POLICY FORUM

ENTREPRENEURIAL ECONOMICS

Expand innovation finance via crowdfunding

Crowdfunding attracts venture capital to new regions

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Crowdfunding (CF) platforms, such as Kickstarter (KS), offer a means of funding innovation, connecting inventors and entrepreneurs with a multitude of supporters, who each provide a small fraction of the amount required to fund the project. Although considerable funding for innovation has historically come from venture capitalists (VCs), the entrepreneurs funded by VCs often mirror the investors in terms of their educational, social, and professional characteristics and end up concentrated in a small number of regions (*1*–*4*). Policy-makers have thus hailed CF platforms, hoping that they will expand access to entrepreneurial finance, including among women and minority innovators, and that the innovations funded will create jobs and spur economic growth (*5*). But if particular regions, or certain sorts of individuals, routinely produce better ideas (*6*), and VC concentrates on them, then CF might simply compete with professional investors to fund the same ideas. We find, however, that CF has been funding innovators in a large number of places that have typically been excluded from VC, and has also been expanding the geographic reach of VC itself.

We compare data from 2009 to 2015 on KS campaigns and on VC investments [see supplementary materials (SM) for details on all data and analyses]. One of the dif-

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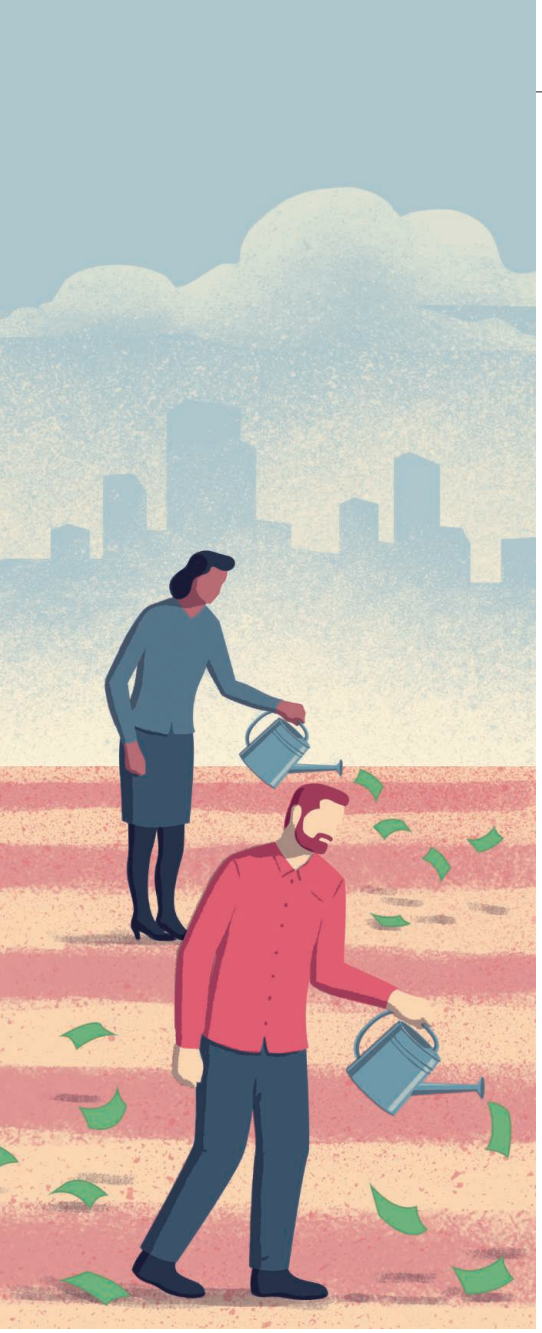

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ficulties in juxtaposing these two sources of funding comes from the fact that many people run KS campaigns for projects that have no real possibility of being backed by VC, such as the creation of artwork, music, and dance. VCs, similarly, invest in some kinds of companies, such as biotechnology and medical devices, that fall outside the scope of the KS platform. VCs can also typically invest larger amounts of money than a KS campaign could raise. To ensure that any differences in geographic distributions of their activities do not simply stem from compositional differences in the kinds of projects funded, we restricted VC investments to the smallest ones made in the youngest companies (seed and early stages), as these investments most closely correspond to KS campaigns. We also used a word-based distance metric to match categories of KS projects to industry codes for VC investments, aggregating all projects in a KS category and firms in a VC industry to create sets of words for matching. This matching identified 55,005 KS projects in categories similar to the industries in which VCs invested and 17,493 VC investments in industries engaged in activities similar to those of KS categories (for example, projects in the KS category "games" had descriptions similar to companies in the VC industry code "computer software"). We used these two sets to count matched KS projects and VC investments at the county-year level.

We first mapped the regions of successful KS campaigns (those that raised at least the target amount they sought) and VC investments (see the map). Although the typical KS campaign involves a smaller amount of money, these campaigns cover a broader swath of the nation. Several places with the largest number of successful campaigns have not been magnets for VC investments, e.g., Chicago, Los Angeles, and Seattle. By contrast, VC investments have been highly concentrated. Just four counties, located in the Boston area and Silicon Valley, account for 50% of all matched VC investments in our data.

To adjust for differences in population and other factors that might produce more investments in all types of innovative activity in some places, we calculated the relative intensity of KS versus VC dollars in each region. KS allocates a much larger share of its resources than VC does to the interior of the country, away from coastal population centers and traditional technology hubs. Even in the Boston area and Silicon Valley, KS investments end up concentrated in different parts. KS in the Bay Area, for example, goes disproportionately to Marin and Napa counties, whereas San Francisco and the peninsula counties receive more VC.

To assess whether VC differed from successful KS campaigns in their degree of geographic concentration and to determine whether these patterns might reflect the same underlying distributions, we calculated locational Gini (LG) coefficients [ranging from 1 (implying concentration in a single location) to 0 (implying perfectly even distribution across regions)] (7). VC investments in 2015 exhibited a much higher level of concentration (LG = 0.98 ± 0.002 SE), than successful KS campaigns (LG = 0.92 ± 0.010) (t = 5.88; $P < 0.01$).

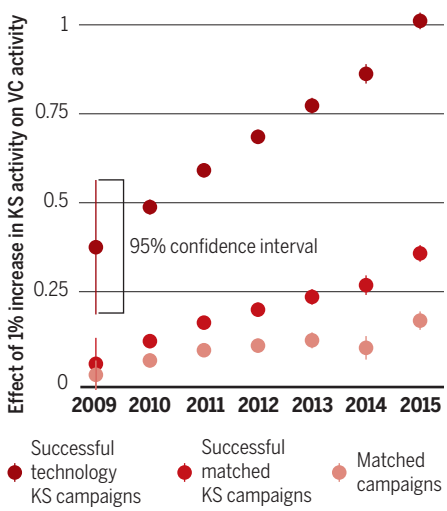
Although these maps and statistics suggest that KS expands access to financing outside the traditional financial hubs of Boston, New York, and Silicon Valley, they only explore the cross section. Regions may vary on a number of dimensions that affect the prevalence of these funding sources. By focusing on the dynamics of investments within counties, we can hold these factors constant, to the extent that they do not vary greatly over time. Analysis of the sequential ordering of investments can also yield further insight into the relation between KS and VC.

Because KS campaigns involve much smaller amounts and can occur at earlier stages in the development of an idea, our temporal analysis focused on exploring the relation between KS campaigns and future VC investments in a region. We first estimated the effects of successful KS campaigns on VC activity in a region in subsequent years. Our analyses focused on the numbers of successful KS campaigns and VC investments rather than dollar amounts, because these better reflect the number of innovations funded. Each of these models included controls for stable county-level characteristics, national-level factors at an annual level, and within-county changes from period to period in the number and quality of inventions.

A 1% increase in the annual number of KS campaigns in 1 year predicted a 0.097% increase in the annual number of VC campaigns in the following year, a 0.092% increase in the subsequent year, and about a 0.067% increase in the third year (all models $P < 0.01$) (see the graph). Successful campaigns may attract the attention of VCs to innovators in the

The Kickstarter effect

Effects of numbers of KS campaigns on the numbers of VC investments in a county, using KS campaigns in unmatched categories (such as art and music) to identify exogenous variation in KS activity.



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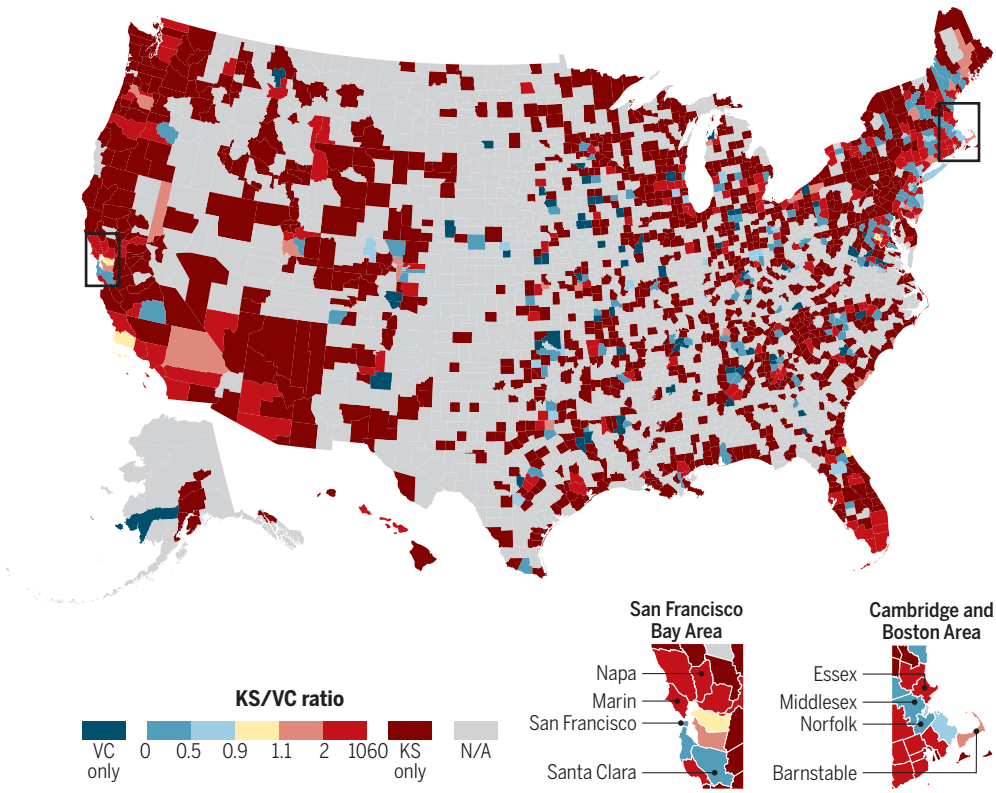
Crowdfunding and venture capital at work

Distributions at county-level of matched Kickstarter (KS) campaigns, venture capital (VC) investments, and the ratio of the amount of KS to VC funding, 2009–2015. Increasing blue to red indicates a higher ratio of KS to VC funding.



region or to the specific people running these successful campaigns.

Although the temporal ordering of these estimates suggests that KS leads to future VC investment in the region, one might worry that some unobserved time-varying factors account for this effect. We therefore estimated the relation using instrumental variables (IVs) to try to eliminate the influence of endogenous or simultaneous confounding variables. Similar to a natural experiment, an instrument uses variation in the odds of being treated that appear random with respect to the outcome of interest. By predicting treatment on the basis of some third factor, unrelated to the outcome, and estimating the effects using these predicted values instead of the actual values, an IV isolates the effects associated with this exogenous source of treatment, which then has a causal interpretation, just as when one can assign the treatment experimentally.

To calculate our instruments, we used KS campaigns in categories distant from the industries in which VCs invest (i.e., the KS and VC categories had almost no common words in their descriptions). We used the number of KS campaigns in distant categories, such as art and dance, to predict the number of KS campaigns in the categories that closely matched VC industries. We then used those predicted values—instead of the observed KS campaigns in matched categories—to estimate the effect of KS on VC.

We instrumented three different measures of KS activity using two different instruments: (i) the total number of KS campaigns (successful and unsuccessful) that closely matched VC, using the total number of KS campaigns that were distant from VC; (ii) the number of matched KS campaigns that were successful, and (iii) the number of successful matched KS campaigns in the technology category (five other nontechnology KS categories also matched to VC industries). Both (ii) and (iii) were instrumented using the number of successful distant KS campaigns. We estimated the effects for each year to explore whether the importance of KS in attracting future VC investments has been changing over time.

The results of these IV regressions are reported in the SM. Although the 2009 estimates for the overall number of campaigns and successful campaigns do not differ significantly from zero, by 2010, a 1% increase in the number of successful matched KS campaigns in 1 year predicted a more than 0.10% increase in the number of VC investments in the same year. VC funding can quickly follow a successful KS campaign, as successful campaigns attract the attention of investors and as entrepreneurs tout their campaigns when pitching investors. A 1% increase in the number of successful KS campaigns in the technology category in 2009 predicted a 0.36% increase in the number of VC investments in the county that year.

Two notable patterns appear. First, the results become stronger as the KS measure becomes more closely restricted to projects of possible interest to VC investors. By comparing the predicted values using each of these models, one can estimate the proportion of the effect coming from each group of projects: Successful matched KS campaigns appear to account for all of the effect of the overall number (successful and unsuccessful) of matched KS projects, and projects in the technology category within the set of matched KS projects appear responsible for most of the effect (89.4%) of successful matched KS campaigns.

Second, these regressions suggest that the importance of successful KS to VC investments in a region has been rising over time. In 2015, for example, a 1% increase in successful KS campaigns corresponded to a more than 0.35% increase in VC investments in the same year; a 1% increase in successful KS campaigns in the technology category predicted a more than 1% increase in VC investments in the same year. As CF has gained legitimacy and entrepreneurs have learned how to use CF platforms, it may increasingly become a complementary source of funds to VC.

The results suggest an interesting and important relation between CF and VC. If these trends continue, the rise of CF may not only fund more innovation in a more diverse set of places but also expand access to VC and other forms of finance in these same regions. ■

REFERENCES AND NOTES

1. A. L. Zacharakis, G. D. Meyer, *J. Bus. Venturing* **13**, 57 (1998).
2. C. I. Rider, *Admin. Sci. Q.* **57**, 453 (2012).
3. O. Sorenson, T. E. Stuart, *Am. J. Sociol.* **106**, 1546 (2001).
4. S. Shane, T. E. Stuart, *Manag. Sci.* **48**, 154 (2002).
5. R. Kitchens, P. D. Torrence, *Econ. Dev. J.* **11**, 42 (2010).
6. J. Guzman, S. Stern, *Science* **347**, 606 (2015).
7. P. R. Krugman, *Geography and Trade* (MIT Press, Cambridge, MA, 1991).

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SUPPLEMENTARY MATERIALS

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