PitchBook

VC Ecosystems

Analysis of key indicators of US VC ecosystem development

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To supplement PitchBook analysis on venture investment activity, this report introduces a framework for deeper evaluation of venture ecosystems in the United States. Building extensively on existing industry research, we present three key indicators of ecosystem development: density, resources and talent. While this report is just a starting point for comparing factors of development, we hope to address the lack of data and research in private markets by providing readers a new lens with which to understand venture ecosystems.

Key takeaways

- **Few states have mature late-stage ecosystems.** Many smaller ecosystems have a healthy density of early-stage startups but lack a concentration of late-stage companies. While states with low late-stage density also have fewer exits, healthy early- and very early-stage vitals could indicate potential for growth.

- **Proximity to capital is expensive.** States with the most access to local capital ($2.5 million+ per venture-backed startup) also have higher costs of labor and housing relative to the national average. States with slightly less capital per startup (around $1 million per venture-backed startup) have costs closer to the mean, while regions with low values of local venture capital also have the lowest costs.

- **Entrepreneurial experience is relatively equal across states, but talent clusters.** Regarding local talent, the proportion of startup founders who previously founded another company hovers around 3%-5% in most states, indicating relative equality in entrepreneurial experience. Local talent retention is more variable, however. The proportion of startups with founders who studied at a four-year institution in-state appears to be strongest in regions with top-tier colleges and universities.

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Introduction

The factors most critical to a startup ecosystem's development have long been subject to discussion and debate. In "Regional Advantage," AnnaLee Saxenian asserts that cultural influences such as intellectual openness and collaboration played a key role in the divergence of development between Silicon Valley and Boston.[1] Further, in "Startup Communities," Brad Feld discusses entrepreneurial density, clusters of talent and leadership as crucial inputs in the development of entrepreneurial ecosystems.[2] Factors of development are important not just to investors, but also to local governments and business communities striving for a healthy business environment.

Beyond factors of ecosystem development, another point of debate is whether startups in well-developed venture ecosystems generate more attractive returns for investors. Some investors and entrepreneurs have argued that startups with more limited access to resources may be more capital efficient and exhibit lower burn rates. Critics assert that the lack of intellectual diversity in saturated ecosystems breeds entrepreneurs that address only problems with which they are familiar, overlooking market opportunities. To address these shortcomings, select VCs (e.g. Rise of the Rest, Elsewhere Partners) have adopted strategies that aim to source deals outside of the coastal venture hubs.

In this report, we investigate several factors that we believe to be indicators of venture ecosystem development, building extensively upon existing industry research.

Approach

Our approach builds on the entrepreneurial ecosystem framework developed by the Ewing Marion Kauffman Foundation.[3] This work asserts that the development of an entrepreneurial ecosystem is a product of density, fluidity, connectivity and diversity. While the Kauffman Foundation studies many types of entrepreneurship (Main Street, small business, etc.),[4] we focus specifically on high-growth, venture-backed startups and transform the structure of their ideas to more acutely measure venture ecosystems. To measure quantitative and qualitative factors in startup ecosystem development, we leverage PitchBook metrics and administrative data to analyze three indicators: density, resources and talent.

1: "Regional Advantage: Culture and Competition in Silicon Valley and Route 128," AnnaLee Saxenian, 1994
2: "Startup Communities: Building an Entrepreneurial Ecosystem in Your City," Brad Feld, 2012
3: "Measuring an Entrepreneurial Ecosystem," Kauffman Foundation Research Series on City, Metro, and Regional Entrepreneurship, Dane Stangler & Jordan Bell-Masterson, March 2015
4: "2017 Kauffman Index of Startup Activity: Metropolitan Area and City Trends," The Kauffmann Index, Arnobio Morelix, Robert Fairlie & Inara Tareque, May 2017

Links to tables:

The purpose of this research is to examine profiles of venture ecosystems by state, as measured by the variables below. In doing so, we aim to identify characteristics of ecosystems at different stages of development, using California, Illinois and Florida as case studies. Private markets generally lack transparency to identify cause and effect. While this report is just a starting point for comparing ecosystem factors to exit success, we hope to address the lack of data and research in private markets by providing readers a new lens to understand underlying factors that may impact ecosystem development and, subsequently, returns.

Indicator 1: Density

$$\textit{Very early-stage density} = \frac{\textit{\# of companies that received angel, seed, acc, inc financing in year t}}{\textit{state population (millions)}}$$

$$\textit{Early-stage density} = \frac{\textit{\# of companies that received early-stage VC financing in year t}}{\textit{state population (millions)}}$$

$$\textit{Late-stage density} = \frac{\textit{\# of companies that received late-stage VC financing in year t}}{\textit{state population (millions)}}$$

The term "entrepreneurial density" generally refers to the concentration of entrepreneurs (and related employees and students) in a geographic region, per population.[5] Researchers from the Kauffman Foundation note that measuring business concentration per population is helpful to compare "relative density of entrepreneurship" across regions, rather than volume of deals or capital invested alone.[6] Because we are interested in venture ecosystems, we measure density by assessing the number of businesses that have received venture funding by stage of funding. Isolating startup density throughout the venture lifecycle (very early, early and late stages) helps to illuminate the relative concentration of companies in an ecosystem.

These variables are standardized by dividing by state population (in millions) for comparison across regions. We view very early-stage (angel, seed, accelerator and incubator-stage companies) density as a leading indicator, because it is representative of new venture-backed startups in an ecosystem, which contribute to density in the long run should they survive.

5: "Entrepreneurial Density," Feld Thoughts, Brad Feld, August 23, 2010
6: "Measuring an Entrepreneurial Ecosystem," Kauffman Foundation Research Series on City, Metro, and Regional Entrepreneurship, Dane Stangler & Jordan Bell-Masterson, March 2015

Links to tables:

Developed venture ecosystems are known to have healthy deal activity across stages. That is, if a startup receives early-stage funding, they can also find late-stage funding to grow, scale and eventually exit. We find that most ecosystems have relatively healthy density of very early-stage companies (we provide further detail later on in this note on how the interaction of variables can provide more color here). Late-stage density, however, appears to be high only in well-developed ecosystems, like California and Massachusetts. While states with low late-stage density also have fewer exits, healthy early- and very early-stage vitals could indicate potential for growth.

Indicator 2: Resources

The second indicator, resources, is intended to measure local capital availability to venture-backed startups, participation of outside investors in an ecosystem and the relative cost of doing business. We assert that the first variable, local VC per venture-backed startup, is a lagging indicator of venture ecosystem development. Investors tend to cluster in areas with perceived investment opportunities to gain advantages in deal sourcing and portfolio company management, so we would expect greater availability of local capital to follow the presence of investable startups. We note that less-developed ecosystems score low here. However, if one observes this factor in conjunction with a low late-stage and high early-stage density score, this could suggest opportunity for investors to provide undercapitalized ecosystems with growth funding.

$$\textit{Local capital per venture-backed startup} = \frac{\textit{dry powder held by state VC firms}}{\textit{\# of state VC-backed startups}}$$

$$\textit{Outside VC participation} = \frac{\textit{\# of state deals led by outside investor}}{\textit{\# of all state deals}}$$

$$\textit{Cost of labor (z-score)}^{7} = \frac{\textit{median state tech salary - average of all median tech salaries}}{\textit{standard deviation of all median tech salaries}}$$

$$\textit{Cost of housing (z-score)}^{8} = \frac{\textit{median monthly state housing cost - average of all median housing costs}}{\textit{standard deviation of all median housing costs}}$$

7: We use computer programmer salary to represent tech salary, per data from the US Bureau of Labor Statistics. The second term is the average of all state median values, and the third term is the standard deviation of all state median values.
8: Due to a lack of availability of standardized office rent data by state, we use estimated median monthly housing cost to represent housing market costs by state. Data is sourced from the US Census Bureau, using 2016 figures. The second term in the equation is the average of all state median values, and the third term is the standard deviation of all state median values.

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Indicator 1: Density

Indicator 2: Resources

Indicator 3: Talent

Conversely, we perceive outside VC participation—the proportion of all ecosystem deals led by outside investors—to be a leading indicator of development. In the absence of local capital, deals led by outside investors could indicate ability to attract capital and larger pools of funding. On the other hand, a prolonged dependence on outside capital could hinder an ecosystem's ability to establish local resources.

Salary and housing costs are included as measurements of primary costs to startups. Given the low capital intensity of lean tech startups, we use these as starting points to measure costs that pull on startup resources. To compare these measures across ecosystems, we normalize each measure of cost by creating z-scores, using average and standard deviation of each sample's medians. A higher z-score indicates a greater deviation of salary or housing costs from the mean.

Indicator 3: Talent

Maryann Feldman states that "innovation depends on knowledge," noting that scientific and technical expertise are necessary for business and product advancements.[9] Innovation also tends to develop within clusters, which makes the knowledge and talent found in universities an important source of both ideas and employees/founders. We use the percentage of state population that is enrolled in four-year higher education institutions to indicate the relative supply of educated individuals available to startups (as employees, collaborators or future founders). To assess the retention rate of local talent, we measure the percentage of founders in an ecosystem that have a degree from a local university.[10]

Next, we posit that founder experience is a lagging indicator of ecosystem development (because it is dependent on previously established businesses), but believe it is informative of the quality and prospective success of businesses in the region. More seasoned entrepreneurs can contribute to success thanks to their experience operating a business, expertise in their chosen sector and developed network. In most states, this metric hovers around 3%-5%, indicating a relative equality of proportionate experience across ecosystems.

Finally, we assert that diversity contributes to business formation and financial success of startups in an ecosystem. We also note that these metrics tend to be more static and provide qualitative

9: "An Examination of the Geography of Innovation," Maryann Feldman, 1993
10: We note that information regarding the university or college attended by founder(s) is known for only 59.5% of the dataset. The unknown data for the remaining portion of the sample may create bias in the local talent retention variable.

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Indicator 1: Density

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information on individuals in an ecosystem. Research aggregated by the Kauffman Foundation suggests that immigrants have a high propensity for entrepreneurship,[11] and the National Venture Capital Association states that as of September 2017, 51% of US unicorns were founded by immigrants.[12] Further, research from the Peterson Institute for International Economics suggests that including women in a company's C-suite may improve financial performance.[13] Last, McKinsey & Company finds that companies with high racial and ethnic diversity are 35% more likely to financially outperform industry peers.[14] Accordingly, we measure diversity via immigrant population in a state, as well as the proportion of regional founders that are female. Because PitchBook does not measure racial or ethnic diversity in its proprietary database, we use a proxy to represent the share of business owners in a region that are racial and/or ethnic minorities. A higher score on all accounts indicates greater diversity within an ecosystem's entrepreneurs or population.

$$\textit{Local talent retention} = \frac{\textit{\# of startup founders with degree from universities in state}}{\textit{\# of all startup founders in state}}$$

$$\textit{Student population}^{15} = \frac{\textit{\# of students enrolled in 4-year higher education institutions in state}}{\textit{state population}}$$

$$\textit{Entrepreneurial experience} = \frac{\textit{\# of repeat founders in state}}{\textit{\# of founders in state}}$$

$$\textit{Gender representation} = \frac{\textit{\# of female founders in state}}{\textit{\# of founders in state}}$$

$$\textit{Minority business owners (proxy)}^{16} = \frac{\textit{\# of minority business owners in state}}{\textit{\# of business owners in state}}$$

$$\textit{Immigrant population}^{17} = \frac{\textit{state immigrant population}}{\textit{state population}}$$

11: "Immigration," State of the Field, Sari Kerr, January 10, 2018.
12: "We're Suing the Government over Immigration. Here's Why," NVCA Blog, Bobby Franklin, September 20, 2017
13:"Is Gender Diversity Profitable? Evidence from a Global Survey," Peterson Institute for International Economics, Marcus Noland, Tyler Moran & Barbara Kotschwar, February 2016
14: "Why Diversity Matters," McKinsey & Company, Vivian Hunt, Dennis Layton & Sara Prince, January 2015
15: We use 2016 figures of student population, as 2017 data is not yet available. 2016 state population figures are also used in this calculation for uniformity.
16: This figure is calculated with data from the Annual Survey of Entrepreneurship, data last available from 2015.
17: 2016 figures are also used for immigrant population, as 2017 data is not yet available. 2016 state population figures are also used in this calculation.

State	California
Angel/seed/acc/inc density	53
Early-stage density	29
Late-stage density	16
Local capital per funded startup	$5,479,920
Outside capital	21%
Cost of labor (z-score)	1.34
Cost of housing (z-score)	1.95
Entrepreneurial experience	5%
Local talent	26%
Student population	4%
Minority business ownership (proxy)	34%
Gender representation	12%
Immigrant population	27%

State	Illinois
Angel/seed/acc/inc density	13
Early-stage density	6
Late-stage density	4
Local capital per funded startup	$1,482,211
Outside capital	30%
Cost of labor (z-score)	0.71
Cost of housing (z-score)	0.23
Entrepreneurial experience	4%
Local talent	30%
Student population	5%
Minority business ownership (proxy)	17%
Gender representation	12%
Immigrant population	14%

State	Florida
Angel/seed/acc/inc density	10
Early-stage density	3
Late-stage density	1
Local capital per funded startup	$285,806
Outside capital	21%
Cost of labor (z-score)	-0.16
Cost of housing (z-score)	0.08
Entrepreneurial experience	4%
Local talent	16%
Student population	7%
Minority business ownership (proxy)	25%
Gender representation	11%
Immigrant population	21%

Case study: California, Illinois and Florida

To illustrate an evaluation of these indicators, we present a comparison of ecosystems in varying stages of development.

California is a good example of a well-developed startup ecosystem because it harbors the mecca of startup hubs: Silicon Valley. These data observations suggest that startup density per capita is high across all stages of maturity in California, particularly late stage. California also has a higher historical exit count than any other state, thanks to the high supply of late-stage companies in the region. We note that despite having a healthy amount of local capital per venture-backed startups, the relative costs of labor and housing are more expensive. These high costs help to explain in part the available capital, though the concentration of global venture firms and large funds also contribute to this statistic. Finally, minority and immigrant representation are also strong in the region. Though these may not have a direct correlation to startup success, they indicate a more diverse state-wide population—that is, local individuals who may be inclined to work for or found a startup. How much this diversity is actually represented in Silicon Valley has been subject to criticism, however, so we take this consideration in tandem with these data observations.

Next, we use Illinois as an example of a less-developed but still active ecosystem, given that venture firms in-state consistently raised nine funds in each of the years between 2015 and 2017 (high values, historically), and capital invested in Illinois startups grew 62% from 2016 to 2017. Density is much lower than California's across all stages, particularly in the late stage, which may be indicative of a lower overall exit count. Local capital per venture-backed startup is also considerably lower, though we see a higher percentage of Illinois deals led by an outside investor. Finally, the data suggests approximately one in three founders attended an in-state four-year institution, indicating a healthy pipeline of local talent, as well as a relatively high student population per capita.

Last, we examine Florida as an example of an ecosystem in early stages of development. Though startups in Florida have consistently closed over 200 rounds in each year from 2015 to 2017, capital raised in these rounds mostly has been small values across early-stage companies with a few exceptions, including Florida's state unicorn, Magic Leap, a mixed reality company. This observation is reflected across Florida's startup density per capita, with a very low representation of late-stage companies. Local capital is also low; however, costs of operation are closer to the average than the previous two examples, an advantage to Florida startups. Similar to California, Florida is home to a diverse population, signaling promise for potential business creation and diversity of thought among founders. Local talent retention is low compared to other regions, however, which may be related to the low density of startups in the region.

Discussion of data

These metrics focus exclusively on indicators of venture-backed startup ecosystems, which are merely a subsector of many regions' business markets. We recognize the selected variables do not capture all factors of a regional venture ecosystem. Due to data availability, we cannot include every important variable in this model. Certain relevant metrics, such as cost of operations in a region, are limited to minimal indicators such as housing and wages. These metrics also do not consider historical metrics that lead to development, including the existence of large, longstanding businesses in the region, such as Google in California or Microsoft in Seattle.

PitchBook's proprietary dataset is a comprehensive aggregation of venture deals, but there is likely underreporting in certain areas due to the general lack of transparency in private markets. Data provided by government agencies is also noted to have inherent reporting and sampling bias, though we regard this data to be of sound and consistent quality. For the sake of uniformity across datasets, we use state-level data. We also exclude the presentation of states with less than 30 unique companies that received venture funding in 2017.[18]

Additionally, we note that all interpretations are our own, and we welcome opinions that illuminate perspectives not mentioned here. We also welcome comments and feedback on relevant, measurable indicators we missed for further development of these variables and general framework.

18: This data can be made available upon request for PitchBook clients. The excluded states include: AK, AR, HI, ID, LA, ME, MS, MT, ND, NE, NH, OK, RI, SD, VT, WV, WY

Appendix

Table 1: Density

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	Population	Angel/seed/acc/inc density	Early-stage density	Late-stage density
Alabama	4,874,747	5.54	0.62	0.41
Arizona	7,016,270	12.83	2.57	1.43
California	39,536,653	52.84	29.09	15.61
Colorado	5,607,154	42.27	11.41	8.92
Connecticut	3,588,184	15.05	9.75	4.18
Delaware	961,939	62.37	16.63	2.08
District of Columbia	693,972	77.81	25.94	10.09
Florida	20,984,400	9.67	2.62	1.24
Georgia	10,429,379	9.68	2.88	3.55
Illinois	12,802,023	13.12	5.78	4.14
Indiana	6,666,818	9.45	2.10	2.55
Iowa	3,145,711	8.90	2.86	0.95
Kansas	2,913,123	5.84	3.09	2.40
Kentucky	4,454,189	6.96	1.12	1.35
Maryland	6,052,177	16.85	5.95	3.14
Massachusetts	6,859,819	66.33	33.38	23.32
Michigan	9,962,311	8.43	2.21	1.81
Minnesota	5,576,606	9.68	4.66	2.33
Missouri	6,113,532	9.00	3.44	1.47
Nevada	2,998,039	9.34	2.33	1.67
New Jersey	9,005,644	11.22	3.89	1.44
New Mexico	2,088,070	11.97	1.44	3.35
New York	19,849,399	42.07	18.74	8.92
North Carolina	10,273,419	13.43	3.02	3.02
Ohio	11,658,609	10.29	2.74	2.74
Oregon	4,142,776	19.31	5.55	6.28
Pennsylvania	12,805,537	15.31	5.39	3.83
South Carolina	5,024,369	3.58	1.99	1.59
Tennessee	6,715,984	11.47	3.72	1.64
Texas	28,304,596	14.38	4.27	2.51
Utah	3,101,833	19.99	10.64	6.77
Virginia	8,470,020	12.99	4.01	3.90
Washington	7,405,743	33.08	13.37	6.89
Wisconsin	5,795,483	11.22	2.42	2.07

Note: All values for 2017.
We also exclude the presentation of states with less than 30 unique companies that received venture funding in 2017.

Table 2: Resources

Return to text

	Local capital per venture-backed startup*	Outside VC participation*	Cost of labor (z-score)*	Cost of housing (z-score)**
Alabama	$6,814	13%	0.56	-1.04
Arizona	$246,181	23%	0.65	-0.10
California	$5,479,920	21%	1.34	1.95
Colorado	$380,909	23%	1.32	0.92
Connecticut	$3,643,979	22%	0.55	1.44
Delaware	$94,002	48%	-0.40	0.29
District of Columbia	$10,969,771	44%	1.83	2.13
Florida	$285,806	21%	-0.16	0.08
Georgia	$372,879	34%	0.35	-0.16
Illinois	$1,482,211	30%	0.71	0.23
Indiana	$19,131	24%	-0.56	-0.81
Iowa	$7,860	36%	-0.59	-0.80
Kansas	$107,855	32%	-0.67	-0.65
Kentucky	$34,848	24%	-1.08	-1.06
Maryland	$335,876	31%	0.68	1.74
Massachusetts	$6,780,108	26%	1.16	1.67
Michigan	$1,450,673	33%	-0.71	-0.59
Minnesota	$216,763	34%	0.72	0.12
Missouri	$1,600,111	30%	-0.14	-0.72
Nevada	$ 60,340	33%	-0.41	0.18
New Jersey	$1,079,216	26%	0.98	2.05
New Mexico	$20,738	25%	-0.15	-0.87
New York	$2,801,531	39%	0.70	1.02
North Carolina	$662,165	23%	0.79	-0.53
Ohio	$723,375	26%	-1.01	-0.67
Oregon	$60,823	22%	-0.06	0.40
Pennsylvania	$356,948	22%	-0.07	-0.27
South Carolina	$13,416	14%	-0.02	-0.69
Tennessee	$1,077,574	25%	-0.44	-0.76
Texas	$239,428	24%	0.42	-0.08
Utah	$1,494,278	32%	-0.06	0.33
Virginia	$934,985	31%	1.27	0.84
Washington	$1,356,422	28%	3.58	0.95
Wisconsin	$447,272	23%	-0.49	-0.38

*All values for 2017
** All values for 2016

Note: We also exclude the presentation of states with less than 30 unique companies that received venture funding in 2017.

Table 3: Talent

Return to text

	Entrepreneurial experience*	Local talent retention*	Student population**	Minority business ownership (proxy)***	Gender representation*	Immigrant population**
Alabama	1%	22%	6%	13%	12%	3%
Arizona	3%	21%	8%	17%	14%	14%
California	5%	26%	4%	34%	12%	27%
Colorado	3%	17%	7%	11%	13%	10%
Connecticut	3%	13%	5%	12%	11%	14%
Delaware	3%	3%	8%	16%	9%	9%
District of Columbia	4%	11%	16%	33%	18%	13%
Florida	4%	16%	7%	25%	11%	21%
Georgia	3%	20%	5%	22%	10%	10%
Illinois	4%	30%	5%	17%	12%	14%
Indiana	3%	28%	6%	9%	9%	5%
Iowa	2%	26%	7%	5%	13%	5%
Kansas	4%	21%	6%	9%	11%	7%
Kentucky	3%	20%	5%	7%	12%	4%
Maryland	4%	19%	5%	25%	13%	15%
Massachusetts	5%	37%	7%	12%	12%	16%
Michigan	3%	34%	5%	9%	12%	7%
Minnesota	3%	25%	7%	6%	12%	8%
Missouri	4%	17%	6%	10%	14%	4%
Nevada	2%	5%	4%	21%	11%	20%
New Jersey	4%	11%	3%	25%	10%	22%
New Mexico	3%	14%	4%	26%	16%	10%
New York	4%	22%	6%	24%	14%	23%
North Carolina	3%	26%	4%	13%	13%	8%
Ohio	3%	30%	5%	9%	10%	4%
Oregon	3%	14%	5%	12%	14%	10%
Pennsylvania	2%	34%	5%	10%	12%	7%
South Carolina	2%	17%	4%	12%	13%	5%
Tennessee	4%	21%	4%	12%	12%	5%
Texas	3%	27%	4%	29%	10%	17%
Utah	3%	39%	11%	7%	8%	8%
Virginia	3%	19%	6%	23%	13%	12%
Washington	4%	19%	5%	17%	13%	14%
Wisconsin	2%	26%	5%	6%	14%	5%

*All values for 2017
** All values for 2016
***All values for 2015

Note: We also exclude the presentation of states with less than 30 unique companies that received venture funding in 2017.

We note that information regarding the university or college attended by founder(s) is known for only 59.5% of the dataset. The unknown data for the remaining portion of the sample may create bias in the local talent retention variable.