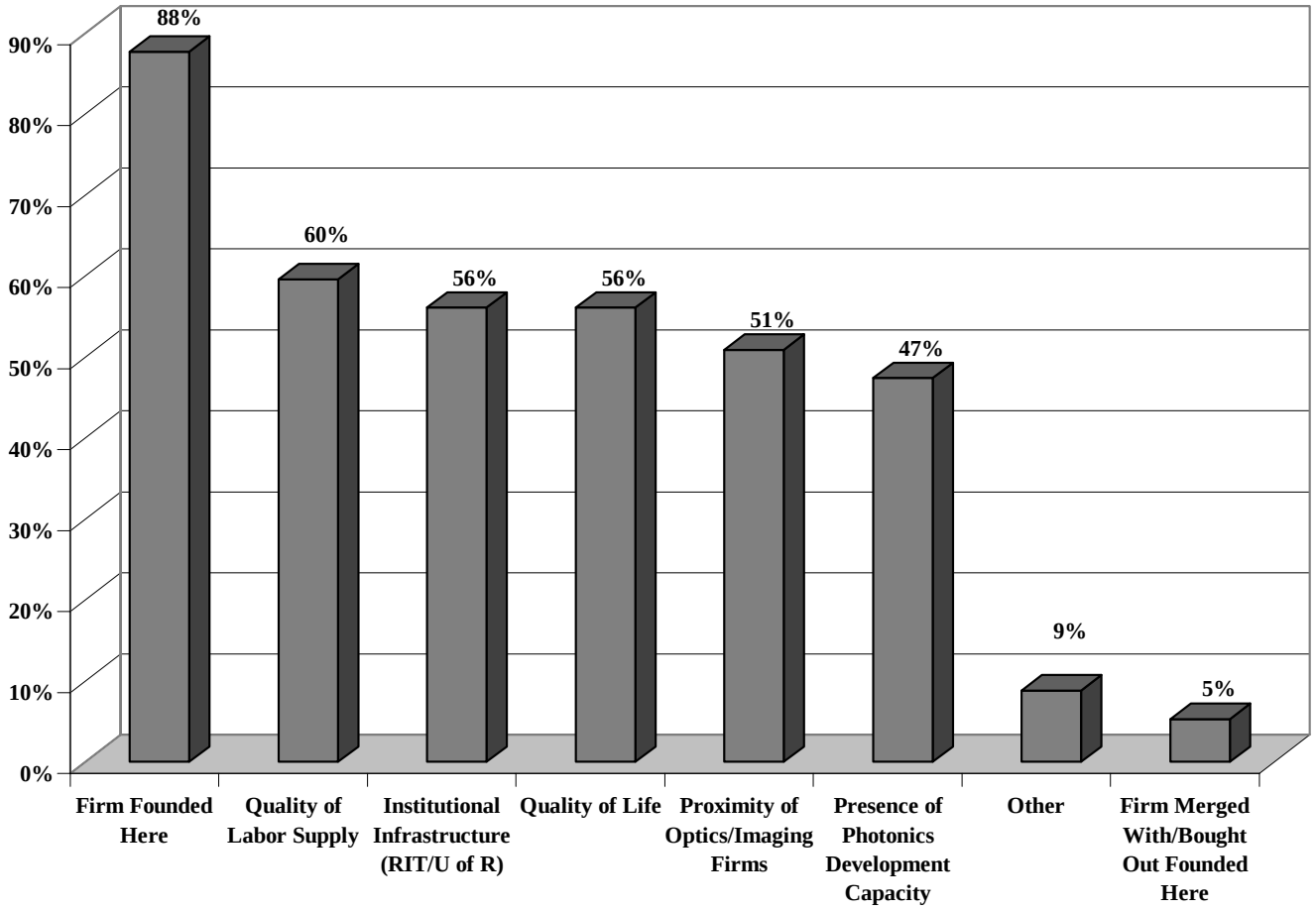

Product Developers 11%
R&D Firms 6%
Distributors/Retailers 9%
Assemblers 7%
Sub-component Manufacturers 14%
Precision Optic Manufacturers 17%
Other (OEMs, Labs, Semi-conductors, Printers, etc.) 36%

Figure 4


90%
80%
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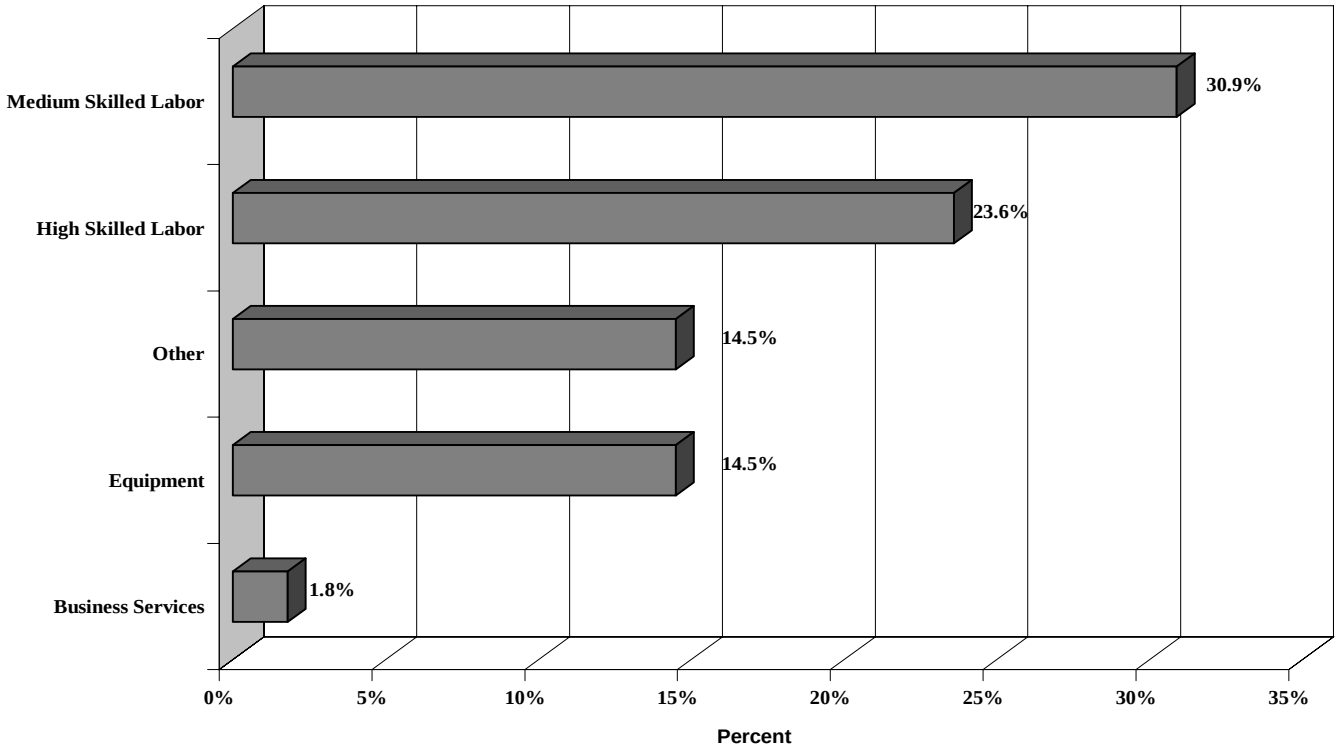
60%
50%
40%
30%
20%
10%
0%
88%
60%
56%
56%
51%
47%
9%
5%
Firm Founded Here
Quality of Labor Supply
Institutional Infrastructure (RIT/U of R)
Quality of Life
Proximity of Optics/Imaging Firms
Presence of Photonics Development Capacity
Other
Firm Merged With/Bought Out Founded Here

Figure 5


Medium Skilled Labor
30.9%
High Skilled Labor
23.6%
Other
14.5%
Equipment
14.5%
Business Services
1.8%
0%
5%
10%
15%
20%
25%
30%
35%
Percent