Clusters of Entrepreneurship and Innovation

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February 2013

Abstract: This paper reviews recent academic work on the spatial concentration in the United States of entrepreneurship and innovation. We discuss rationales for the agglomeration of these activities and the economic consequences of clusters. We identify and discuss policies that are being pursued in the United States to encourage local entrepreneurship and innovation from both national and local perspectives. While arguments exist for and against policy support of entrepreneurial clusters, our understanding of what works and how it works is quite limited. The best path forward involves extensive experimentation and careful evaluation.

Keywords: Entrepreneurship, innovation, agglomeration, cluster, place making.

JEL Classification: H70, L26, L52, L53, M13, O25, O38, R00, R10, R12, R50

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Acknowledgments: This paper will be presented at the Innovation Policy and the Economy Forum, April 2013. We thank Josh Lerner and Scott Stern for helpful comments.

1. Introduction

For many decades, the common wisdom among local officials pursuing employment growth for their areas was to attract a large firm to relocate. This "smokestack chasing" led to many regional governments bidding against each other and providing substantial incentives to large plants making their location choice decisions (e.g., Greenstone et al. 2010). The success of entrepreneurial clusters in recent decades, however, has challenged this wisdom, and now many policy makers state that they want their regions "to be the next Silicon Valley". This has led to extensive efforts to seed local entrepreneurship (e.g., Lerner 2009), with today's politicians routinely announcing the launch of an entrepreneurial cluster in a hot industry, such as biotechnology, nanotechnology, or advanced manufacturing. In this paper, we explore the rationale for and efficacy of policies to promote local entrepreneurship and innovation and reflect on recent initiatives in this domain.

Section 2 provides a conceptual introduction to industrial/innovation policy that grounds the later empirical discussions. The move away from smokestacks to small-scale entrepreneurship is understandable given the strong correlation between small establishment size and local economic development (Glaeser et al. 2010, 2012). Section 3 discusses the link between entrepreneurship and innovation and local economic growth. Figure 1 highlights a representative graph from this work taken from Glaeser et al. (2012). The horizontal axis of each panel provides a potential way to measure entrepreneurship around 1982, and the vertical axis of each panel measures the employment growth of the city during 1982-2002. There is a very strong connection between initial entrepreneurship and subsequent employment growth. While striking, there could be many factors behind this correlation, and we discuss the existing, but still nascent, evidence to establish causal connections. We also identify some recent studies that looked at the impact of local innovation on regional economic performance.

While it is possible to have pro-entrepreneurship policies that are not tied to cluster-making, supporting a cluster of small-scale entrepreneurs allows policy makers to affect many entrepreneurs together, providing important scale to their policy interventions, and appears to respect the empirical tendency of economic activity to cluster. Section 4 reviews the extent to which we see economic activity spatially concentrated. Clusters of related businesses exist in most sectors of the economy and have been present throughout modern economic history. We further discuss the extent to which forms of high-impact entrepreneurship (e.g., venture capital) and patenting display additional concentration above and beyond that of general economic activity.

Section 5 then turns to the local traits of places that correspond to higher entrepreneurship levels. Relative to the literature that seeks to link local entrepreneurship to growth, the literature on spatial determinants of entrepreneurship in Section 5 is more established. We review factors that have been found important at the city level for the United States, and we also consider evidence regarding industries within cities. At the end of this section, we discuss some open questions about access to cluster benefits with which researchers are currently grappling.

Section 6 discusses recent policy initiatives at the federal and local level to encourage entrepreneurship and innovation. We first outline some of the goals of these policies, especially as they relate to entrepreneurship and innovation. We also review the role of policy in the development of three well-known innovative clusters: Silicon Valley, Boston's Route 128 corridor, and North Carolina's Research Triangle Park. Finally, we discuss the recent emphasis on promoting high-growth entrepreneurship at the federal level. We close the paper with some conclusions and a call for further experimentation on this important question.

2. Industrial Policy, Entrepreneurship and Clusters

Since Alexander Hamilton wrote his "Report on Manufactures," American governments have tried to actively prod the growth of one or more sectors of the economy. There is an even stronger traditional of industrial policy outside of the United States. Sometimes these policies are justified by an obvious market failure, but often they reflect a public desire to seem to be doing something to engineer economic growth from the top down.

While it is hard to clearly document that the benefits of industrial policy exceed the costs, it is easy to provide plausible stories that justify public interventions to aid new or old industries, in declining areas or in areas that are just taking off. Three classes of justification are more common: externalities, redistribution, and credit constraints. First, entrepreneurship or industrial policy helps internalize externalities. If governments will benefit from taxes paid by a successful firm in the future, then it may make sense to aid the firm up front with public subsidy: tax breaks to million-dollar plants can be seen as an up-front payment compensating the plant for the future taxes that the local government will extract from them.

Real externalities can also exist that could justify interventions. Hamilton himself was eager to subsidize the import of technical knowledge which would presumably spread throughout the country. If there are human capital externalities (Rauch 1993), and if industrial policy builds human capital, then this may have beneficial results throughout the region. The existence of industrial clusters seems to suggest that there are externalities across firms, which provide intellectual support to policies that encourage industries. Of course, those clusters may not reflect

real externalities at all, but unobserved geographic advantages to particular locales (Ellison and Glaeser 1997) or just cost savings from reduced transportation costs.

The redistributive aim of industrial policy is best seen in "Empowerment Zones" and the Appalachian Regional Commission in the United States, "Enterprise Zones" in the United Kingdom, and the numerous European policies meant to bolster declining regions. These policies are seen as tools for fighting centralized poverty by encouraging nearby business formation. Economists often question whether it makes sense to help poor places—rather than poor people—but there is some limited evidence suggesting that Empowerment Zones, at least, have provided some benefits for local residents (Busso et al. 2012).

A final, popular, justification for policies that particularly benefit smaller firms is that there are credit market imperfections that somehow make it difficult to fund worthy start-ups, and that government aid can solve this problem. While it is assuredly true that not every profitable project is funded, it is hard to see exactly how the government has any comparative advantage as a venture capitalist (Lerner 2002). Nonetheless, the public sector has provided either loan guarantees or direct lending to various entrepreneurs.

Credit market interventions can be justified directly if there are credit market imperfections. In the first two cases of support being justified due to externalities or redistribution concerns, the optimal means of providing a subsidy may still take the form of a loan. If the government's risk tolerance and patience are higher than the subsidized entrepreneur, then the optimal subsidy can easily take the form of aid that is largely repaid given good outcomes. Loans or loan guarantees have the added advantage, from the public official's perspective, of not seeming like a direct outlay of taxpayer money.

These justifications are relevant for any kind of industrial policy, but our focus here is on local policies towards innovation and entrepreneurship. We therefore ignore national policies such as tariffs, immigration policy, and patent policy, and we focus on support for industry and entrepreneurship at the local level. This aid can take the form of direct subsidies (including tax abatement), non-priced public infrastructure, and credit support (including both loan guarantees and direct lending).

Figure 2 highlights two key policy choices: specificity of location and specificity of aid recipient. Industrial or entrepreneurship policy occur at different levels of geography—nation, region, state, city, or neighborhood. The policies can also be economy-wide, industry or sector-specific, or even focused on particular firms. The largest determinant of the degree of geographic specificity is the geographic reach of the governmental unit itself. Nations make national policies, while cities make policies within their own borders. But there are cases, like the Appalachian Regional Commission or Empowerment Zones, where a nation focuses on the

region or the neighborhood. Indeed, since neighborhood-level governments are essentially non-existent, any neighborhood-level policy, like a local cluster, reflects the decision of a larger government to target resources towards a specific area.

The decision to go local and focus on clusters can reflect a redistributive impulse, as in Empowerment Zones, or cost-related concerns about infrastructure. New subways stops cannot go everywhere, so they go to a specific locale and support businesses in that area. But modern cluster policy reflects a sense that there are strong local externalities that can be coordinated by a governmental entity that attempts to connect different firms.

We discuss the evidence on local externalities and geographic clusters in Section 3, but it is worth stressing in advance that even if such externalities are real and powerful they may not justify attempts to concentrate economic activity. For example, if each entrepreneur benefits his neighbors, but if there are decreasing returns to such spillovers, then it may make sense to spread those entrepreneurs out rather than consolidating them in one place. The case for clustering policies is that there are profound non-linearities in the nature of local spillovers (Glaeser and Gottlieb 2008).

Governments choose industrial specificity along with geographic specificity. All governments make general public policies that impact the economy—our interest lies in policies that focus on specific industries or sectors. One choice is to focus on specific industrial groups, as Hamilton wanted a focus on manufacturing as opposed to agriculture. Typically, local governments choose industry-specific policies to target fields that appear to have a long-standing comparative advantage in the city, such as fashion or finance in New York, or industries that seem to be poised for growth in the future, like the life sciences. The focus on novel sectors is often justified as reflecting the new ideas and human capital that can be created by these sectors. The economic case for subsidizing specific industries typically relies on documenting that these industries have obvious positive externalities. As an example, support for green energy is seen as a tool for dealing with the negative externalities, like carbon emissions, associated with traditional energy sources.

Along with the choice of older versus new industry, government policy can also choose whether to focus on old versus new firms. While this can be done firm-by-firm, as we discuss next, it can also be done with more general policies. For example, a shift from local labor taxes to business taxes will tend to favor start-ups over mature industries since profits are rare in new firms, but those firms still typically have to pay their workers. Tougher regulations on new entry will tend to favor incumbents over start-ups. The removal of non-compete clauses (Fallick et al. 2006, Marx et al. 2009) will tend to favor start-ups over incumbents.

When we turn to firm-by-firm policies, there is always discretion over industry and maturity. Often those firm-level policies work either through loans or tax abatements at the local level, and they can be the expression of policies which were originally designed to operate at a sectoral level. The Energy Department Loan guarantees that supported Solyndra, for example, reflected a national decision to support green energy more generally. The State of Massachusetts' decision to support Evergreen Solar reflected a similar state-wide priority.

The perpetual local game of attracting million-dollar plants is the classic example of local, firm-by-firm policy. We include these decisions as reflecting city-level, rather than neighborhood-level policies in Figure 2, but in some cases, the appeal of a specific firm is that it will put a physical plant in a specific, perhaps blighted, area. In many cases, these policies simply reflect the political reality that a plant that is of sufficient importance to the political jurisdiction will be able to bargain its way towards privileged treatment.

The case for firm- versus industry-level policies, assuming that either such policy makes sense, depends on the degree of confidence in local competence and impartiality. If local governments have the capacity to select firms that bring particularly large local benefits and the incorruptibility to ensure that their aid does not flow to the well-connected, then firm-level policies would seem to enable them to target subsidies more efficiently. If local governments are not good at choosing effective firms or are likely to be swayed by less-lofty motives, then such discretion can be quite counter-productive. Economists, who are persuaded by the historical track record to be skeptical about governments, typically argue against firm-specific policies.

Cluster policies for entrepreneurship and innovation occupy a very distinct place in the scheme. They are narrowly place-specific, favoring a very specific locale, such as Boston's Innovation District. This geographic concentration is justified both as a tool for generating positive externalities and as a means of getting the most out of scarce infrastructure dollars. They are also oriented towards either specific industrial sectors (life science, computers) or more generally towards start-ups. They are not usually firm-specific, largely because start-ups are too small to address on a firm-by-firm basis, but also because the proponents of these policies often share the economists' skepticism about the ability to pick winning firms, even though they believe in the ability to pick winning sectors.

As we turn to the empirical results, therefore, we ask about whether the track record shows that there are benefits from supporting smaller rather than larger firms, whether there are benefits from engineering clusters, and what local attributes typically attract entrepreneurs. We will spend less time on the empirical track record of industry-specific support.

3. Entrepreneurship, Innovation and Local Growth

Before turning to factors that promote or discourage entrepreneurship and innovation in a local area, we first review the academic literature on the economic consequences of these forces. While some academics and policy makers assume from the start that more entrepreneurship and innovation are for the good of the local area, this relationship has been difficult to pin down due to the endogeneity of both forces. While there is little debate over the correlation between local growth and smaller, new firms, that correlation may reflect a tendency of rapidly growing areas to attract new firms rather than the impact of smaller, newer firms on local growth. These issues make interpretation of typical evidence like Figure 1 difficult. Moreover, it is quite possible to imagine that some places have assets, like strong research universities or pro-business policies, that engender growth and attract start-ups.

Some older studies provided multivariate correlations between these factors, but empirical work seeking causal assessments are remarkably few in number. We discuss the state of the academic literature, with the most important conclusion being that much more work is needed in this regard.

The intellectual tradition behind Figure 1 and similar observations about entrepreneurship's role for urban success dates back to Chinitz's (1961) comparison of New York and Pittsburgh. Chinitz believed that Pittsburgh's dearth of entrepreneurs in the 1950s reflected its historical concentration in the steel industry, which had significant returns to scale and potentially crowded out more entrepreneurial activities. Chinitz suggested that this dampening of entrepreneurship came through both static factors (e.g., access to inputs or financial capital for new businesses) and dynamic factors (e.g., the transmission of skills and attitudes from parents to children). By contrast, Chinitz saw in New York a vibrant entrepreneurship impetus descending from the city's early work in the decentralized garment industry, and Chinitz argued that this industrial pedigree helped explain why New York was growing faster than Pittsburgh. While his analysis pointed to the power of local cultures of entrepreneurship, Chinitz refrained from making any strong policy recommendations related to that conclusion.

This notion of differences across places in their entrepreneurial culture—and in particular the link it has to regional performance—has also been famously put forward in recent years by Saxenian (1994) when contrasting the regional performance of Boston and Silicon Valley. Saxenian argued that the regional structure and entrepreneurial culture of Silicon Valley allowed it to displace Boston as the center for semiconductor manufacturing in the second half of the 20th century, despite Boston's dominance and perceived advantages after World War II. The role of public policy looms large in Saxenian's work, most notably the role of the defense industry in

building up both areas. But again, Saxenian refrained from urging local policies meant to duplicate the complex cocktail of cooperative competition that she observed in Silicon Valley.

More systematic empirical evidence confirms that a general correlation lies behind these famous case studies. For example, Glaeser et al. (1992) find a strong correlation between small establishment size and subsequent employment growth across sectors within U.S. cities. Glaeser et al. (2010) also document the strength of this relationship when modeling entrepreneurship more carefully or when looking at industries within cities. Similar conclusions are reached recently by Delgado et al. (2010a,b), Rosenthal and Strange (2003, 2010), and Gennaioli et al. (2012).

The first beachhead for developing causal assessments of the real effects of entrepreneurship focused on venture capital (VC) financing, rather than entrepreneurship itself. This was an attractive starting point because it was easier to identify exogenous shocks in VC financing; moreover, data on VC financing was more readily linked to data on outcomes like employment or patenting, without necessarily observing the middle step of entry rates where data collection was much harder. Kortum and Lerner (2000) analyzed industries, while Samila and Sorenson (2011) considered cities. The latter paper is closest to the spatial spirit of this review, and the study found modest employment growth roles for VC financing using variation across U.S. cities. The work suggested that a doubling the VC activity in a typical city would lead to about a 1% higher number of jobs and that these jobs would be higher skilled than average. This provided some foundation for concluding that important spillovers exist in entrepreneurship. Yet, the authors estimated that VC financing accounted for less than 10% of the differences in growth and activity across U.S. cities. These magnitudes are quite reasonable given the relative size of the VC industry.

The impact of VC financing can be seen as suggesting a role for credit-related policies, but there are profound questions about whether such policies are beneficial. First, it is possible to argue that the endogeneity of VC financing makes causal inference difficult. Second, it seems quite possible that direct public attempts at mimicking VC finance will be far less successful in picking winners than VCs themselves, especially if public sector choices are colored by non-economic influences. Finally, even if the public sector supports VC in a more general way, with beneficial tax treatment for private VCs, for example rather than engaging in direct lending itself, that support has costs and those costs may offset any benefits. If the government needs to raise sales taxes to offset the VC subsidies, this could easily do more harm than good.[1]

[1] Effective policy also needs to consider the marginal entrepreneur that will be induced to enter (de Maza 2002). In a study of the state-level banking deregulations that began in the 1970s, Kerr and Nanda (2009) found a very strong entrepreneurship response to greater banking competition in the local area. Some of these new firms also grew to a size to challenge incumbents. This work also demonstrated, however, that a large number of the induced

In a more recent paper, Glaeser et al. (2012) examined the broader question of entrepreneurship's impact for growth. Returning to the empirical relationships evident in Figure 1, these authors implemented an instrument variable analysis that used the extent to which cities were built near historical mines, especially with respect to coal and iron deposits, as predictors of their modern levels of entrepreneurship. The logic of this approach followed upon the observations of Chinitz (1961), who noted the role of mineral access in shaping the industrial origins of cities (i.e., Pittsburgh strong start in the iron and steel industry was due to its proximity to coal mines). Even after these initial industries fade in importance, these initial conditions could have long lasting effects on the traits of the cities going forward (e.g., due to children's aspirations and the city's culture towards entrepreneurship).

With this approach, Glaeser et al. (2012) continued to find that entrepreneurship was a key driver of U.S. city employment growth since the 1970s. The paper further dissected the industries in which the growth was occurring and its dynamic nature. Among the more interesting findings was that cities with strong foundations in entrepreneurship were not growing faster through the endless replication of small businesses. Instead, much of the employment growth in these cities was ultimately retained in establishments that became large employers. The cities thus possessed a more dynamic industrial structure that pushed firms through an up-or-out process that generated more rapid urban growth.[2]

But this work also few direct policy implications. It is not as if the choice of proximity to mines is a current policy variable, and presumably over the long haul, these mines yielded plenty of local economic benefits as well. Perhaps the strongest suggestion generated by this work is that directly subsidizing large-scale manufacturing employers can be dangerous if those employers crowd out local entrepreneurship. However, given the benefits that Greenstone et al. (2010) have found from winning competitions for million-dollar plants, it seems sensible to be cautious about even this modest conclusion.

Moving from entrepreneurship to innovation, much of the recent work on the link between innovation and city performance has focused on a theoretical model developed by Duranton (2007). This model features prominently in urban economics for why cities grow or

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entrants were shortly-lived and failed within the first few years, typical of many entrepreneurial endeavors. This process of needing many failures to find the best entrants explains why policies often have a much larger effect on the entry margin than they do on general margins like economic growth.

[2] The outcomes of these assessments of entrepreneurship and entrepreneurial finance in the local area have been quite consistent with studies that have assessed firm-level consequences. Examples include Haltiwanger et al. (2012), Hurst and Pugsley (2012), Puri and Zarutskie (2012), Nandy et al. (2012), and Kerr et al. (2013). Fritsch and Wyrwich (2012) and Gutberlet (2013) have observed similar conditions in Germany to the Glaeser et al. (2012) study. Klapper et al. (2010) and Schoar (2009) discuss evidence from developing countries.

shrink and the movement of industries across cities. The premise of the model is that the location of industries in cities is determined by where past breakthrough inventions occurred. For example, Boston will be home to the mousetrap industry while Boston is the site of the latest frontier of mousetrap inventions, but should a better mousetrap be invented in Memphis, the model predicts that the industry would migrate from Boston to Memphis. This conceptual model produces patterns that line-up well with the data: for example, it predicts that industries will move across cities much more rapidly than cities will move up-and-down the city size distribution.

While case studies of this process exist, the heart of the model's link to breakthrough inventions has been rarely tested. And there were plausible reasons why one might be skeptical—why move a whole industry to a new location instead of just moving the invention itself? Some work on this topic predated the Duranton (2007) model. For example, Zucker et al. (1998) described the exceptional embodiment of human capital in specialized workers in the emergence of the U.S. biotech industry. Much of the early development of the biotech industry occurred in cities that were home to the nascent industry's star scientists, rather than in places with lots of potentially related factors like VC funding, universities, etc. Audretsch and Feldman (1996) provide related evidence with the clustering of R&D industries.

To more generally assess the model's validity, Kerr (2010a) identified the spatial location of the top 1% of new patents in 36 patenting technologies during 1975-1984. The study then compared the subsequent patenting growth in these locations for the ten cities with the highest relative concentration of these top patents to the next ten cities for the technology. Figure 3 is reproduced from this study. During the 1975-1984 period, these groups of cities looked quite similar to each other with the exception of the degree to which they experienced breakthrough inventions. However, over the next 20 years, the patenting growth was 20% higher in the group of cities with the largest share of breakthrough patent inventions. This was not the sharp exodus built into the theory, but it did confirm that the Duranton (2007) framework provides a good foundation for considering the dynamic evolution of cities. The paper also demonstrated how immigrants, especially upon initial entry to the United States, are more spatially mobile than natives and provide a powerful mechanism for industry relocation (e.g., the rapid shift of semiconductors from Boston to Silicon Valley, the rapid rise of Micron in Boise, Idaho).

Beyond this the development of breakthrough patents and new industry formation, there has been limited work about factors that promote the overall innovation rates and employment growth of local areas. Agrawal et al. (2010) considered the traits of innovation in "company towns" that were dominated by one large firm. Their work found that these large firms often become insular in their innovation, drawing more on the past experiences of the company and being less explorative in their R&D efforts. Building on this study and earlier work on the anchor tenant hypothesis, Agrawal et al. (2012) considered what mix of large and small firms provided

the most productive environment for innovation. The study found that an optimal mix for patenting growth in a local area involved at least one large innovative firm but also a sufficient mass of many small innovative firms. This mix captured be best the benefits of innovation coming out of large firms with fertile soil for new start-up companies, often founded by former employees of incumbent firms (e.g. Gompers et al. 2005; Chatterji 2009).

Hausman (2012) examined the role of universities in the local area. This study examined the extent to which U.S. universities stimulated nearby economic activity using passage of the Bayh-Dole Act in 1980 for identification. Long-run employment and wages increased quickly after Bayh-Dole in industries more closely related to the local university's pre-existing strengths for innovation. This effect was realized through the entrance of new firms and especially the expansion of multi-unit firms into the area. The power of local universities to engender economic growth is also found by Moretti (2004) and Glaeser and Saiz (2004) and that would seem to support a limited policy conclusion favoring education. Again, however, costs must be weighed against benefits. Hausman's work seems most directly relevant to the question of allowing the commercialization of publicly-funded research, which does seem to have created sizable local economic benefits.

Despite the quite long tradition of researchers working with patent data, there has been relatively little work beyond these studies in U.S. context that credibly identifies the role of local innovation in local employment growth. The existing body of work clearly highlighted the importance of multiple actors in facilitating this link between innovation and regional prosperity (e.g., universities, R&D labs in large firms, start-ups). This finding, along with case studies of the origin and rise of innovation regions (e.g., Kenney 2000, Lee and Nicholas 2012) suggest that the regional foundation for growth-enabling innovation is complex and that we should be cautious of single policy solutions that claim to fit all needs.

The existing work on entrepreneurship and local innovation does not imply any natural local policy. It does, however, point to the power of small start-ups, which can collectively shape the economic destiny of a locale. Seattle and Detroit were both dominated by large local manufacturers in the 1960s, and Boeing reduced employment just like General Motors. Seattle today, however, is thriving, unlike Detroit, because of a spate of local entrepreneurs, some of whom grew up in the city (like Bill Gates) and others off whom were attracted to the city (like Jeff Bezos). A key question for local innovation policy is whether there is anything that can be done to inculcate more of that local entrepreneurship. Clusters are seen as a tool for advancing that goal, and we turn to the empirical evidence on economic clustering next.

4. Spatial Concentration for Entrepreneurship and Innovation

As discussed in Section 2, the case for cluster policies depends on the existence and nature of cross-firm externalities that generate clusters naturally and are necessary to justify spatially-oriented entrepreneurship policies. But for these policies to make sense, these externalities must be non-linear or accrue disproportionately to members of a particular industrial sector. So for example, even if entrepreneurs generate spillovers, it would only make sense to cluster those entrepreneurs if those spillovers either worked non-linearly or if only entrepreneurs benefit from the clustering. We first outline a few descriptive facts about the spatial concentration of entrepreneurship and innovation in the United States. We do not spend too much time on this feature as this general feature of the economic landscape is well-known and not in much debate.

A starting point is the observation that industry itself is quite concentrated, even before considerations related to entrepreneurship and innovation. High-profile examples like movie production in Hollywood and automobile manufacturing in Detroit are well-known, and the pattern extends more deeply. Ellison and Glaeser (1997) designed a metric to estimate the degree to which an industry was more spatially concentrated than the general population. These authors found that 446 out of 459 manufacturing industries were more spatially concentrated than would be generally expected based upon underlying population.[3] They also emphasize, however, that this clustering can represent either spillovers across firms or an uneven distribution of productive factors across space.

Beyond this industrial baseline, however, is the additional factor that some key aspects of entrepreneurship and innovation are even more spatially concentrated. This is particularly true for VC-backed entrepreneurship, as shown in Figure 4. Silicon Valley accounts for 40% of the total funding in 2011, with Boston and New York about 10% each. This is despite the fact that these cities together account for only about 11% of the U.S. population. Figure 5 similarly compares the distribution of VC investments, patents, and population across U.S. cities during the 1990-2005 period, showing that patenting is also spatially concentrated.[4] But just as the geographic concentration of industry can reflect uneven natural advantage, the geographic clustering of industry may represent forces beyond spillovers, like a fondness for living in New

[3] Using a second technique developed by Duranton and Overman (2005), Kerr and Kominers (2010) calculate that over two-thirds of U.S. industries, within and outside of manufacturing, are spatially concentrated. Spatial concentration has been a key topic in economic geography since at least Marshall (1920). Ciccone and Hall (1996) provided an early link between this concentration and productivity. Duranton and Puga (2004) and Rosenthal and Strange (2004) reviewed the theoretical and empirical literatures, respectively.

[4] See Carlino et al. (2007), Kerr and Kominers (2010), Carlino et al. (2012), and Murata et al. (2012) for further work on the spatial concentration of patenting in the United States.

York or San Francisco or the location of top research universities. Differences across places are naturally less when measuring all entrepreneurship, rather than focusing on high-growth entry. Nevertheless, the horizontal axes in Figure 1 highlight that entry rates differ quite substantially across U.S. cities.

Does this natural clustering make the case for policies that artificially induce clustering? Despite our caveats about clustering due to natural advantages of places being empirically difficult to distinguish from clustering due to economic interactions among firms[5], there does seem at least the possibility that there are significant spillovers across entrepreneurs. It is possible, at least, that the government can help in coordinating these placements through cluster policy. Yet if the public role is primarily coordination, then this should require relatively minimal financial outlays. After all, if the entrepreneurs benefit from coordination, they should come of their own accord. In principle, this function of clustering entrepreneurs can also be done by private developers, which is essentially the role played by Fred Terman in founding the Stanford Industrial Park. A recent example of this is the Cambridge Innovation Center in Kendall Square of Cambridge, MA, that co-locates 450 start-ups in a single building.

A large question in cluster policy is the relative benefits of industrial homogeneity within the cluster. Certainly, entrepreneurs in the same industry will often have the most to share. Yet there is also evidence for important intellectual spillovers across industries, and some of the most important breakthroughs reflect leaps from one industry to another. Michael Bloomberg, for example, succeeded in information technology precisely because he was not in Silicon Valley, but rather in New York City and better understood what New York traders needed. While there is little rigorous evidence on the causal impacts of industrial diversity, there is at least some correlational evidence suggesting that industrial monocultures do poorly (Glaeser et al. 1992) and some coarse evidence that technological diversity is associated with greater R&D spending (Cohen and Malerba 2001). Perhaps those downsides are mitigated if a single industry cluster is sited within a metropolitan area that is otherwise industrially diverse.

A final critical question regarding clusters and cluster policy is the role of infrastructure. Some industries require specialized infrastructure including physical highways and information highways. Governments have long taken on the role of supporting infrastructure provision, even though economists since Smith have discussed the virtues of user fee financing. The need for specialized infrastructure does increase the value of clustering. By contrast, industrial groups with little need for specific government-provided technology will have fewer benefits from clustering.

[5] In a study of U.S. manufacturing, Ellison et al. (2010) found that clustering due to natural advantages of places was more important than any single form of economic spillovers among firms, but that the collective weight of cross-firm interactions was more important than the natural advantages component.

5. Spatial Determinants of Entrepreneurship and Innovation Clusters

Even if clusters of entrepreneurship are good for local growth, it is less clear that cities or states have the ability to generate those clusters. We now describe studies of spatial factors that relate to entrepreneurship and innovation, and we ask what actually does attract entrepreneurs to specific areas. Unlike the sparse literature reviewed in Section 3 on the economic consequences of entrepreneurship and innovation, the literature on local factors that generate or support clusters is quite broad, with research having been conducted in many countries and crossing multiple academic disciplinary boundaries (e.g., Acs and Armington 2006, Parker 2009). Space constraints do not allow us to mention every study. Instead, we review here some of the major themes emerging from this literature, and we attempt to highlight a few recent studies that provide special evidence.

General Traits of Cities

Among the general traits of cities that matter for entrepreneurship and innovation, three factors have most stood out in the recent literature. First, the general education of the workforce has been linked to higher entry rates (e.g., Doms et al. 2010, Glaeser et al. 2010). This link is part of a larger finding in the urban literature that local human-capital levels are important to the development and growth of areas (e.g., Simon 1998, Simon and Nardinelli 2002, Glaeser and Saiz 2004, Gennaioli et al. 2012). Within the manufacturing sector, Glaeser and Kerr (2009) did not find a city's education level to be important for entrepreneurship, so this connection appears to depend somewhat on the sector.

A second factor that is often found to be important is the age structure of the local area. Here, however, a lot depends upon the metric one uses to measure entrepreneurship, a subject discussed in greater detail in Glaeser and Kerr (2009). Studies that utilize self-employment status (e.g., Evans and Jovanovic 1989) to measure entrepreneurship often find older workers to be conducive to higher entry due to the greater weight placed on small-scale, independent operators. This can be most easily seen in self-employment rankings that list West Palm Beach, FL, as America's most entrepreneurial city but place San Jose, CA, near the bottom. On the other hand, studies employing metrics that emphasize more the creation of start-ups that employ other workers tend to find workers in ages near 40 years old to be most important (e.g., Bönte et al. 2009, Glaeser and Kerr 2009).

Finally, and perhaps the most surprising finding, is the importance of the "local supply" of entrepreneurs. This factor has an odd ring to it, as we tend to think of entrepreneurs as rapidly

responding to new opportunities and not confined to one location. While this mobility is certainly true at the very high end of start-ups, with entrepreneurs from around the world flocking to Silicon Valley, a strong and growing literature is pointing out that regions may differ in the extent to which their general population is inclined towards entrepreneurship. Several studies have identified that entrepreneurs tend to disproportionately found their companies in their regions of birth (e.g., Figueiredo et al. 2002, Michelacci and Silva 2007, Audretsch et al. 2012), and that these business are in fact stronger on average than the businesses of the typical migrating entrepreneur. This strength of place was further behind the arguments put forth in the Glaeser et al. (2012) paper on why the Chinitz effect and industrial origins of cities would persist over time to affect recent entrepreneurship. This fact is not easy to reconcile in standard urban economic models that assume a spatial equilibrium holds through rapid mobility of workers and firms, but the empirical fact is quite robust to alternative analyses (e.g., Glaeser et al. 2010). This line of work suggests that policy efforts to build entrepreneurship among a location's existing residents may be more powerful than efforts to attract outside entrepreneurs to the city.

Beyond these factors, we make the simple observation that more needs to be learned about the role of local physical infrastructure (e.g., roads, broadband internet access). The prior section noted the links between infrastructure and clusters. A variety of studies from development economies stress the importance of these factors, but evidence using variation across regions in the United States is less common. These studies would constitute an important input for policy makers, since entrepreneurial cluster projects are often launched as part of downtown revitalization projects and paired with investments in connectivity (e.g., the Google Fiber project in Kansas City).

Industry-Level Clustering

Turning to industry-level entry rates in cities, studies consistently find the most powerful predictor of future entrepreneurship for a city-industry to be the presence and strength of incumbent firms in the city-industry (e.g., Figueiredo et al. 2009). For a typical estimate in this regard, Glaeser and Kerr (2009) estimated that a 10% higher base of incumbent firms associated with a 6% higher number of start-ups in the city-industry. For U.S. manufacturing, the existing business landscape explained about 80% of the spatial variation in new entry rates.

This persistence is not too surprising for two reasons. First, many entrepreneurs leave incumbent firms to start their companies. Klepper (2010) showed in detail the importance of this spawning process in the history of Detroit and Silicon Valley. Gompers et al. (2005) found the spin-off process especially important among entrepreneurial high-tech firms, leading to persistence in local technology clusters. Second, given the high degree to which start-up

companies draw resources from their local area and knowledge from incumbent firms, with former employees as a frequent conduit (Chatterji 2009), it is not surprising that they are attracted to places that have proven hospitable for the industry in the past.

While the older literature on this latter point was mostly anecdotal, research over the last five years has developed sharper techniques for quantifying how the broader industrial composition of a city relates to entrepreneurship for a particular industry. A methodological advance in this regard uses the lens of the traditional agglomeration rationales first defined by Marshall (1920): access to customers and suppliers, access to required labor inputs, and access to ideas or technology. Recent studies first develop metrics of how related industries are to each other on these dimensions (e.g., input-output tables, occupational similarity). The second step then combines micro data on industrial distribution within a city with these metrics of industry relatedness. This approach effectively consolidates data on hundreds of industries into a small number of easily interpreted traits about how amenable a local area was in terms of factors like access to customers, access to labor, etc.

Glaeser and Kerr (2009) first applied this approach to the United States using the indices developed in Ellison et al. (2010). The approach has also been used to describe spatial entrepreneurship rates and city structures in other countries (e.g., Jofre-Monseny et al. 2011, Dauth 2011, Ghani et al. 2011, Mukim 2011). The strongest conclusions from this body of work emphasize the importance of labor inputs for start-ups firms and the Chinitz effect. Local industrial structures that contain the types of workers most needed by an industry have significantly higher entrepreneurship levels. Combes and Duranton (2006) also emphasized this suitability of the local labor force. Local industrial structures with smaller firms in supplier industries to a given industry also have higher entry rates.

A final feature worth discussing is the strong reliance on immigrants for the U.S. science and engineering (SE) workforce (e.g., Stephan and Levin 2001). We group this under industry-level clustering given its particular importance for technology sectors. Immigrants represented 24% and 47% of the US SE workforce with bachelor's and doctorate educations in the 2000 Census, respectively. This contribution was significantly higher than the 12% share of immigrants in the US working population. Moreover, Kerr and Lincoln (2010) estimated that immigrant scientists and engineers accounted for more than half of the net increase in the U.S. SE labor force since 1995.

U.S. cities and states differ strongly in the extent to which they rely on immigrant scientists and engineers. As one example, Kerr and Lincoln (2010) estimated the most-dependent cities like San Francisco are twice as reliant on immigrant scientists and engineers as the 10th most dependent cities like Atlanta or Dallas. The consequence of this dependency is that immigration policy can create supply shocks across areas in the innovation workforces (e.g.,

Kerr and Lincoln 2010, Hunt and Gauthier-Loiselle 2010). While the United States was on a long-term trend for patenting to become less spatially concentrated, Kerr (2010b) described how the spatial concentration of immigrants and their growing importance for U.S. innovation has reversed the trend, leading to more spatially concentrated innovation.

A City is Full of Different People and Places…

The San Francisco Bay Area has many types of people—differences by gender, education, race and ethnicity, etc.—and the metropolitan area is comprised of many unique places. Palo Alto is quite different from Oakland, and even neighborhoods within Palo Alto are quite distinct from each other. An emerging frontier in this literature is better defining who partakes in these cluster benefits and who is excluded. This is important for policy design to the extent that the argument for promoting a local district, like the Boston Innovation District discussed earlier, is being made about broader benefits to the region.

Starting with types of entrepreneurs, Rosenthal and Strange (2012) considered the spatial sorting of male and female entrepreneurs within U.S. cities. The authors noted that female entrepreneurs may benefit less from being in the core of an industrial cluster to the extent that they have either weaker networking contacts than their male counterparts or face greater commuting costs (e.g., due to higher domestic responsibilities). The authors found empirical evidence that women-owned businesses are more segregated in local areas and that female entrepreneurs are exposed to 10-20% less of their own-industry employment. Looking at India, Ghani et al. (2013) found evidence in line with Rosenthal and Strange (2012) and further showed it linked through the industrial structure framework reviewed in the prior sub-section. This recent work on the gender of entrepreneurs is more broadly continuing a longer literature on racial segregation in local areas. This specificity of local networks suggests that policy makers need to consider the extent to which various groups will benefit from a targeted intervention and whether inclusionary selection criteria are therefore warranted.

The second frontier of recent work focuses on a better understanding of places and spatial distances within cities. Since at least the work of Rosenthal and Strange (2003), it has been clear that spillovers can attenuate rapidly. Recent improvements in data allow much finer assessments, and Arzaghi and Henderson (2008) brought this issue to central focus through an analysis of advertising agencies in Manhattan. While prior work thought about cities as the aggregate level, or always measured distances in terms of miles, Arzaghi and Henderson (2008) found spillover benefits in Manhattan decayed very rapidly over just a few city blocks. This work made clear that future research needs to develop a better sense of how clusters are structured and how this structure governs spillover flows (e.g., Kerr and Kominers 2010). This feature will govern the

extent to which an intervention like the Boston Innovation District also aids entrepreneurs in Cambridge's Kendall Square or even farther out of the city on Route 128. It would also provide insights into whether a waterfront site like the Boston Innovation District limits the potential for spillovers compared to a location that would have offices on all sides.

6. Policies for Encouraging Entrepreneurial Clusters

We now return to the questions raised in Section 2, using the evidence provided in the previous three sections. Instead of discussing the general classification of industrial and innovation policies, we turn to specific policies aimed at engendering local entrepreneurship. While these policies have proliferated recently (Acs et al. 2008), there is a longer tradition in the United States, dating back to at least 1953 with the creation of the Small Business Administration (SBA), of supporting small businesses by increasing access to credit and opening up opportunities for government procurement. For our purposes, Haltiwanger et al. (2012) provides a useful delineation between small businesses and new businesses, which most often start small. The authors find that the job creation and associated benefits typically ascribed to small businesses are disproportionately provided by these new start-ups. Thus, we apply this lens to our discussion and focus on policies that explicitly target start-ups.

In principle, the various public policies that could influence entrepreneurship span tax, education, immigration, technology and standards, financial markets, intellectual property, and several other policy domains. Moreover, entrepreneurship policies are often embedded in larger regional cluster initiatives and can emanate from federal, state, and local authorities. To provide a parsimonious but informative review of relevant policies, we focus our attention to initiatives targeted at supporting the founding and growth of start-ups in specific geographic regions. Reflecting on Figure 2, we do not discuss general policies (e.g., patents) or aid to specific companies. Furthermore, rather than providing a comprehensive list of state and local entrepreneurship policies, we highlight the general practices that underpin nearly all of these initiatives. We also discuss a notable shift in recent federal government policy towards actively promoting high-growth entrepreneurship in regions. As we are not aware of other work that compiles all of these different initiatives, we spend a bit more time in this section reviewing the origin of programs and their sponsors.

Policies to Increase the "Local Supply" of Entrepreneurs

As discussed above, entrepreneurship has a surprisingly local flavor in that entrepreneurs tend to disproportionately found firms near where they were born. In this spirit, policymakers

have initiated several programs that seek to increase the supply of entrepreneurs. These include entrepreneurial education programs, science and technology education initiatives, and high-skilled immigration policy. To increase the local supply, entrepreneurship courses have proliferated at colleges and universities around the United States, and today approximately 2/3 of all institutions offer at least a course[6] while 500 institutions offer a major, minor or certificate[7]. Federal government support for entrepreneurship education and training is funneled most directly through SBA's Office of Entrepreneurship Education. In addition, there are smaller programs in the Department of Commerce and USDA to support entrepreneurship education. These programs are typically quite small. For example, SBA's 2012 budget request for their SCORE counseling program was $7 million.[8] At the state level, 18 states have passed some legislation as of 2007 to encourage entrepreneurship education, with significant variance in terms of requirements and curriculum.[9]

There is no systematic assessment of these entrepreneurship education programs that we are aware of. Assessments of these programs outside of the United States have been inconclusive, with some studies finding positive effects, but just as many not seeing an impact. Moreover, it not clear what the appropriate outcome of interest should be. One view of entrepreneurship education might be that its goal should be to produce more entrepreneurs. On the other hand, entrepreneurship education could also help students learn more about their own inclination towards entrepreneurship and chances of success, leading to better informed career choices, but not necessarily more entrepreneurs.

Next, science, technology, engineering, and math (STEM) education policy is frequently paired with entrepreneurship initiatives. Since a disproportionate percentage of high-growth start-ups are in technical fields, policymakers have sought to increase the supply of technically skilled individuals through investments in teachers, facilities, scholarships and grants. As an example, the National Science Foundation recently provided a grant to North Carolina Central University to implement "DREAM STEM", a $1.75M program to identify scientists and integrate entrepreneurship into scientific education.[10]

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[6] http://www.kauffman.org/entrepreneurship/teaching-entrepreneurship-in-colleges.aspx

[7] https://www.ida.org/upload/stpi/pdfs/d-4091nsfinal072910.pdf

[8] http://www.sba.gov/content/fiscal-year-2012-budget-summary

[9] https://www.ida.org/upload/stpi/pdfs/d-4091nsfinal072910.pdf

[10] http://nccueagles.yuku.com/topic/7648/New-Program-Combines-STEM-Education-and-Entrepreneurship#.URwZmmdX98E

Finally, high-skilled immigration policy is a key component of increasing the supply of entrepreneurs. While there is large literature on high skilled immigration and entrepreneurship, for the purposes of our review, the most relevant policies are those which seek to attract immigrant entrepreneurs to specific regions. While there exists no specific U.S. visa program for entrepreneurs, there have been proposals recently for a "Start-up Visa" for immigrant entrepreneurs who can attract investment from a qualified U.S. investor.[11] This program draws heavily from the EB-5 visa program, enacted in 1990, which provides a path to permanent residency for foreign investors depending on the size of investment and the number of jobs created. Under a pilot program, some U.S. states and regions have created over 260 "Regional Centers" to attract EB-5 investors to their areas. If a Startup Visa program is ever enacted, it is possible that this "localization" dimension could also be developed. Absent these specific policies, local leaders can take simpler steps to make their cities more attractive to immigrants should they want to expand this input into their economy (e.g., educating local employers about visa programs, providing online information about the city to immigrants). Michael Bloomberg, for example, has been particularly vocal on skilled immigration topics and aggressive in his support of recruiting skilled immigrants to New York City.

Direct Subsidies and Targeted Tax Breaks to Promote Entrepreneurship

U.S. states are also actively providing more direct assistance to startup firms. Several states have created programs to provide R&D funds to local start-ups, sometimes in the form of loans or convertible debt. One of the rare rigorous evaluations of these state-level programs found that recipients in Michigan were 15-25% more likely to survive after three years relative to a set of comparable firms (Zhao and Ziedonis 2012). A serious question going forward is whether these programs also develop ventures that scale significant in the local area.

Many states have also developed state VC funds that can operate through certified capital companies (CAPCOs) or related models. Lerner (2009) provides insights into why these kinds of programs often fail and offers several recommendations for best practices across these programs. Lerner's (2009) result suggest that the "table setting" activities that government can provide to create a stronger business environment for start-ups tend to be more successful than direct investments in firms. These programs have historically had numerous design flaws, leading to reduced flexibility for investors and entrepreneurs, adverse selection of investment managers, and limited upside with significant downside risk for the taxpayer. Other states and cities have tried to directly attract entrepreneurs to relocate by sponsoring incubators (e.g., New York City)

[11] http://www.kerry.senate.gov/press/release/?id=4e6a51f6-fb2b-4212-b299-b0c46c7e6b58

or explicitly requested VC investors to visit the area and meet local entrepreneurs as a condition for state investment in a particular venture fund.

Finally, there have also been many efforts to create tax incentives for investments in start-ups in particular areas. For example, over 20 U.S. states have instituted tax credits for angel investors. Other states have established early-stage investment tax credits for investments in qualified startups. Despite the proliferation of these programs, we are not aware of robust evidence of their impact on early-stage investments. For example, it could be possible that these tax credits reduce government revenue without inducing new investments or increasing the number of companies that receive funding. These credits could also simply increase competition for deals and bid up valuations.[12]

Regional Clusters Policies to Promote Entrepreneurship

Next, we explore policies to promote entrepreneurship as part of regional clusters. Cluster policies have proliferating in the United States since at least 1990, following Porter (1990). Despite wide adoption at the regional, state, and local level, U.S. federal policy has paid little attention to clusters until very recently.[13] Porter argues that regional cluster policy operates below "macro-level" polices to improve the general business environment for all firms through "setting the table" activities (Lerner 2009) and above "micro-level" policies that aid individual firms (Porter 2007).[14]

Silicon Valley, Boston's Route 128, and Research Triangle Park are three of the most well-known clusters in the United States and among those most often associated with entrepreneurship and innovation. The role of public policy in creating and sustaining these regions as attractive locations for entrepreneurship is complex. Interestingly, while Silicon Valley and Route 128 certainly benefited from federal research funds (Dorfman 1983), neither arose as a result of a cohesive federal vision and plan, perhaps with not even much intentionality from any level of government or academic institution. On the other hand, The Research Triangle Park in North Carolina was clearly a product of dedicated state-level planning, beginning with

[12] http://www.businessweek.com/smallbiz/content/aug2010/sb20100820_461551.htm

[13] There have been several high profile place based strategies to develop U.S. regions that lag behind economically, from the Reconstruction period after the Civil War to the New Deal programs of the 1940s to the Appalachian Regional Commission.

[14] Related work includes Furman et al. (2002), Duranton (2011), Kline and Moretti (2012), and Falck et al. (2012).

Gov. Luther Hodges in 1955, and continuing through successive administrations which worked to identify and attract private investors for the project (Link and Scott 2003). While the federally sponsored National Environmental Health Sciences Center was an early tenant in the park, the arrival of IBM in 1965 was much more pivotal (Link and Scott 2003). Taken together, while public policy played some role in the creation of the United States' most successful clusters, there was no national-level strategy to develop and sustain these clusters. Even after these clusters rose to prominence and were celebrated in the 1980s and 1990s, U.S. federal policy towards clusters was minimal and remained so until at least 2010.

Policies at the state and local level to build and support clusters typically involve a mix of initiatives depending on the stage of the development of the cluster. The first step in cluster development to identify the candidate cluster by geography, industrial composition, and existing networks. Government funds can be awarded to do this initial study or private organizations may commission this work to raise awareness and use in applications for government funding in the future.

Once the cluster is identified and recognized by government authorities, there are several approaches to build capacity within the cluster, some of which can be targeted at entrepreneurial start-ups. For example, a report from the OECD indicates that one common set of policies relates to building a pipeline between university research and start-up formation.[15] These can include providing funds for joint research, encouraging the development of standardized licenses to facilitate technology transfer, or coordinating seed funding for university spinoffs. Broadly, regional cluster policy levers to encourage start-up formation and growth typically aim to spur knowledge transfer across various organizational boundaries, whether it be universities, incumbent firms, or other start-ups. Government funds are most often used to convene various organizations and facilitate networks, and less frequently directly invested into new firms. In light of the positive studies of university contributions noted earlier, efforts in this regard may yield decent returns.

New Federal Focus on Promoting High-Growth Entrepreneurship

Since 2009, there has been much more emphasis on federal policies to promote high-growth entrepreneurship. The Obama Administration launched "Startup America", an umbrella initiative to encompass several related efforts to promote high-growth entrepreneurship. It includes proposals to increase access to capital, enhance entrepreneurial education and

[15] OECD, Competitive Regional Clusters: National Policy Approaches (OECD Reviews of Regional Innovation, 2007)

mentorship, limit regulatory barriers to starting and growing companies, spur technology commercialization efforts from universities, and open up entrepreneurial opportunities in key industries like healthcare, energy and education. Various parts of the Startup America agenda have been enacted through legislation, while other parts have not required legislative approval and have been implemented by relevant agencies.

Some key components of the Startup American policy agenda were passed in the 2011 JOBS Act (Jumpstarting our Business Startups). The focus of the JOBS Act was on reducing the financial reporting requirements for small firms and facilitating crowd funding, making it easier for individuals to invest or contribute funds to start-ups. It raised the limit of Regulation A securities offerings to $50 million, lifted the ban on general solicitation, and created a new class of companies—called emerging growth companies—that will have fewer disclosure requirements.

The federal government has also taken other lower profile steps explicitly to promote high-growth entrepreneurship. We list a few notable examples below. The Obama Administration modified the Small Business Investment Company program to offer two new one billion dollar funds to invest in high growth businesses. Several government agencies, including SBA, Veterans Affairs, and the Department of Energy have sponsored business accelerators. The USPTO also announced a new fast track 12 month patent application process that is especially targeted at entrepreneurial firms. The National Institutes of Health have simplified the process to license technologies for biomedical start-ups.

Another key set of initiatives to promote high-growth entrepreneurship have been introduced as part of regional cluster programs. Over the past five years, the U.S. government has been much more active in supporting regional cluster efforts. The Obama Administration has framed this shift as redeploying existing resources more strategically rather than allocating significant new funds. As of 2008, the federal government already had 250 overlapping programs worth $77 billion that were designed in part to spur regional economies.[16] The Obama Administration has launched three key efforts to try to allocate this funding with regional clusters in mind.[17]

Most efforts to spur regional economies originate from the Department of Commerce's Economic Development Agency (EDA), which was launched in 1965 to assist economically depressed urban and rural areas. EDA was allocated $50 million in 2010 to support regional

[16] Karen G. Mills, Elisabeth B. Reynolds, and Andrew Reamer, "Clusters and Competitiveness: A New Federal Role for Stimulating Regional Economies," Metropolitan Policy Program at Brookings, April 2008.

[17] The Empowerment Zones program, discussed earlier, expired at the end of 2011.

innovation clusters and the America Competes Reauthorization of 2010 also called on the Secretary of Commerce "to establish a regional innovation program to encourage and support the development of regional innovation strategies, including regional innovation clusters science and research parks."[18]

While Commerce's EDA continues to play a pivotal role, beginning with the 2011 budget, the Obama Administration has included several different agencies in its regional clusters strategy.[19] The largest investment in clusters to date is $129 million investment over five years in the Energy Regional Innovation Cluster in Philadelphia involving many parts of the federal government. Nearly all of the funds ($122 million) will come from the Department of Energy's Energy Innovation Hubs program which was funded through the Recovery Act.[20] The other agencies are providing either small amounts of funding or technical assistance from existing programs, such as the Department of Labor's One-Stop Career Centers. As is typical with regional cluster policies, the recipient of the funding and technical assistance is a consortium of academic institutions, government bodies, and regional development groups called the Greater Philadelphia Innovation Cluster.

In addition to this large investment, there have been two other regional innovation cluster investments worth several million dollars in total in Florida (Space Shuttle Shutdown Transition) and Ohio (Water Technology Innovation Cluster). [21] Finally, SBA also invested $1 million each in 10 pilot clusters in 2010, three of which focused on Advanced Defense Technologies.[22] Another key clusters initiative launched in September 2011 was the $37 million Jobs and Innovation Accelerator Challenge sponsored by SBA, Commerce and Labor which supported 20 clusters. The DOL's ETA provided $19.5 million for technical skill development, Commerce's EDA provided $14.5 million for economic adjustment assistance, and SBA added $3 million in technical assistance. The winning clusters provided matching funds of $13 million.

The 2nd stage of this initiative was a Rural Jobs and Innovation Accelerator Challenge launched in March 2012 with $15 million of funding. The 3rd Jobs and Innovation Accelerator

[18] America COMPETES Reauthorization Act of 2010 (http://thomas.loc.gov/cgi-bin/bdquery/z?d111:HR05116:@@@L&summ2=m&)

[19] http://www.newrepublic.com/blog/the-avenue/budget-2011-industry-clusters-paradigm-job-growth

[20] http://scienceprogress.org/2010/08/a-win-for-regional-innovation/

[21] http://www.sba.gov/cluster; http://billnelson.senate.gov/news/details.cfm?id=334172&; http://yosemite.epa.gov/opa/admpress.nsf/0/5C6E98E36238C0898525781C005B7B73

[22] http://www.entrepreneur.com/slideshow/225398

Challenge began in May 2012 with $20 million with a focus on Advanced Manufacturing. Each of these rounds involved a competitive grant application to seed public-private partnerships. Most of the clusters funded by these grants existed formally or informally before receiving funding.

The participation of SBA in these initiatives is specifically designed to increase opportunities for small businesses in the clusters and other SBA services, such as those provided by Small Business Development Centers, are typically part of the overall effort. Finally, both Commerce's EDA and NSF launched multimillion dollar initiatives to accelerate technology transfer from universities within the context of regional clusters.

In sum, as of April 2012, the Obama Administration has spent over $225 million on regional cluster projects and requested another $25 million in the 2013 budget.[23] This is a small amount of money in the context of the overall budget but is consistent with an emphasis on organizing existing funding streams more strategically to support clusters.

7. Conclusions

Even if entrepreneurship is a powerful force that engenders local and economic growth, it is not obvious that government policy can create entrepreneurship. Even if entrepreneurs naturally cluster in tight geographic units, it is not obvious that the government should use public policy to support such clusters. While the entrepreneurship policies discussed above generally do not require large funding streams, it is still important to consider the downsides of ineffective policies. At this point, we are still just beginning to acquire enough wisdom to create sound policies that internalize the externalities that can come from innovation and new start-ups.

While we believe that there are conclusions that can be drawn at this stage—research universities powerfully impact local development, focusing on large-scale employers can crowd out small scale start-ups—we need far more information before entrepreneurship policy can attain the relatively mature status enjoyed by, for example, policies towards international trade and monopoly. The primary need is for experimentation and evaluation, especially with randomization.

For example, if a government is creating an entrepreneurial cluster that is oversubscribed, it can randomize at least some of the spaces in the cluster. By comparing the outcomes of winners and losers in the "space lottery", the government can evaluate the impact of the policy.

[23] http://www.politifact.com/truth-o-meter/promises/obameter/promise/309/support-regional-innovation-clusters/

If the government is going to persist in providing loan guarantees on a firm-by-firm basis, at least some of the loans can be randomly allocated in a way that permits ex post evaluation of the impact of those loans.

Experimentation is happening all across the nation today, as government at all levels (along with numerous private and non-profit organizations) craft policies "to be the next Silicon Valley". The problem is that this experimentation is almost entirely ad-hoc and often it is unclear what outcome variables (i.e., number of startups, employment, patents) should be measured. Moreover, most policymakers, especially when programs are relatively inexpensive, might naturally favor the "kitchen sink" approach whereby every potential intervention that could increase entrepreneurship be tried simultaneously. In fact, efforts to provide entrepreneurial education, access to capital, export promotion, and the like in a concentrated region are often favorably billed as a "one-stop shop" for startups, which makes evaluation of any single policy intervention challenging.

Evaluation as a concept is becoming more important to regional cluster initiatives in particular and some other programs to promote entrepreneurship. The key challenge here is that plausible counterfactuals against which benchmark performance are difficult to construct and thus rarely considered, making interpretation of any results very difficult. Relatedly, the use of randomization to create research opportunities is especially complex in this domain, where policymakers are often intentionally targeting specific areas for additional funding and where "winners and losers" are highly visible.

While the obstacles to creating better research designs to study these programs are formidable, they are not impossible to overcome. Many agencies, including SBA, already submit evaluations of certain programs to Congress along with their budget request. It should be possible to provide broad outlines of what a good evaluation should look like, and Congress could provide guidance informed by academics in this regard. Moreover, given the U.S. government's newly prominent role in promoting high growth entrepreneurship and regional clusters specifically, the federal grant competitions could be designed to reward rigorous evaluations and specific milestones achieved.

It would be ideal to conclude that paths towards better entrepreneurship policies are clear, but they are not. Some policies do seem to have many upsides and few downsides, such as allowing more skilled immigrants, strengthening education systems, and eliminating unwise regulations. But when we move beyond such simple broad policies towards specific entrepreneurship strategies like clustering, our ignorance becomes obvious. The best path forward involves experimentation and evaluation. With advances in these dimensions, we cannot be confident that policies to promote entrepreneurship will have their intended impact.

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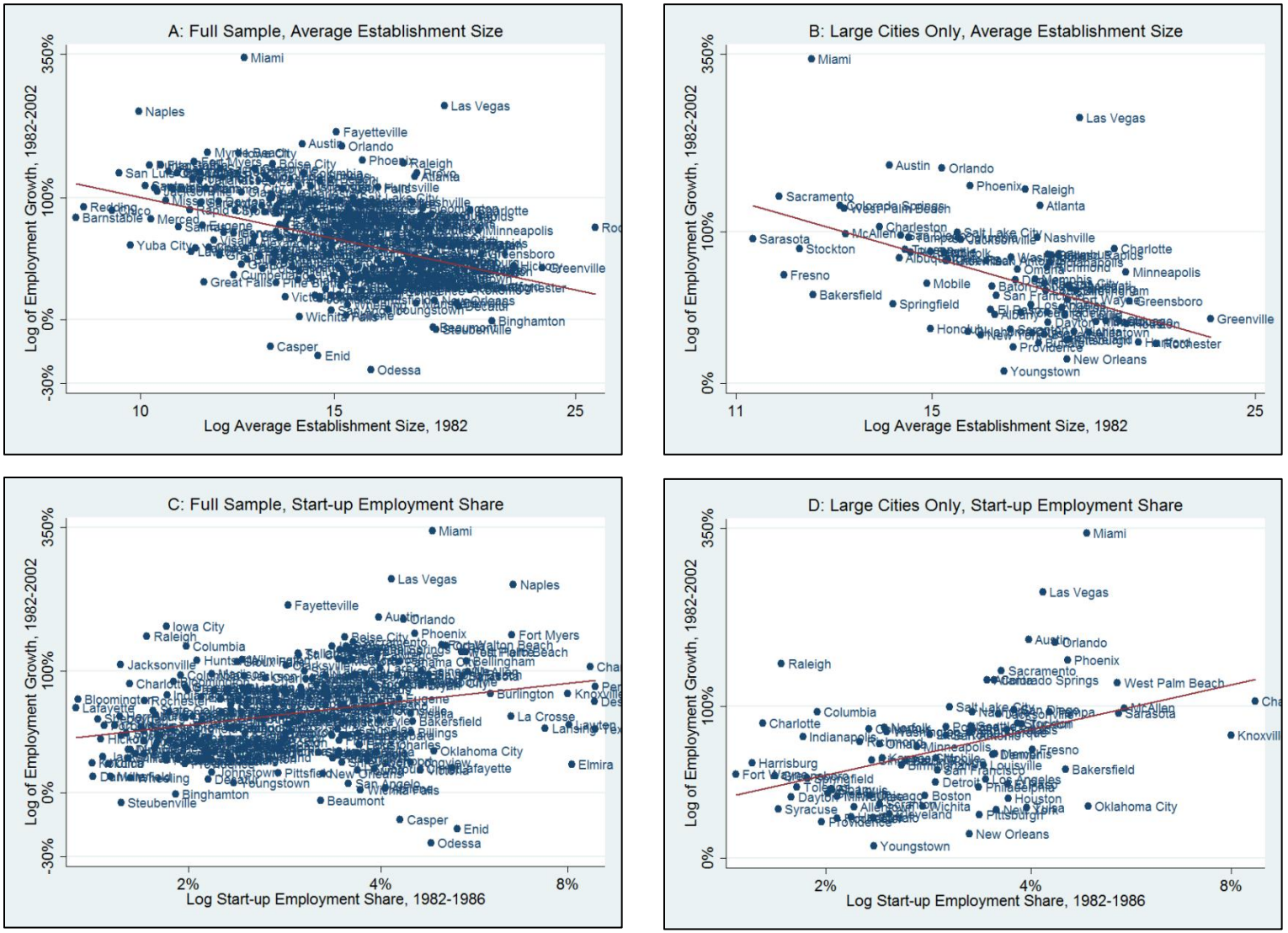
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Fig. 1: City employment growth and initial entrepreneurship

Cross-sectional plots of urban growth 1982-2002 vs. initial traits



Notes: Taken from Glaeser, Kerr, and Kerr (2012). Figure presents city employment growth over the 1982-2002 period against measures of local entrepreneurship in 1982. Panels A and B use average establishment size, with places with smaller establishments associated with greater subsequent growth. Panels C and D use start-up entry rates, with places with greater start-up shares showing greater subsequent growth.

Fig. 2: Dimensions of government policy

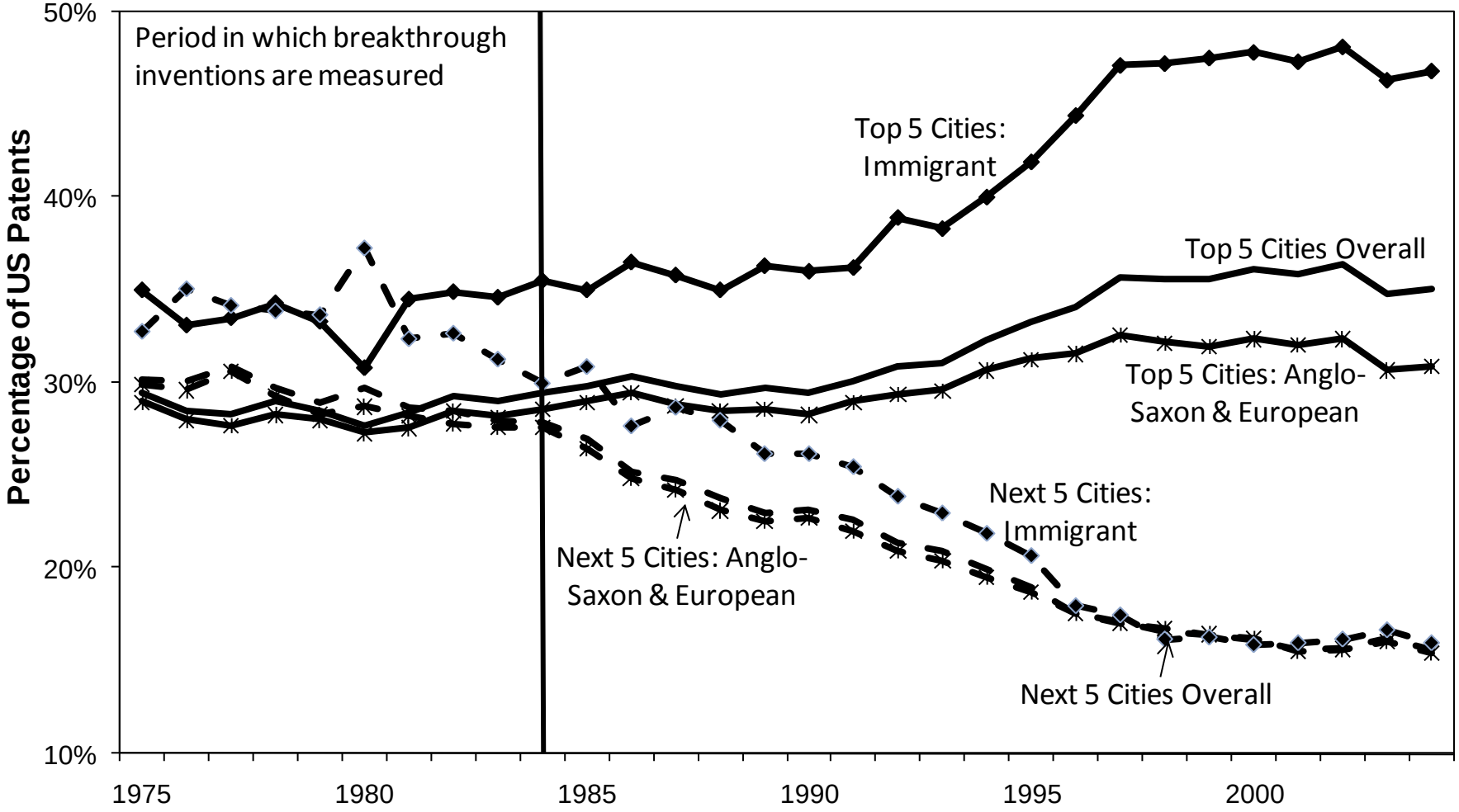
Degree of specificity towards industries and firms

Degree of specificity towards locations

	General	Industries/sectors	Firms
National and state	Overall tax code Patent policy Non-compete clauses	Industry-specific tax provisions, e.g. film industry subsidies Research subsidies	National and state loan guarantees for specific firms, e.g. Solyndra
City and county	Citywide taxes and business regulations Inter-urban transportation	New York City industrial support for life science or fashion industries, tax breaks for finance industry	City-level tax breaks for million-dollar plants Contracts tied to local firms
Neighbor-hood	Empowerment Zones Local infrastructure	Innovation clusters Industry-specific local infrastructure	Firm-specific infrastructure

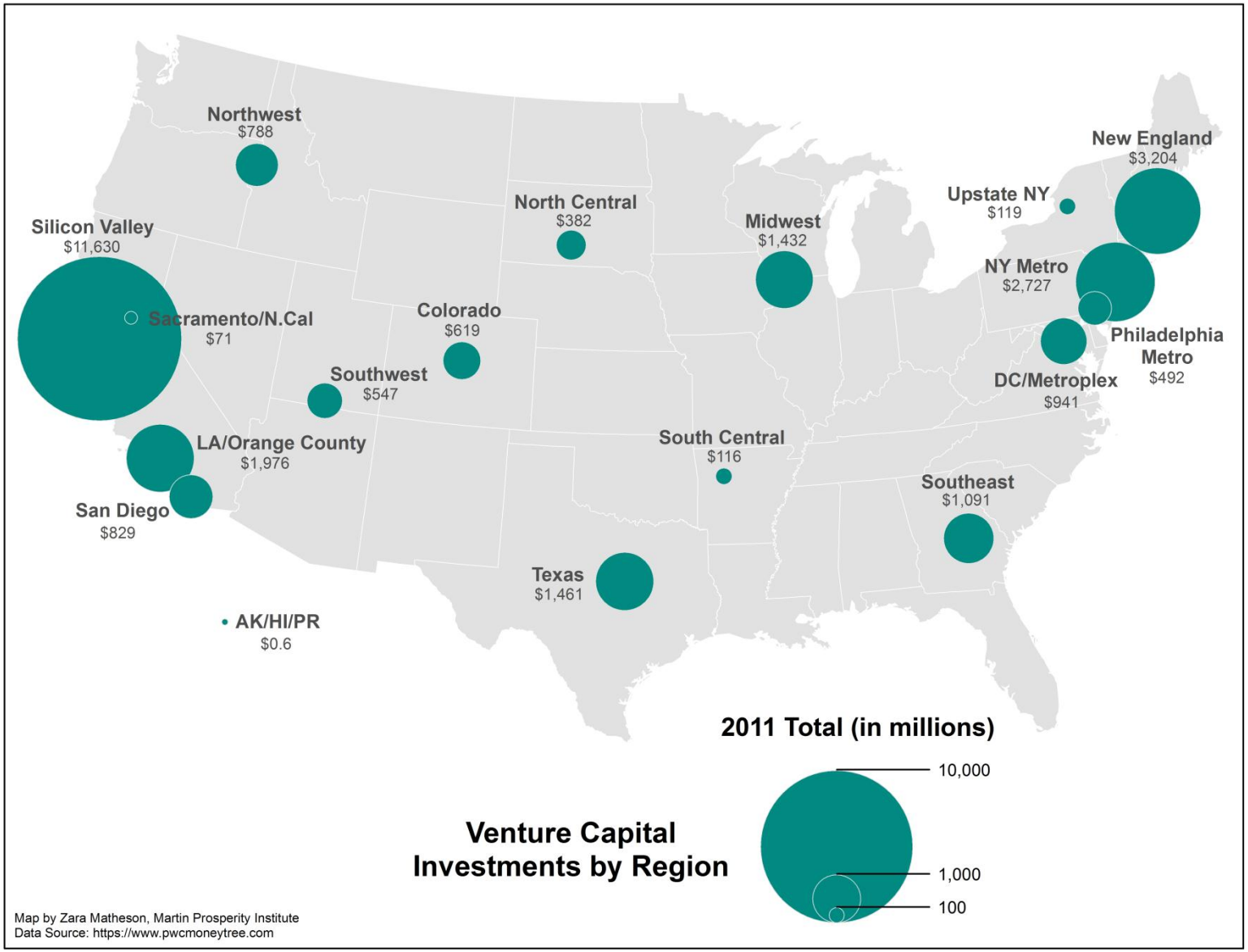
Fig. 3: City patenting growth after breakthrough inventions

Ten largest cities per technology split by their breakthrough share



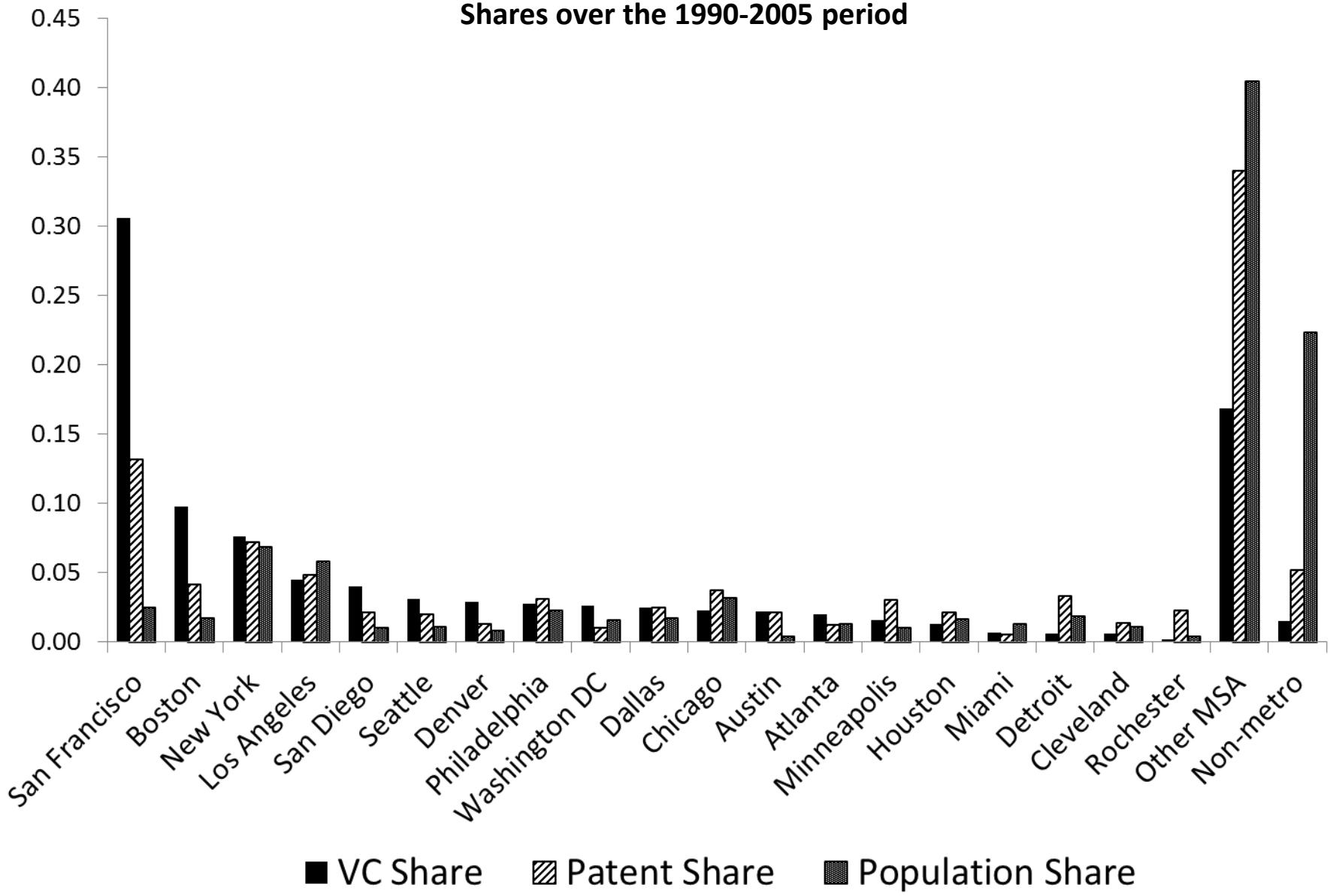
Notes: Taken from Kerr (2010). Figure presents city growth in US patenting following breakthrough technologies. The sample includes the top cities per technology in 1975-1984 in terms of numbers of patents. Within each technology, these ten cities are grouped into the top five cities and the next five cities in terms of breakthrough patent ratios. These ratios are the city's share of breakthrough patents for the technology divided by the city's total share of patents for the technology. Breakthrough patents are defined as the top 1% of each technology's 1975-1984 patents in terms of citations subsequently received. Included city-technology pairs are held constant to measure the migration of innovation following breakthroughs. Shares for Anglo-Saxon/ European ethnicity inventors and immigrant ethnicities are provided for each series. Immigrant ethnicities play a disproportionate role in the migrations.

Fig. 4: Spatial concentration of venture capital investments, 2011



Notes: Taken from Martin Prosperity Institute's Zara Matheson and based upon PWC MoneyTree data.

Fig. 5: Spatial concentration of U.S. venture capital and patenting



Notes: Calculated by the authors from Venture Xpert, USPTO patent data, and county-level population statistics. VC calculations use share of deals over the 1990-2005 period. Patent calculations use share of granted patents applied for from each city during 1990-2005. Population share is from 1999.