

**Preliminary Assessment of the Factors That Led Austin to Become a
High-Tech Entrepreneurial City**

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This appealing college town set in the lovely Texas hill country is rapidly becoming a major city with a high-technology economy, and many an Austenite is wondering if that will spoil a good thing.

—Robert Reinhold, *New York Times*, October 8, 1983.

Introduction

The Austin–Round Rock metropolitan area² was ranked first in 2015 and second in 2014 by the Kauffman Foundation for startup density among the largest U.S. metropolitan areas. Austin also ranks among the top high-tech city-regions in the United States as evidenced by several indicators. The growth of the technology economy in Austin has been extensively studied. In contrast, there is little scientific documentation of the factors that led Austin to become a vibrant entrepreneurial city. The main objective of this report is to fill this void by presenting reliable data on longitudinal entrepreneurial activity in the city and advancing some hypotheses on the factors that explain the accelerated growth of locally founded startups since 1990. This task is accomplished in several sections. Section one summarizes key events and the institutional development and interventions facilitating Austin’s transition from an economy based in two primary sectors—the University of Texas at Austin and state government—to a high-tech center. Section two describes Austin’s increasing high-tech specialization in four information and communications technologies (ICT) sectors and the benefits of spatial co-agglomeration. Section three uses full-time employment data to document Austin’s economic transition to a technology center and the increasing diversification of the ICT sector. Section four shows data on local

¹ **Acknowledgement**—This report was funded by the Kauffman Foundation. We appreciate the support of Maryann Feldman and David Gibson. We also appreciate the enthusiasm and collaboration of our team of researchers: Jeremiah Spence, Yimeng Zhao, Alyse Polly, and Hayden English. Evan Johnson, the research assistant who worked in preparing the complex data for analysis as well as figures and tables, deserves special recognition. He displayed great intelligence in analyzing, organizing, and interpreting the detailed data.

² The Austin–Round Rock metropolitan area includes the following counties: Travis, Bastrop, Caldwell, Hays, and Williamson. This reports refers interchangeably to Austin or Central Texas, as the metro is locally known.

entrepreneurial trends. Section five advances three factors that explain the rapid growth of Austin's entrepreneurial ecosystem: corporate cascade spawning, human capital immigration, and adaptive local "small-i" institutions. This report concludes by summarizing the main factors that lead to the development of Austin's entrepreneurial economy and outlining the next steps to empirically validate these factors with data, insights from current research literature, and interviews with key respondents over the next four months of the research project.

Birth of the Local High-Tech Economy

Until the 1980s, Austin's economy was largely based on income generated by the state government and by its large research university, the University of Texas at Austin (UT–Austin). Private-sector employment was centered in a half-dozen large plants that had moved to Austin in the 1960s and 1970s including IBM, Texas Instruments, Motorola, and Advanced Micro Devices. These branch plants of established high-tech firms began the high-tech industrial cluster in Austin. The early growth of the high-technology industry was also spurred by the birth of three startups that became large corporations: Tracor, National Instruments, and Dell. This is in line with Avnimelech and Feldman (2010a, 2010b) findings that successful homegrown companies played an important role in regional cluster developments.

Other events, leveraged by a strong and strategically focused set of state and local institutions also contributed significantly to the birth of what Powers (2004) calls the Austin technology cluster. A crucial event was the city's winning a national competition for the first U.S. for-profit consortium of 10 high-technology companies in the computer industry, the Microelectronics and Computer Technology Corporation (MCC) in 1983. MCC chose Austin over 57 other cities in 27 states after a vigorous national competition. Some of MCC's member companies—such as AMD, Texas Instruments, Motorola, Lockheed, and National Semiconductors—had branch plants in Austin and came together with a highly dedicated state and local coalition to ensure that MCC selected Austin as its home (Gibson and Rogers 1994). Several researchers at the IC² Institute at UT–Austin have extensively documented the importance of MCC in the early growth of the high-tech economy in Austin.³ This research shows that a key ingredient

³ Smilor et al. (1987), Smilor et al. (1988a, 1988b), Phillips (2006, 2009), Gibson and Rogers (1994), Cunningham and Jones (2013), and Gibson and Butler (2013).

to Austin's victory was careful collaboration among government, business, and the University of Texas. In the words of Powers (2004, p. 56): "The MCC experience dramatically brought these forces together, for the first time in Texas, to develop incentives and present a very impressive bid." Among the key MCC participants were the governor's office, the UT–Austin and its college of engineering, and the Greater Austin Chamber of Commerce (GACC).⁴

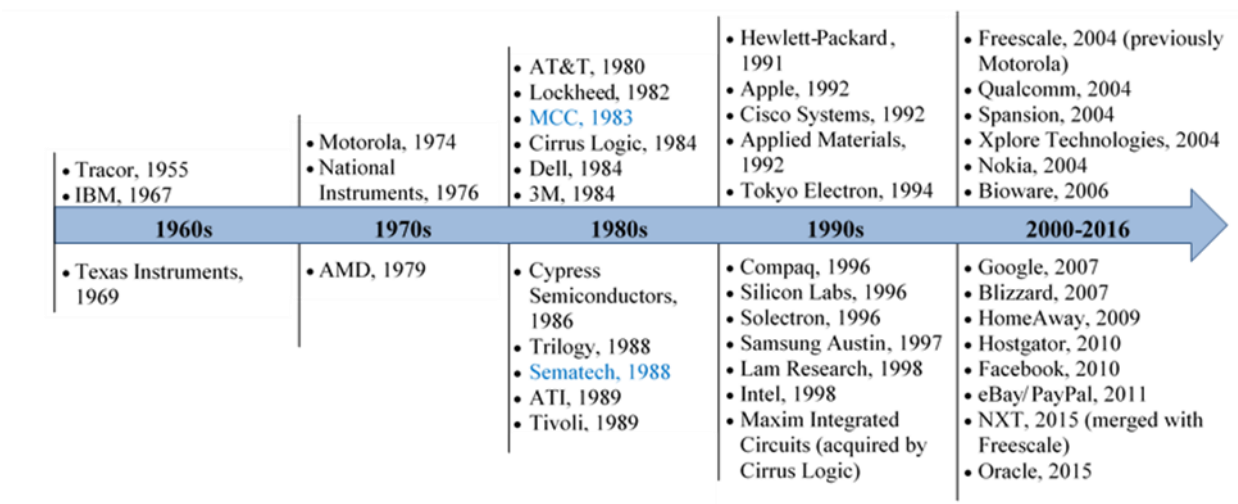
The MCC experience was followed by the recruitment of 3M research operations in 1984 and, in 1988, winning the national competition for a second major U.S. semiconductor R&D consortium, Sematech (Semiconductor Manufacturing Technology)—a government, academic, and industry consortium that sought to create an integrated research and development structure to support and enhance innovation and the international competitiveness of semiconductor producers and suppliers, and maintain key supplies of advanced microelectronics to the U.S. Department of Defense.⁵ Sematech chose Austin over 137 competing cities (Powers 2004), and the consortium received \$62 million in incentives from the state of Texas. Once more, in 1988, Austin was picked as one of four finalists for U.S. Memories, another semiconductor manufacturing consortium that was not ultimately implemented.

As Figure 1 shows, the tendency to attract branch plants of large high-tech firms, many from Silicon Valley, accelerated exponentially in the 1990s after the arrival of MCC and Sematech. This trend has continued to be an important component of the growth of Austin's high-tech economy. A recent visible example is Apple opening its second-largest worldwide operation in Austin in 2015 with plans to employ about 8,000. (Its largest office complex is in Silicon Valley.) This would make Apple the second-largest technology employer in the city behind Dell Computers, which employs about 13,000 local workers (Hawkins and Novak, 2015).

⁴ A statewide task force was created to find the resources and talent MCC required. MCC received more than \$20 million in incentives. Powers (2004) names two of the major incentives: a facility and lab at the University of Texas at Austin leased for \$10 a year (financed by university and private statewide contributions) and the creation of 32 \$1 million endowed chairs in engineering and science.

⁵ The National Cooperative Research Act of 1984 loosened antitrust restrictions on research and development (R&D) joint ventures. Partly as a result of this legislation, Sematech was incorporated in 1987 with 14 founding members (Irwin and Klenow 1996).

Figure 1
The development of the high-tech economy in Austin, 1960 to 2016



Source: Authors' calculations adapted from figures 2 and 4 in Smilor et al. (2007)

MCC listed an affordable cost of living as one of its main site-selection criteria in choosing Austin (Gibson and Rogers 1994). The favorable cost of living in Austin would continue to be important in the relocation of high-tech firms, especially from Silicon Valley, and their supplier plants to Austin after the successful bid for the two large computer and semiconductor research consortia (Oden and Yilmaz 2006). Several other endogenous resources such as the location of a large local research university (the University of Texas at Austin) and one relatively nearby (Texas A&M University),⁶ as well as Austin's cultural and natural amenities including music, scenic hills, and lakes have continued to attract and retain high-tech firms and talent in the last 30-plus years. Yet other cities had similar initial factor endowments including a large research university, relatively low costs of living, and attractive amenities, but have not developed a technology based economy.

Austin's endogenous resources, especially a large proportion of highly-educated workers, were important in winning national R&D consortiums and attracting plants of large high-tech

⁶ The National Science Foundation's Higher Education Research and Development (HERD) Survey ranked Texas A&M University 17th in the United States with R&D expenditures of more than \$854 million during fiscal year 2014. The University of Texas at Austin ranked 34st with \$585 million in this survey. <https://today.tamu.edu/2015/11/19/texas-am-advances-to-17th-in-new-nsf-research-rankings/> Both universities have more than 50,000 students.

multinationals. However, Austin's competitive advantage has been based on a successful development of what Storper (2015) called "small-i" institutions in contrast to "big-I" (formal) institutions. Smilor et al. (1988a, 1988b) describe the local small-i institutional environment as a strong collaboration between influencers from the private and public sectors in Austin. This provided leadership and networking across key segments of the city including the university, large and small technology companies, business and civic support organizations such as the Austin Chamber of Commerce, and federal, state, and local governments. As we will discuss later in this report, while new institutions permeate the current local environment (e.g. Capital Factory), most local institutions and institutional collaborations have existed and evolved since the beginning of the high-tech industry in the 1980s, showing an impressive capacity to successfully adapt to the local economic changes.

Other factors that contributed to the growth of the Austin high-tech economy were exogenous. Competition from Japanese semiconductor companies led the U.S. private sector and the federal government to create favorable conditions for MCC and Sematech, who played a key role in the birth of Austin's high-tech economy. Other exogenous events such as changes in the competitive strategy of major U.S. semiconductor firms were also important. Saxenian (1994) explains that, starting in the 1970s, Silicon Valley's chipmakers minimized costs by shifting manufacturing out of the region to lower-cost locations, both in the United States and overseas. She notes they relocated wafer fabrication to lower-cost areas such as Austin and that a competitive strategy, based on the organizational separation of design and development from manufacturing, facilitated this shift. She points out that by the early 1980s, it appeared that only research, design, and prototype production of chips remained in Silicon Valley. As conferred in the next section, the continuous relocation of branch plants of high-tech firms to Austin has generated an important co-agglomeration of four ICT-related industries in the city.

ICT Specialization and Co-Agglomeration Economies

When the large plants that have located and expanded operations in Austin are grouped within specific industrial sectors, they, together with key homegrown corporations, fit mainly into four interlinked innovative information and communication technologies (ICT) sectors: (1)

semiconductor manufacturing, design, and research, (2) semiconductor manufacturing equipment manufacturing, (3) computer and related equipment manufacturing, and (4) software and computer system design services.

There are plenty of economic reasons to expect industrial agglomeration to benefit firms. Carlino and Kerr (2014) review many such reasons recently, highlighting the role of input sharing, labor market matching, and knowledge spillovers among others. The significance of knowledge spillovers has received prominent attention in the literature overall (Audretsch and Feldman 1996, Jaffe et al 1993, Echeverri-Carroll 2001, Rosenthal and Strange 2004, Moretti 2004, 2012, Kerr and Kominers 2013). Most of this attention, however, has been on the benefits of spatial concentration of one industry (Rosenthal and Strange 2004). In a recent article about the spatial concentration of innovative activity in the Bay Area (which includes Silicon Valley), Forman et al. (2016) distinguish between colocation and co-agglomeration of innovative industries. Colocation refers to the linked location of firms within an industry, often because they accomplish different tasks in the value-added chain such as invention and industry production. In contrast, co-agglomeration emerges from the location of firms from different, but related industries in the same place.

Some dissimilar industries may share labor skills and institutional services (e.g. engineering or scientific consulting services), and these forces could lead to the agglomeration of many types of innovations from different industries in one place. However, one of the most important sources of co-agglomeration economies is the mobility of skilled employees across firms in related industries. Inter-industry job-hopping promotes cross-pollination of ideas, benefiting in this way innovations across industries. When engineers and scientists move between firms in related industries, they are able to apply their knowledge, skills, connections, and experience acquired at their previous job in one industry to their new job in a related industry. Inter-industry migration of labor and knowledge exchange is then a source of spillovers from one type of product or process innovation to another.

The location of MCC and Sematech, which specialized in semiconductor and computer research in the 1980s, planted the seeds (capital, talent, and research) for the development of the core ICT sectors in which Austin's economy ultimately specialized: semiconductors manufacturing, semiconductor equipment manufacturing, software, and computers. There is

evidence that these research consortia facilitated linkages across industries. Irwin and Klenow (1996) report that in the 1990s, Sematech started to subcontract research and development through grants to semiconductor equipment manufacturers to develop better equipment and to support the domestic supplier base as well as to strengthen links between equipment and semiconductor device manufacturers.

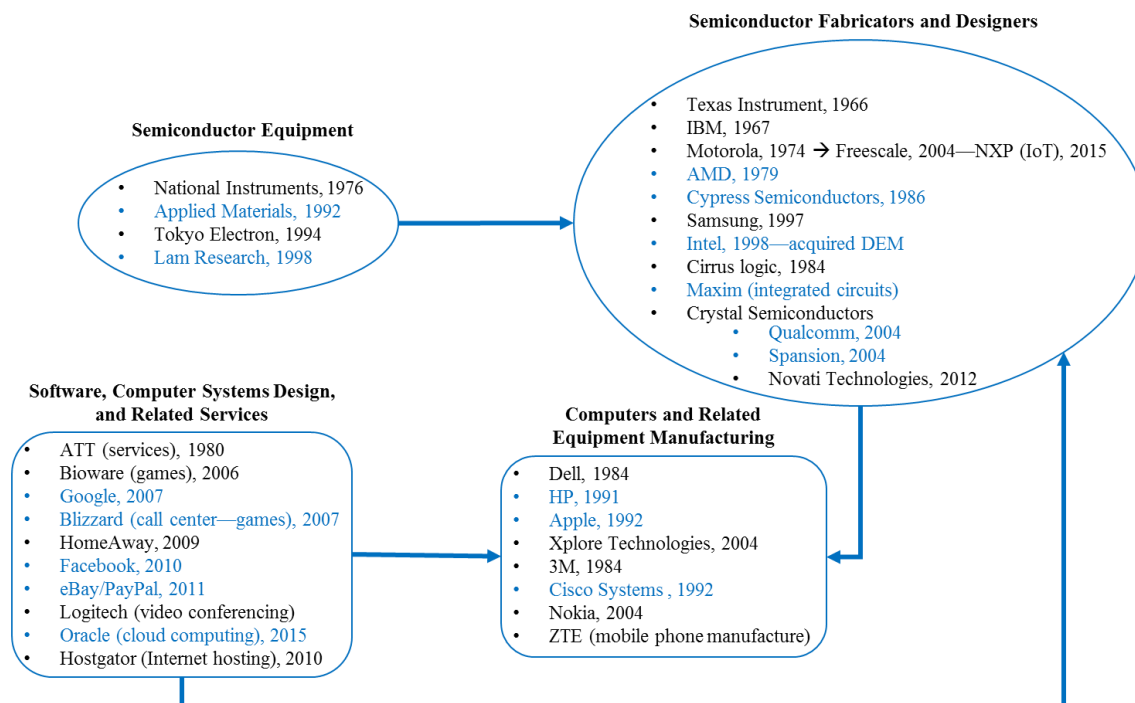
Supporting institutions programs designed to match the skill needs of the ICT sector have also been important sources of agglomeration economies. The University of Texas at Austin and the Austin Community College (ACC) have developed numerous educational programs that targeted the specific needs of the ICT core sectors. For instance, the ACC's semiconductor and nanoelectronics manufacturing programs prepare technicians to work in semiconductor manufacturing. These workers process silicon wafers into computer chips and record quality control data in addition to repairing equipment. Similarly, the Austin Area Research Organization (AARO), founded in 1980, and the Austin Software Council (ASC, renamed the Austin Technology Council, ATC), founded in 1992, were created by a group of chief executive officers who found themselves needing a forum to discuss issues that affected the ICT sector. Indeed, the co-founders of Tracor corporation, a spinoff from UT-Austin's Balcones Research Park, and Radian, a Tracor's spinoff, were among the founders of the ASC.

The computer industry underwent a change from the vertically integrated industry structure of the 1970s and 1980s to a horizontally integrated structure in the 1990s. As the number of applications for computers and semiconductors or software increased, it resulted in vertical disintegration of the computer manufacturing industry into four ICT sectors: computer manufacturing, semiconductor manufacturing, software, and computer services (Bresnahan and Gambardella 1998). Kumar (1997) and Kauffman and Kumar (2006) maintain that another underlying rationale for the co-location of these four ICT sectors is that they evolved from a single vertically-integrated industry and they retained local externalities in their innovation processes. They note that the semiconductor industry continues to have innovation linkages with computer manufacturing and software. Innovations in the semiconductor industry led to exponential growth in the memory capacities of chips, which has had a direct impact on the number of lines of code which chips could process. There are also strong linkages between the semiconductor and software industries because software complexity and performance abilities increased in stride with

increasing semiconductor capacity. Innovations in semiconductors also made computers more powerful, with ability to more efficiently process more information. These backward and forward linkages gave rise to network effects between ICT industries, which are an important cause of their co-agglomeration (Vicente and Suire 2007).

Figure 2 illustrates innovation linkages among the four core ICT sectors. As the computer industry grew, it enticed suppliers of semiconductors to locate in Austin. Similarly, the location of semiconductor manufacturers attracted the location of suppliers such as producers of semiconductor machinery. Austin companies, such as Applied Materials and National Instruments, produced equipment for semiconductor companies such as Samsung and Crystal Semiconductors. Semiconductors are crucial inputs in computers and related equipment manufactured by companies such as Dell and Cisco Systems. Similarly, new software becomes an input for computer companies. Unsurprisingly, many of the companies in the four sectors that define the core of Austin's high-tech economy have headquarters in Silicon Valley (blue text).

Figure 2
Co-agglomeration and strong innovation linkages among ICT industries



Source: Authors' calculations from a variety of sources including the *Austin American Statesman*, *Austin Business Journal*, etc.

Many top computer and microchip firms have design and production centers in Austin—including Samsung, Freescale (formerly Motorola), ARM, Silicon Laboratories, and Cirrus Logic. Trends in the semiconductor industry have led to consolidation in manufacturing around semiconductor foundries and a proliferation of fabless semiconductor companies; thus some semiconductor companies design microchips in Austin but outsource actual production to other countries. The city has diversified its semiconductor sector mainly by benefiting from the vertical disintegration of microelectronics and computing firms, leaving significant design and product management in Austin while outsourcing production, and by attracting new large firms. The next section will show how these trends have significantly reduced the number of full-time workers in the semiconductor and computer manufacturing sectors.

In contrast, the broad software and computer system-design sector has continued to expand in the city. The *2015 Texas IT Services Industry Report* discusses how several large companies in these sectors have recently expanded in Austin. Examples include:

- Oracle, a market leader in enterprise software, is expanding its Austin facilities and creating 200 new jobs.
- IBM, which opened its first software development studio at its North Austin campus in 2013, employs over 6,000 in the city. Austin's IBM studio, one of four in the United States and nine worldwide, focuses on how software is designed, developed, and consumed by companies. Its Austin campus includes an R&D lab and SmartCloud Innovation Center.
- eBay, providing ecommerce services, with greater future expansions planned.
- Microsoft, offering computer system design services and utilities software.
- Rackspace, one of the world's largest hosting and cloud computing companies; and
- Computer Science Corporation, providing cloud and Internet services.

In a parallel trend, the National Venture Capital Association reported that Austin-area investments surged 40% to \$620 million, largely fueled by software startups in 2014. This is evidence that the growth of the software and computer system design sector is fed not only by the expansion of large companies, but also by the growth of startups. Austin video and online game startups such as Activision Blizzard, Electronic Arts, Zynga, and NCSoft are expanding in the city. This is also the case for online services startups such as HomeAway, Bazaarvoice, Bigcommerce, and RetailMeNot.

Employment Changes across Economic Sectors

An analysis of full-time employment data documents two important economic transformations, outlined in the two previous sections.⁷ First, it shows the decreasing importance of the government and the increasing importance of the high-tech industry in job opportunities between 1980 and 2000. Second, it shows a major restructuring of the high-tech industry after the dot-com bust in 2000, with significant job losses in semiconductor and computer manufacturing and subsequent job gains in software and computer design.

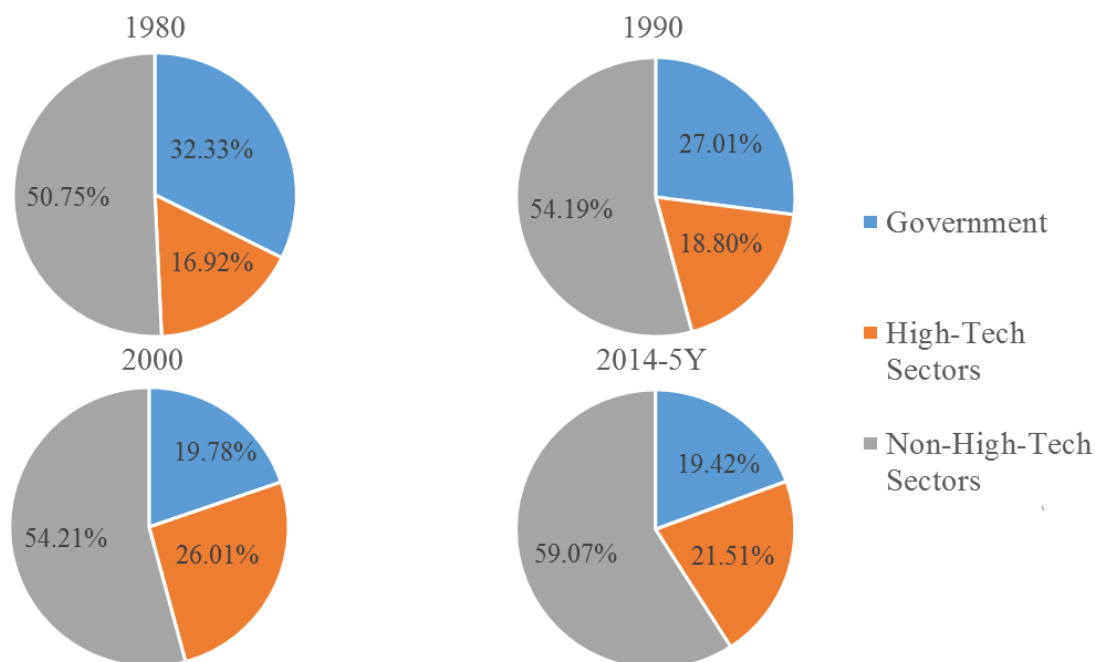
From a Government Town to a High-Tech Center, 1980–2000

Figure 3 shows that, at the onset of high-tech development in Austin in 1980, government accounted for 32.3 percent of total full-time employment in the city, while high-tech industries accounted for only about 17 percent (see definition of high-tech industries in Appendix A). By 2000, the local high-tech industry had grown substantially, accounting for 26 percent of total full-time employment in the city, while the government share had dropped significantly to 19.7 percent. After the 2000–2001 high-tech bust, high-tech employment's share in the local economy dropped to 21.5 percent in 2014 5-year period, four percentage points below the proportion before the bust, and government's participation in full-time employment stayed constant at around 19 percent in this period. Meanwhile, non-high-tech private industries increased their share from 50.7 percent in 1980 to 59 percent in 2014 5-year period, in part reflecting the parallel growth of the low-skill service sector.

⁷ As noted by Baum-Snow and Pavan (2013), measurement error is a justification for using full-time, full-year workers. Baum-Snow and Neal (2009) demonstrate that the census and ACS data appear to contain false reports of part-time hours. More specifically, some of these errors involve false reports of daily hours worked instead of usual weekly hours.

Figure 3

Employment share by major sector in the Austin MSA, 1980 to 2014



Source: Authors' calculations using the U.S. Census with 5% samples in 1980, 1990, and 2000 and the ACS with a 5-year aggregated sample in 2014 (1% samples 2010 to 2014) from IPUMS (Ruggles et al., 2015).

Notes: Sample includes full-time, non-self-employed workers living in the Austin MSA. High-tech sectors defined by Hecker (2005). Full-time defined as working at least 35 hours per week for at least 14 weeks in the year surveyed.

Uneven Growth of the Core High-Tech Sectors, 2000–2016

We now turn to an analysis of full-time job trends among the core ICT sectors in which the local economy specializes. In conducting this exercise, we aggregated chip and machinery semiconductor producers in the semiconductor and electrical equipment manufacturing sector.

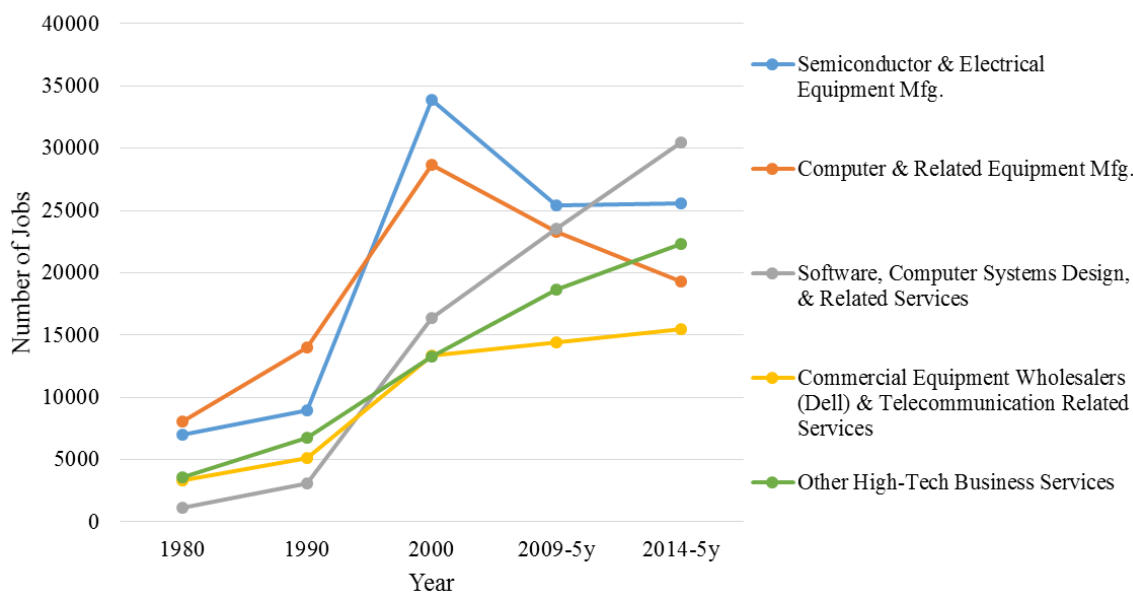
We also expanded the high-tech services sector to accommodate the unique situation of Dell Inc. Dell Computer Corporation prospered by focusing on two aspects of the computer business: direct sales and build-to-order production. To account for its employment in direct sales and manufacturing, this report analyzed full-time employment data for the commercial wholesalers and telecommunication related services sector as well as for the computer manufacturing sector. Moreover, the growth of other high-tech business sectors—engineering, architecture, and survey services; management and public relation services; and R&D services—has been very strong, so we added full-time employment trends in this sector to our analysis. These five high-tech sectors

account for the bulk of full-time employment in the city. Four ICT sectors (semiconductor chips and machinery manufacturing, computers, software and computer design, and commercial equipment wholesalers) accounted for about 59 percent, other high-tech business services accounted for 14 percent, and the remaining high-tech industries accounted for only 26 percent of full-time employment in the overall high-tech industry employment in the city in the 2014 5-year period.

Figure 4 shows Austin’s full-time employment in five ICT sectors. Semiconductor manufacturing and design and computer manufacturing dominated the high-tech job market before the 2000 dot-com bust when Motorola and Dell Computer were the two largest private employers. The software industry generated relatively fewer full-time job opportunities during this period. In contrast, full-time employment in the software industry grew rapidly after the dot-com bust, as well as in wholesale computer services dominated by the extraordinary growth of Dell Inc., but in a reversal of fortune, the semiconductor and computer manufacturing sectors experienced large employment losses.

Figure 4

Number of jobs in five high-tech, ICT sectors in the Austin MSA, 1980 to 2014



Source: Authors’ calculations using the U.S. Census with 5% samples in 1980, 1990, and 2000 and the ACS with 5-year aggregated samples in 2009 (1% samples 2005 to 2009) and 2014 (1% samples 2010 to 2014) from IPUMS (Ruggles et al., 2015).

Notes: Sample includes full-time, non-self-employed workers living in the Austin MSA. Full-time defined as working at least 35 hours per week for at least 14 weeks in the year surveyed. See Appendix B for definition of ICT sectors.

As we discuss next, the extraordinary growth of the Austin cluster of large ICT high-tech firms coincides with the development of a vibrant entrepreneurial ecosystem that moved the city toward the top ranks of entrepreneurial activity among U.S. metropolitan areas. In contrast to the development of the high-tech industry in Austin in general, there is little documentation of which factors and events led Austin to develop a vibrant entrepreneurial ecosystem, or of the possible linkages between the parallel events.

Austin's Vibrant Entrepreneurial Ecosystem

Guzman and Stern (2016) noted that a practical requirement for any growth-oriented entrepreneur is business registration—as a corporation, partnership, or limited liability company.⁸ As they explained it, although it is possible to found a new business without registration (e.g., sole proprietorship), the benefits of registration are substantial. These include limiting liability, tax benefits, and the ability to issue and trade ownership shares. Limited liability companies must register with a secretary of state in order to take advantage of these benefits, as the act of registering the firm triggers the legal creation of the company. Therefore, the business registration records reflect the population of businesses that adopt a form that is a practical prerequisite for growth.

Following the work of Guzman and Stern (2015a, 2015b, 2016), we used business registration records from the Texas Secretary of State to show that aggregate entrepreneurial activity in Austin sped up significantly in the 1990s.⁹ Our analysis draws on the complete population of firms satisfying one of the following conditions: (a) a for-profit firm in the Austin–Round Rock MSA jurisdiction or (b) a for-profit firm whose jurisdiction is in Delaware, but whose principal office address is in Austin. In other words, our analysis excludes non-profit organizations and companies whose primary location is not Austin. The resulting database contains 219,007 observations for the period 1960 to 2016.¹⁰

⁸ Business registration records are public records created endogenously when an individual registers a new business as a corporation, LLC, or partnership. We included businesses founded in Austin but registered in Delaware to facilitate equity financing. External investors often prefer to invest in firms governed under Delaware law.

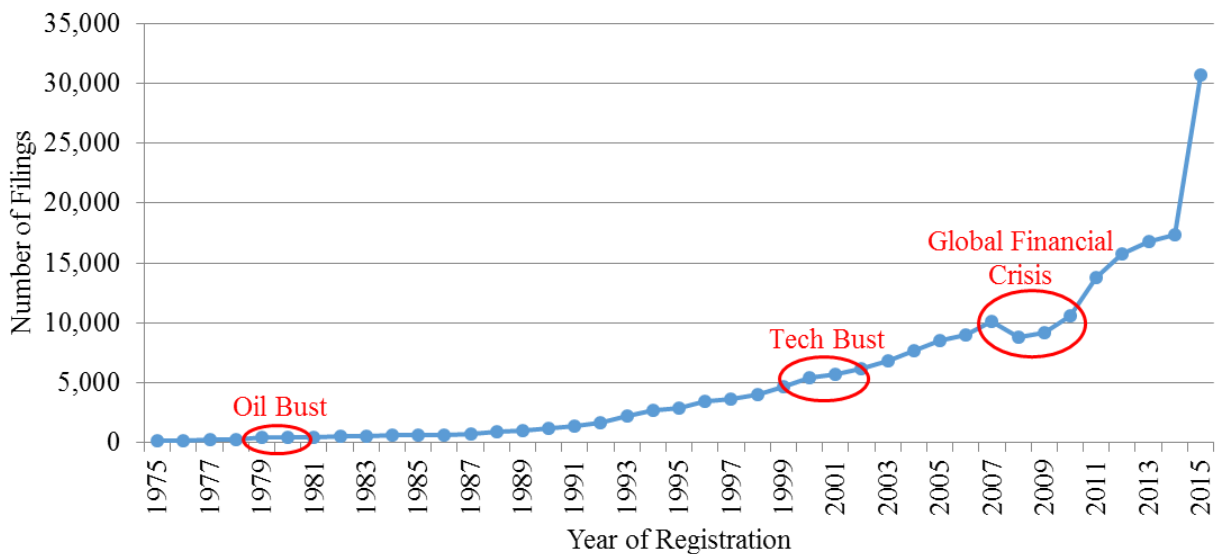
⁹ Guzman and Stern (2015a, 2015b, and 2016) provide a rich and detailed overview of this data set in the data appendix of their publications.

¹⁰ Guzman and Stern (2016) find that corporations are more likely to grow than startups organized under other legal structures, and firms registered under Delaware jurisdiction (instead of the local jurisdiction) are also more likely to grow.

Figure 5 shows a rise of entrepreneurial potential that started in the 1980s and accelerated in the 1990s through the year 2000, with a drop between 2000 and 2001 during the dot-com bust. However, the level observed during the 2000s through 2008 is consistently higher than the level observed during the first half of the 1990s. After a decline during the Great Recession (2008 and 2009), we observed a sharp upward swing starting in 2010. Austin’s entrepreneurial trends have followed a cyclical pattern that appears sensitive to the capital market environment and overall market conditions.¹¹ Specifically, our business registration data show there has been a steep rise in overall (tech and non-tech) entrepreneurial activity over the past several years, with a significant spike in the 2014-2015-year period, the peak of the recent dot-com boom.¹² The year 2015 shows the highest level ever registered —30,000 versus the previous peak of 17,345 in 2014.

Figure 5

Number of registration filings with the Texas Secretary of State, 1975 to 2015



Source: Authors’ calculations using data from the Texas Secretary of State.

Notes: Sample includes for-profit entities within Austin MSA jurisdiction and for-profit entities within Delaware jurisdiction and principal addresses with an Austin MSA zip-code (see Appendix C).

¹¹ These broad patterns closely agree with the patterns Guzman and Stern (2016) found for U.S. average entrepreneurial activity and for Massachusetts (Guzman and Stern 2015b).

¹² Guzman and Stern (2016) find a similar average spike of entrepreneurial activity in 2014 based on a sample of 15 U.S. states. They argue that the recent “explosion” of start-up activity over the past half-decade may be, in part, the result of levels of venture capital investment not observed since the late 1990s.

Parallel to this process has been the spike in venture capital invested in the city since 2014. Hawkins (2016) reported that the flow of venture capital into Central Texas surged in 2015. A total of 99 Austin-area deals received \$740 million that year, the largest annual dollar figure for investment in Austin since 2001, when 127 companies received \$1.14 billion. A key question is then is what other forces explain the growth of Austin's entrepreneurial ecosystem starting in the early 1990s?

What Factors Explained Austin's Entrepreneurial Trends?

In this section, we explain three factors leading Austin to become a high-tech entrepreneurial hub: corporate-spawning cascade effects, immigration of entrepreneurial talent, and adaptive local organizations.

Spawning Cascade Effects

Most empirical evidence for other high-tech regions¹³ shows that large technology firms can act as corporate incubators and have significant impact by spawning founders and top executives of successful local startups. Similarly, these locally founded startups can have important entrepreneurial cascade effects by being a downstream source of more founders. We document this trend by studying the family tree of founders from Tivoli, a local independent startup from 1989 to 1996. Robert Adams, who has been involved in the software industry in Austin since 2000 and is director of the Austin Labs at McCombs School of Business, defined Tivoli as the “big bang” of the software industry in Austin.¹⁴ Tivoli was founded in 1989 by former IBM employees Robert Fabbio, Steve Marcie, Todd Smith, and Peter Valdez. The company completed an initial public offering in 1995, one year before IBM acquired it for \$743 million. Tivoli's family tree,

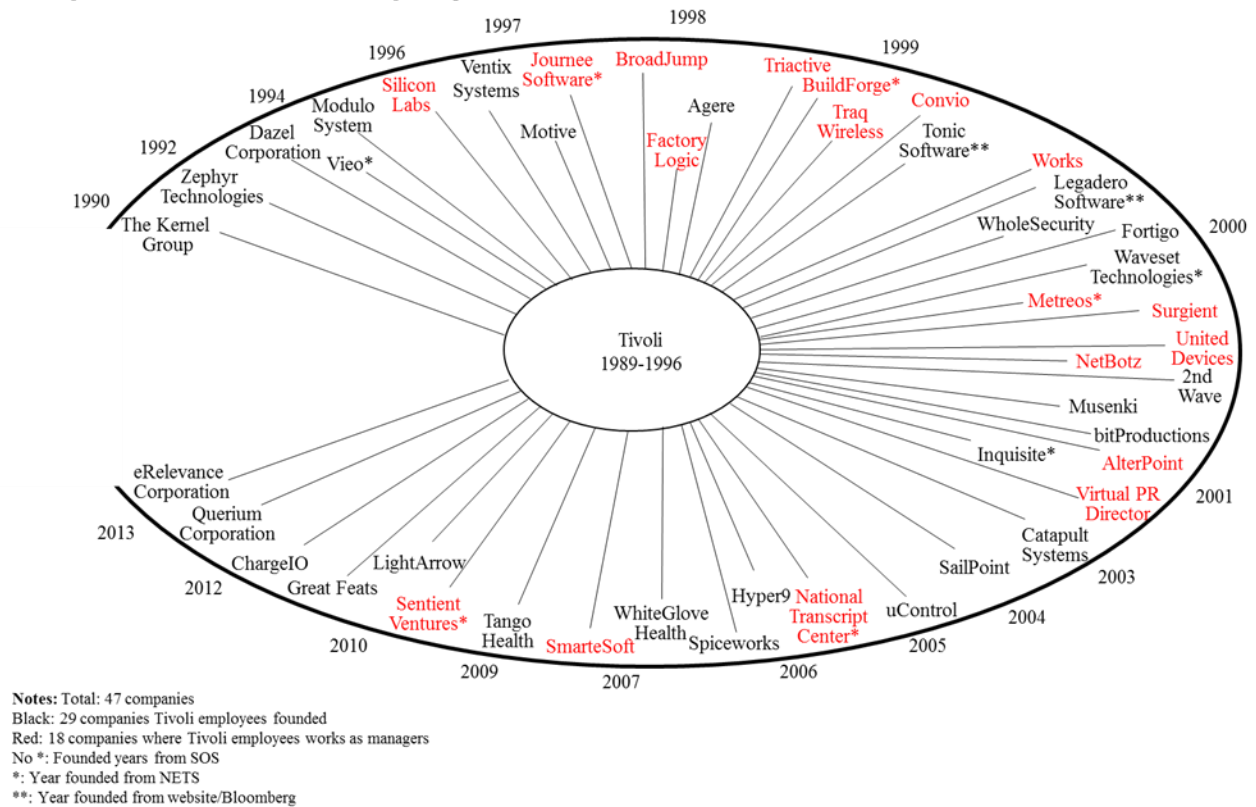
¹³ Spawning of new startups from large corporations has been fundamental in the development of the entrepreneurial ecosystem in Silicon Valley (Gompers, Lerner, and Scharfstein 2005, Lerner 2009) and the Research Triangle (Avnimelech and Feldman 2010a, 2010b).

¹⁴ Interviewed on June 29 at McCombs School of Business.

startups created or managed by ex-Tivoli employees, is a great example of local corporate-spawning cascade effects.

Tivoli operated as an independent startup for just seven years, but the company's legacy remains a significant part of the city's entrepreneurial landscape. The company produced a group of entrepreneurs who have been able to launch or operate at least 29 startups in Austin. Using data from LinkedIn, Figure 6 shows that the effect of Tivoli employees on Austin's entrepreneurial ecosystem extended through 2013. What is more intriguing is how successful many of these companies have been, as evidenced by the fact that only three of the 29 companies were not acquired or recipients of outside funding. Indeed, most of these spin out companies were acquired by large corporations—including Lucent Technologies, Sun Microsystems, and SolarWinds—or were able to raise funding from venture capital firms or angel investors. The Tivoli startup was also an important source of top managers for 27 startups, highlighted in red in the figure. Most of the literature focuses on the spawning of company founders from large corporations; Tivoli is evidence that startups are also an important downstream source of startups' founders and managers.

Figure 6
Tivoli spinoffs in Austin and their founders or top managers, 1990 to 2013



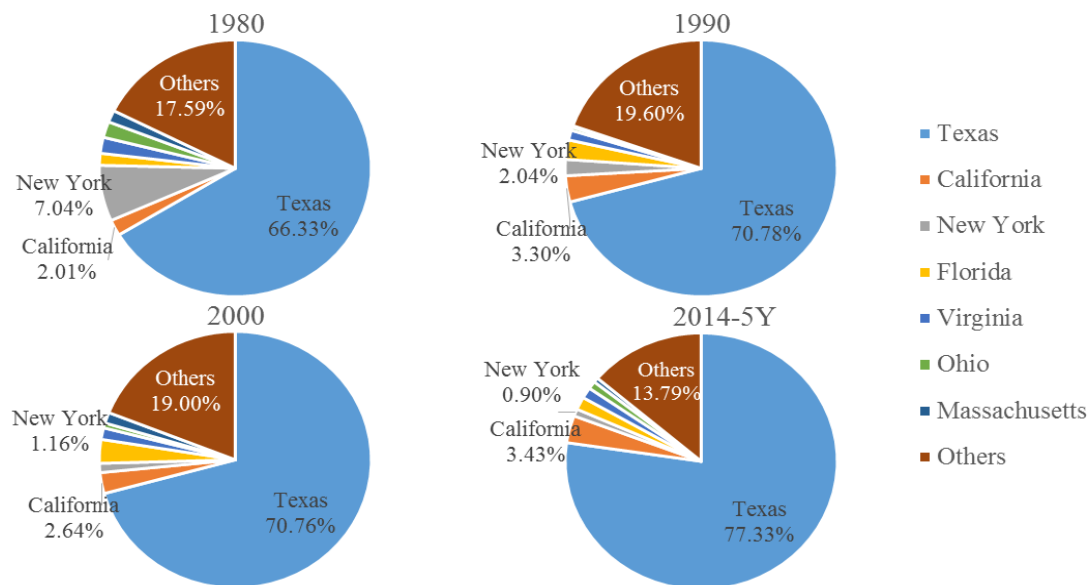
Immigration of Entrepreneurial Talent

Irwin and Klenon (1992) noted that, of the 400 technical employees of Sematech, about 220 were assignees from member firms who stayed at Sematech's facility in Austin from six to 30 months. MCC and Sematech brought many talented workers to the city that were assigned temporarily to Austin and many ultimately stayed in the city. A 1991 General Accounting Office study found that Sematech technology was disseminated more easily through person-to-person interaction and argued that the assignee program of sending personnel to Austin was very helpful in promoting knowledge externalities. Although the location of Sematech and MCC raised the floor of the talent market, Austin's entrepreneurial success after the location of the research consortia has been mainly tied to the continuous migration of talent, mostly from other cities in Texas and Silicon Valley. Indeed, the capacity to attract and retain an abundance of educated and skilled people led Powers (2004) to call Austin the "human capital city."

In most academic studies, high-tech industries are defined as those with a large proportion of technology oriented workers (TOWs; see detailed definition in Appendix A). Therefore, the ability to attract TOWs to Austin is an important determinant of the growth of the local high-tech economy. Figure 7 shows domestic migration of TOWs to the Austin metropolitan area from different states. Data are from the decennial Census and the American Community Survey for years since 1980. Two features are noticeable. First, more than 70 percent of skilled workers who migrated to Austin in the five years prior to both 1990 and 2000, and the average percentage of TOWs who migrated in the 2014 5-year period migrated from within Texas. The second important feature is that, although skilled workers migrated from many states, California (home to Silicon Valley) has consistently been the top source of skilled workers since 1990; perhaps an indication of the increasing integration of Silicon Valley and Austin as the two regions progressively specialize in similar ICT sectors.

Figure 7

Domestic migration of tech-oriented workers to the Austin MSA, 1980 to 2014



Source: Authors' calculations using the U.S. Census with 5% samples in 1980, 1990, and 2000 and the ACS with a 5-year aggregated sample in 2014 (1% samples 2010 to 2014) from IPUMS (Ruggles et al., 2015).

Notes: Sample includes full-time, non-self-employed) technology-oriented workers living in the Austin MSA who moved to Austin 5 years ago (1980, 1990, 2000) or 1 year ago (2014-5y). Technology-oriented workers include occupations defined by Hecker (2005). Full-time defined as working at least 35 hours per week for at least 14 weeks in the year surveyed.

The relative importance of other cities in Texas and California as sources of talent for local large firms and startups is not surprising for several reasons. First, Houston and Dallas are not only

two of the largest metropolitan areas in the United States, but also have important clusters of high-tech industries. These two metropolitan areas are also closer to Austin than any other major U.S. high-tech city. Second, Austin's industrial linkages with Silicon Valley are legendary. An indicator of linkages between Silicon Valley and Austin is the increasing availability of direct flights between the two regions (Echeverri-Carroll and Brennan 1999). Echeverri-Carroll and Ayala (2004) note that American Airlines (AA) made news in the fall of 1992 when it initiated direct flights from Austin to San Jose. These direct flights, which became known as "nerd birds," numbered three per day in 2004 and claimed the highest laptop-per-passenger ratio in the airline industry. It also became the most profitable direct flight route for AA in the 1990s.¹⁵

Adaptive Institutions— the Case of the Austin Greater Chamber of Commerce

Following Lerner (2009), we believe institutions, such as the Greater Austin Chamber of Commerce (GACC), can play *implicit* and *explicit* roles in the growth of local entrepreneurial activity. Institutions implicitly contribute to entrepreneurship when they participate with other institutions in building an environment where new ventures can thrive (e.g. commissioning economic development plans that identify infrastructure or institutional gaps) and *explicitly* when they directly invest in entrepreneurial-focused programs and activities (e.g. programs to support incubators). When accounting for both types of contributions, we find that the GACC has been one of the most important institutions in the birth and growth of Austin's entrepreneurial ecosystem.

The GACC began in 1877 as the Board of Trade, changing its name to the Chamber of Commerce in 1914, and to the Greater Austin Chamber of Commerce in 1987 to reflect its larger regional role in catalyzing economic activity. The temporal endurance of this institution and its ability to change in sync with the fluctuations of Austin's high-tech economy has significantly contributed to the sustainability of local entrepreneurial vibrancy. The GACC's implicit contributions to the dynamism of the local entrepreneurial system are associated with its active participation in groups involved in the development of the ICT cluster of large branch plants in

¹⁵ Interview with Glenn West.

Austin and in seeding early entrepreneurial support institutions. In contrast, its more focused attention toward the Austin startup scene is relatively more recent.

Austin's efforts to attract MCC and Sematech were led by the Governor's office, university leaders, and significantly aided by the Chamber.¹⁶ According to Glenn West, the belief was that the location of these two research consortia in Austin would greatly enhance opportunities for local spinoffs. In his words:

this [the possible creation of spinoffs] was greatly enhanced by MCC and Sematech, both of which were staffed one third by transferees from member companies that were assigned here for 1 to 3 years and then [supposed] go back to Minnesota, California, New York, [etc.,] but decided to start their own entrepreneurial endeavors.

More important, however, were the facts that winning these two research consortia allowed the Chamber to adopt a leadership role in attracting large branch plants of high-tech firms, especially from California, a process that reinforced the spawning of startup founders that will develop over the years. In Glenn West's words:

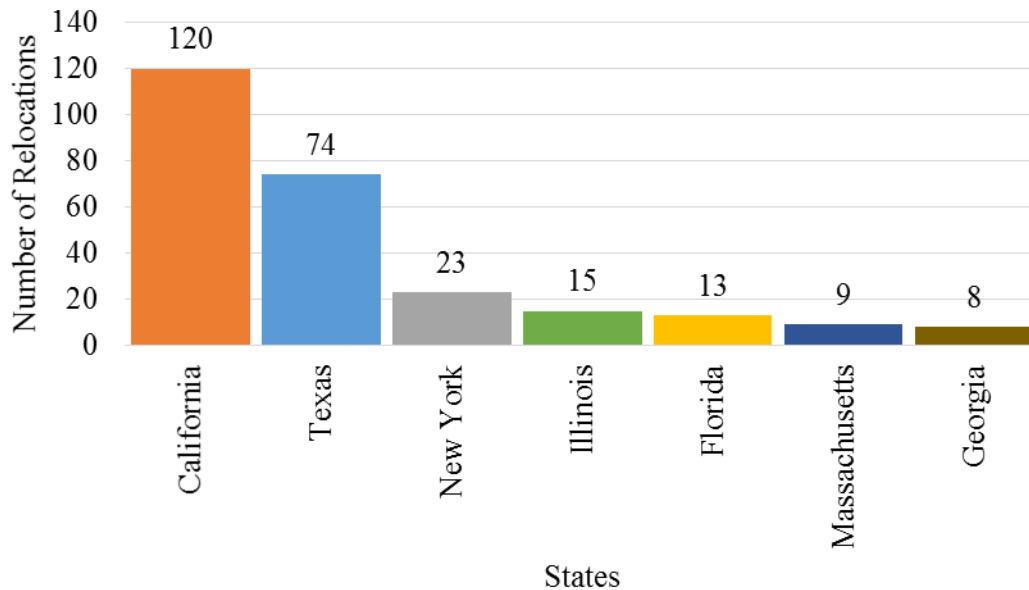
Once we [Austin] have both MCC and Sematech, the ability to call on Californian companies changed radically. After MCC and Sematech, when the Chamber called the CEOs of Californian companies they said, "I've never been to Austin, Texas. I don't think I can place it on a map. But how in the world did you get MCC and Sematech? I want to hear the story." We have a lot of success with Californian companies. We went through a period in the 1990s in which we were probably attracting 25 to 40 California companies a year. On top of that were the companies already here that were expanding.

According to some estimates, the Chamber spent at least \$20 million on industrial recruitment between 1960 and 2003 (Robinson 2003). Relocations, mainly from California, continue to be an important activity of the GACC today under the leadership of Mike Rollins, the Chamber's President since 2003. Figure 8 shows that the relocation of companies mainly from California continue to be an important component of the Chamber's objectives under his leadership.

¹⁶ Interview with Glenn West, CEO of the GACC from 1987 to 1999.

Figure 8

Top company relocations to Austin by state of origin, 2004 to 2015



Source: Adapted from Austin Chamber (2015) “Opportunity Austin 3.0: Moving Momentum Forward, Regional Economic Development Game Plan.”

Notes: An additional 44 international and 99 other domestic relocations for a total of 405 relocations occurred between 2004 and 2015.

The Chamber also played an important role in the development of the ICT-based high-tech economy through the commission of several economic development plans that were fundamental in two ways. First, the early commissioned plans, conducted by the IC² Institute and Stanford Research Institute (SRI), identified the need to diversify the local economy beyond university- and government-based economic activities to include high-tech sectors, particularly the electronics industry. Second, the most recent plans, Opportunity Austin 1, 2, and 3, identified the need to further diversify the Region’s economy from high-tech manufacturing, semiconductors and computers, to software development (see Table A1 in Appendix D).

During the beginning of the high-tech economy in the 1980s and during its take off period in the 1990s, the Chamber’s contribution to Austin’s entrepreneurial ecosystem was mainly implicit through its participation in the inter-institutional efforts to win Sematech and MCC and attracting branch parts of large high-tech firms. In Glenn West’s words:

George Kozmetsky¹⁷ knew about [entrepreneurship], but the rest of us did not fully understand it. While we were out chasing companies, George was putting in place all the support infrastructure for entrepreneurship: the capital area network, a computerized data service for investors and entrepreneurs, the Austin Technology Incubator, [and] the Austin Software Council).

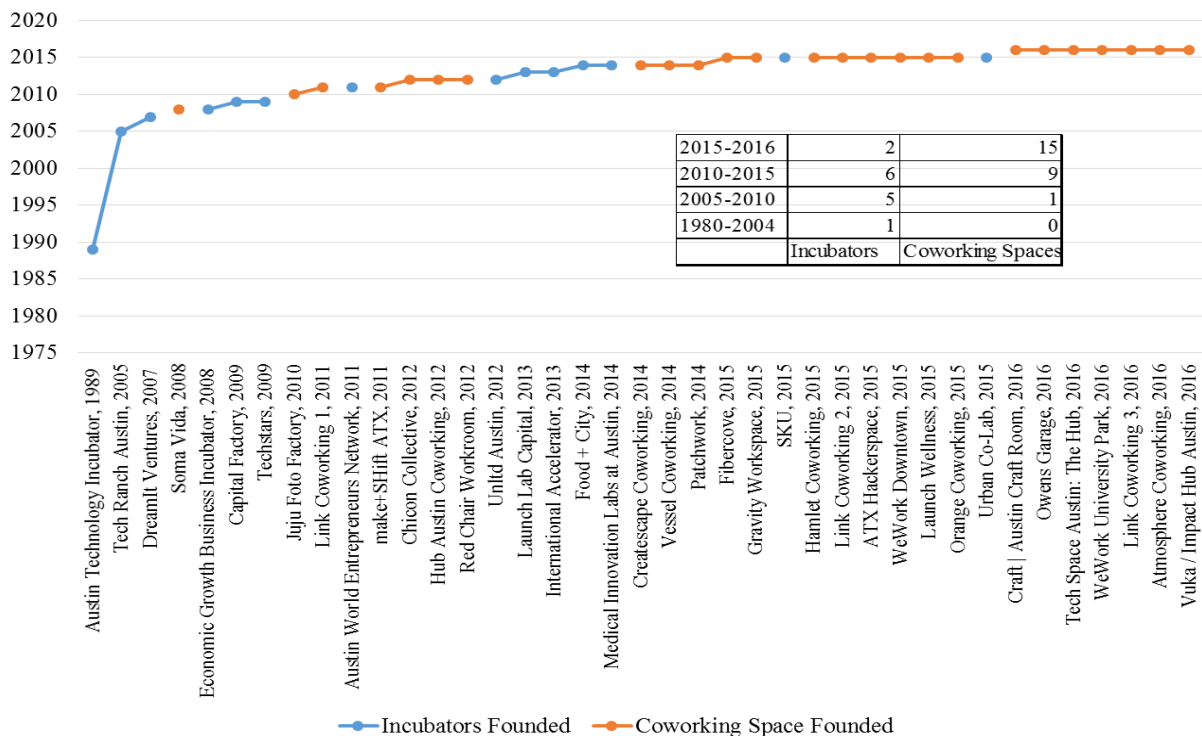
While the GACC was an early investor in the Austin Technology Incubator, only in later years did the Chamber combine its traditional business retention and expansion activities with more explicit entrepreneurial activities. We would like to emphasize one activity because of the significance it has for the entrepreneurial ecosystem today. The Chamber identified an important gap in the Austin entrepreneurial ecosystem in 2012: the need for accelerators and co-working spaces. These were successful in high-tech larger cities, like New York, by attracting and enabling millennials who were graduating from school and wanted to work in collaboration with others.¹⁸ It put together a RFQ and got 4 or 5 respondents, including Capital Factory, who had a small presence in Austin since 2009. The Chamber signed a MOU outlining their promotion of the accelerator and what CF would do in return. Capital Factory moved into the 16th floor of the Omni Hotel. This was the first bold step of the most important business accelerator in Austin today and the explosion of co-working spaces as shown in Figure 9.

¹⁷ George Kozmetsky, a co-founder of Teledyne in the Silicon Valley, moved to Austin to become the Dean of the Business School at UT-Austin. During this period, he founded the IC² Institute in 1977, a think-and-do-tank to study and implement entrepreneurship, as well many other institutions to support the entrepreneurial ecosystem.

¹⁸ Interview with Mike Rollins.

Figure 9

Founding dates of innovation and collaboration spaces in Austin



Source: Authors' survey of accelerators and incubators in Austin conducted in 2016.

Conclusions

The Austin–Round Rock metropolitan area was ranked first in 2015 and second in 2014 by the Kauffman Foundation for startup density among the largest U.S. metropolitan areas. There is little scientific documentation of the factors that led Austin to become a vibrant entrepreneurial city. The main objective of this report is to fill this void by presenting reliable data on longitudinal entrepreneurial activity in the city and advancing three hypotheses on the factors that explain the accelerated growth of locally founded startups since 1990.

We start by documenting the transformation of Austin from a university- and government-based economy to a top-ranked high-tech city noting that most of the high-tech activity is within four core ICT sectors—semiconductor manufacturing, semiconductor machinery manufacturing, computer manufacturing, and software. We then summarize the main events that led this economic transformation, highlighting Austin's successful bid for two of the first and largest U.S. research

consortia—Sematech and MCC—and the enduring civic capacity to attract branch plants and talent from other high-tech cities in Texas and Silicon Valley.

We find that branch plants of technology firms that locate in Austin have benefited from co-agglomeration economies associated with knowledge spillovers favored by the vertical disintegration of the computer industry in four ICT sectors which still have strong innovation linkages and by their need for similar labor skills and local services. Feldman (2014) proposes turning the agglomeration question, which focuses on the co-location benefits to firms, on its head by asking *how the actions of firms affect the places in which they are located*. As she observed, the effect of the actions of firms is a notably missing piece of the puzzle in the consideration of regional economies. We find and document with data and interviews that spawning cascading effects from large firms and the implicit and explicit activities of local institutions, such as the Greater Austin Chamber of Commerce, have transformed the Austin economy from a co-agglomeration of large homegrown and imported ICT firms into a highly-ranked entrepreneurial economy.

Data from the Texas Secretary of State show a rise of entrepreneurial potential that started in the 1980s and accelerated in the 1990s through the year 2000, with a drop between 2000 and 2001 during the dot-com bust. After a decline during the Great Recession (2008 and 2009), we observed a sharp upward swing starting in 2010. There has been a steep rise in entrepreneurial potential over the past several years, with a significant spike in 2014 5-year period, the peak of the recent dot-com boom. The year 2015 shows the highest level ever registered —30,000 versus the previous peak of 17,345 in 2014. What factor explain the vibrancy of Austin entrepreneurial activity since the 1990s?

We argue that corporate-spawning cascade effects have been crucial for the growth of the region's entrepreneurial ecosystem. Austin's high-tech economy has generated a cluster of startup founders, as is the case of Tivoli, started in 1989 by three IBM engineers. We document the family tree of successful startups created by Tivoli engineers and scientists through 2013. The immigration of technology-oriented workers has been another important factor for the growth of both large-technology branch plants and the spawning of startups in Austin. The Austin entrepreneurial ecosystem has also benefited from institutions such as the Greater Austin Chamber of Commerce, whose long-term commitment to attract technology companies to Austin has been

the seed for cascading entrepreneurial effects. Its more recent efforts to directly target local entrepreneurs, such as its support of Capital factory, have been also important. The local entrepreneurial economy has also benefited from the vision of local influencers like George Kozmetsky, who was instrumental in creating a set of enduring support institutions, such as the Austin Technology Incubator, and building transformational connections in the local entrepreneurial ecosystem.

We will focus in the near future on two major tasks. First, we will compare entrepreneurial data from the Texas Secretary of State with similar data from the National Establishments Time Series (NETS) data we recently acquired. This will require familiarization with fuzzy matching using the SAS statistical package. The benefit of this exercise will be to allow the study of entrepreneurial trends sorted by industrial sector that Texas Secretary of State data does not allow us to do. The second task is to expand our study of the institutional ecosystems and their implicit and explicit contributions to Austin's entrepreneurial ecosystem, in particular, we want to expand our archival work for the contribution of the GACC and conduct a similar exercise for three other institutions that have been consistently mentioned in our interviews: UT-Austin's computer science department, the Central Texas Angel Network (CTAN), the Austin Area Research Organization (AARO), the Austin Technology Incubator (ATI), and the Austin Software Council (now the Austin Technology Council —(ATC)). Finally, we will continue working with Maryann Feldman and her team in a comparative study of the software industry in the Research Triangle and Austin.

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Appendix

A. High-Technology Industries and Technology Oriented Workers (TOW) Definitions

As Hecker (1999, 2005) points out, there is no single definition of high-technology industries (or firms); however, there is wide agreement on their general characteristics. In particular, he cites a report from the Office of Technology Policy (1982) describing high-technology firms as those engaged in the design, development, and introduction of new products or innovative manufacturing processes through the systematic application of scientific and technical knowledge. To classify industries by their relative innovativeness, studies have used a large variety of proxies for innovation (Chapple et al. 2004). In most academic studies, high-tech industries are those with a large proportion of workers in scientific, technical, or technology-oriented occupations (TOWs) (Hadlock et al. 1991, Hecker 1999, 2005, Luker and Lyons 1997; Markusen et al. 1986, Yu 2004). These studies define four Standard Occupational Categories as technology-oriented: engineers, life and physical scientists, computer professionals and mathematicians (except actuaries), and engineering, computer, and scientific managers. Workers in these occupations need in-depth knowledge of theories and principles of science, engineering, and mathematics (Hecker 1999, 2005). Such knowledge is generally acquired through specialized post-high school education, ranging from an associate degree to a doctorate, in some field of technology. In this paper, we used Hecker's (2005) definition of high-tech industries and crosswalked his 46 2002 high-tech NAICS codes with the 32 time-consistent IND1990 codes in IPUMS.¹⁹ As noted by Decker et al (2015), Hecker's definition of high-tech industries has become standard in the literature.

¹⁹ Hecker (2005) classified 46 of the 2002 4-digit NAICS codes as high-tech industries. High-technology industries are technology-oriented-worker (TOW) intensive (having at least twice the national average of 9.81 percent of TOWs). Echeverri-Carroll et al. (2015) present a detailed explanation of the crosswalk between Hecker's 46 TOW-intensive high-tech 2002 NAICS codes and the mostly three-digit 32 IND1990 codes in the IPUMS to find consistent high-tech industries for all censuses and ACS samples.

B. NAICS Codes that Define the ICT Sectors

Our definition of ICT sectors is a subset of the 46 high-technology four-digit 2002 NAICS industries defined in Hecker (2005). These five ICT sectors are explicitly defined by the following 69 six-digit 2012 NAICS industries:

IT Sector Title	2012 NAICS code	2012 NAICS Industry	4-Digit
Semiconductor & Electrical Equipment Manufacturing	Semiconductor Machinery Manufacturing	333242	3332
	Bare Printed Circuit Board Manufacturing	334412	3344
	Semiconductor and Related Device Manufacturing	334413	
	Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing	334416	
	Electronic Connector Manufacturing	334417	
	Printed Circuit Assembly (Electronic Assembly) Manufacturing	334418	
	Other Electronic Component Manufacturing	334419	3346
	Blank Magnetic and Optical Recording Media Manufacturing	334613	
	Software and Other Prerecorded Compact Disc, Tape, and Record Reproducing	334614	
	Power, Distribution, and Specialty Transformer Manufacturing	335311	3353
	Motor and Generator Manufacturing	335312	
	Switchgear and Switchboard Apparatus Manufacturing	335313	
	Relay and Industrial Control Manufacturing	335314	3359
	Storage Battery Manufacturing	335911	
	Primary Battery Manufacturing	335912	
	Fiber Optic Cable Manufacturing	335921	
	Other Communication and Energy Wire Manufacturing	335929	
	Current-Carrying Wiring Device Manufacturing	335931	
	Noncurrent-Carrying Wiring Device Manufacturing	335932	
	Carbon and Graphite Product Manufacturing	335991	
	All Other Miscellaneous Electrical Equipment and Component Manufacturing	335999	
Computer & Related Equipment Manufacturing	Electronic Computer Manufacturing	334111	3341
	Computer Storage Device Manufacturing	334112	
	Computer Terminal and Other Computer Peripheral Equipment Manufacturing	334118	3333
	Optical Instrument and Lens Manufacturing	333314	
	Telephone Apparatus Manufacturing	334210	3342
	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	334220	
	Other Communications Equipment Manufacturing	334290	3343
	Audio and Video Equipment Manufacturing	334310	
	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	334513	3345
	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals	334515	
	Other Measuring and Controlling Device Manufacturing	334519	
Software, Computer Systems Design, & Related Services	Software Publishers	511210	5112
	Custom Computer Programming Services	541511	5415
	Computer Systems Design Services	541512	
	Computer Facilities Management Services	541513	
	Other Computer Related Services	541519	
	Data Processing, Hosting, and Related Services	518210	5182
Commercial Equipment Wholesalers & Telecommunication Related Services	Photographic Equipment and Supplies Merchant Wholesalers	423410	4234
	Office Equipment Merchant Wholesalers	423420	
	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers	423430	
	Other Commercial Equipment Merchant Wholesalers	423440	
	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	423450	
	Ophthalmic Goods Merchant Wholesalers	423460	
	Other Professional Equipment and Supplies Merchant Wholesalers	423490	
	Wired Telecommunications Carriers	517110	5171
	Wireless Telecommunication Carriers (Except Satellite)	517210	5172
	Satellite Telecommunications	517410	5174
	Telecommunications Resellers	517911	5179
	All Other Telecommunications	517919	5191
	Internet Publishing and Broadcasting and Web Search Portals	519130	
Other High-Tech Business Services	Architectural Services	541310	5413
	Landscape Architectural Services	541320	
	Engineering Services	541330	
	Drafting Services	541340	
	Building Inspection Services	541350	
	Geophysical Surveying and Mapping Services	541360	
	Surveying and Mapping (except Geophysical) Services	541370	
	Testing Laboratories	541380	
	Administrative Management and General Management Consulting Services	541611	5416
	Human Resources Consulting Services	541612	
	Marketing Consulting Services	541613	
	Process, Physical Distribution, and Logistics Consulting Services	541614	
	Other Management Consulting Services	541618	
	Environmental Consulting Services	541620	5417
	Other Scientific and Technical Consulting Services	541690	
	Research and Development in Biotechnology	541711	
	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	541712	
	Research and Development in the Social Sciences and Humanities	541720	
Total		69	22

The 69 six-digit NAICS codes correspond to 22 four-digit NAICS codes that are included in Hecker's (2005) high-tech NAICS codes. The categorization of the software sector comes from definitions in Osman (2015), Spigel (2013), Bessen and Hunt (2007), Rosenthal and Strange (2006), and Saxenian (1994). The categorization of the other four sectors is based on Osman (2015) and table A1 from Kauffman Foundation report number one, *A Tale of Two Innovative Entrepreneurial Regions: The Research Triangle and Austin*.

C. ZIP Codes That Define the Austin–Round Rock MSA

The following 135 ZIP codes define the Austin–Round Rock MSA, which comprises Bastrop, Caldwell, Hays, Travis, and Williamson counties. The ZIP code to MSA (or CBSA) crosswalk is taken from the U.S. Department of Housing and Urban Development (HUD: https://www.huduser.gov/portal/datasets/usps_crosswalk.html). The geographical county composition of the Austin–Round Rock MSA did not change in 2000 or 2013 (Geffen 2003, Texas Workforce Commission).

78602, 78612, 78616, 78617, 78621, 78650, 78653, 78659, 78662, 78941, 78942, 78953, 78957, 78959, 78610, 78616, 78622, 78632, 78640, 78644, 78648, 78655, 78656, 78661, 78662, 78666, 78953, 78959, 78130, 78610, 78619, 78620, 78623, 78640, 78652, 78656, 78663, 78666, 78667, 78676, 78736, 78737, 78738, 73301, 76574, 78610, 78612, 78613, 78615, 78617, 78620, 78621, 78634, 78640, 78641, 78642, 78645, 78652, 78653, 78654, 78660, 78663, 78664, 78669, 78691, 78701, 78702, 78703, 78704, 78705, 78708, 78709, 78710, 78711, 78712, 78713, 78714, 78715, 78716, 78718, 78719, 78720, 78721, 78722, 78723, 78724, 78725, 78726, 78727, 78728, 78729, 78730, 78731, 78732, 78733, 78734, 78735, 78736, 78737, 78738, 78739, 78741, 78742, 78744, 78745, 78746, 78747, 78748, 78749, 78750, 78751, 78752, 78753, 78754, 78755, 78756, 78757, 78758, 78759, 78760, 78761, 78762, 78763, 78764, 78765, 78766, 78767, 78768, 78772, 78774, 78778, 78779, 78799, 76511, 76527, 76530, 76537, 76573, 76574, 76577, 76578, 78605, 78613, 78615, 78621, 78626, 78627, 78628, 78630, 78633, 78634, 78641, 78642, 78646, 78660, 78664, 78665, 78673, 78674, 78680, 78681, 78682, 78683, 78717, 78727, 78728, 78729, 78750, 78759.

D. Table A1: Summary of Austin’s economic development plans

Year	Strategic Planning Document	Author	Key Recommendations
1985	<i>Creating an Opportunity Economy: Enhancing Quality of Life in a Changing Community</i>	Stanford Research Institute (SRI), Public Policy Center	1. Leverage emerging local R&D base in research institutions (MCC), the university at large, and technology companies to diversify—especially into software; 2. More focus on SMEs and entrepreneurial development; 3. Maintain and promote high quality of life; 4. Strive to make growth more inclusive for women and minorities.
1991	<i>The Austin Technology-Based Industry Report</i>	IC2 Institute, et al.	1. Continue to focus on software sectors as large and growing segments of Austin’s tech economy; 2. Increase focus and investment on vocational and technical education related to tech workforce; 3. Sharpen focus on high-quality general public services and quality of life.
1998	<i>The Next Century Economy Report</i>	Greater Austin Chamber of Commerce	1. Region should focus on supporting key technology cluster (microelectronics, computing, and software), but should also pursue diversification in new related sectors; 2. Continued focus on building local, public and, private R&D base; 3. Aggressive development of financial access, professional service, and support for entrepreneurial firms; 4. Greater investment in education (K-12 through higher education) to expand local technical workforce.
2003	<i>Opportunity Austin 1.0</i>	Market Street Services	1. Continue to build and support key pillars of high-tech cluster, but diversify into new segments and promote “next wave” industries; 2. Focus aggressively on expanding the base of small and entrepreneurial businesses; 3. Upgrade R&D investment and technology transfer mechanisms; 4. Focus on international exports and trade relationships for local firms.
2007	<i>Opportunity Austin 2.0</i>	Market Street Services	1. Expand target industries to include “convergent” technology sectors; 2. Improve capacity and coordination of small businesses, entrepreneurs, and technology commercialization services; 3. Refine and enhance business retention and attraction efforts; 4. Better leverage regional higher education and community college resources to expand R&D, commercialization, and skilled workforce development; 5. Expand focus and support for international trade relationships.
2012	<i>Opportunity Austin 3.0</i>	Market Street Services	1. Encourage high-value growth in Austin’s existing businesses both locally and internationally; 2. Develop the region’s emerging renewable energy, biomedical, and multi-media technology sectors; 3. Refine the startup support and commercialization sectors, especially through local universities, incubators, accelerators, and development capital; 4. Create an education-to-career pipeline by endowing students with talents vital to their growth and matching regional employers’ needs.