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Abstract
The Small Business Innovation Research (SBIR) program is entering its 35th year, and has issued over 150,000 awards totaling nearly $44 billion. Most literature on the SBIR program is primarily focused on three of the four program priorities, summarized here as: (1) stimulating innovation; (2) increasing private sector commercialization from federal R&D; and (3) meeting federal R&D needs. However, we identified and discussed the handful of recent studies that considered the remaining priority area, fostering participation in innovation and entrepreneurship by woman and socially and economically disadvantaged persons. Building on this second body of literature, we empirically examine regional influences on minority-owned and woman-owned firms that got SBIR awards relative to the base firm type, white, male-owned firms. We developed a "revealed choice" modeling framework, where agencies that participate in the SBIR program make award decisions based on range of factors that include regional, geographic, and demographics factors. For our empirical specification, we constructed a multinomial logistic regression panel model that includes a spillover term, and report the average particle effects (APE). Three sets of results are highlighted in the summary and conclusion. First, there is variation across agencies in terms of selecting different firm types for SBIR awards, which is consistent with the prior literature we reviewed. Next, regional factors appear to only influence phase I award selection under our revealed-choice framework. Finally, spillovers and knowledge flows appear more important for minority-owned and woman-owned firms in terms of getting SBIR awards, and compared to base firms.

Introduction

In 2016, the Regional Rural Development Centers (RRDC) collaborated with the U.S. Department of Agriculture (USDA) on a national-level extension and outreach effort intended to encourage increased participation in the Small Business Innovation Research (SBIR) program (specifically targeting the topic areas facilitated by the USDA), especially by minority-owned and woman-owned firms. A second-generation effort launched in 2017 included extension training and outreach, where extension professionals from selected land-grants identified small businesses that may be interested in the SBIR program and aided the firms in proposal development and submission.[1] While much of the training focused on the technical issues related to proposal development, one challenge recognized was the variability of state resources available to firms interested in pursuing the SBIR program. Further, small businesses interested in the SBIR program may face other regional constraints limiting their abilities to successful obtain awards. The motivation of this study is to consider how some of these state and regional differences may impact minority-owned and woman-owned firms relative to other firms (white, male-owned) in terms of being selected to receive SBIR awards.

Background

What follows is brief description of the SBIR program, followed by recent selected literature relevant to study context: the SBIR program and minority-owned and woman-owned small businesses.

Small Business Innovation Research Program

[1] As of presenting this paper in June 2018, this effort is still in progress.

The SBIR program provides research and development (R&D) grants or contracts (depending on the agency) to small businesses (500 or fewer employees; majority owned by U.S. citizens or legal permanent residents). The program is funded through set-side dollars and administered by the eleven federal agencies that have annual research budgets greater than $100 million. Awards are allocated through a competitive process and based agency priorities. Regardless of agency, the broader program has four common goals:

1. Stimulate technological innovation.
2. Meet Federal R&D needs.
3. Foster and encourage participation in innovation and entrepreneurship by woman and socially and economically disadvantaged persons.
4. Increase private-sector commercialization of innovations derived from Federal research and development funding.

This study is focused, in part, on goal three and specifically interested in identifying potential difference in regional factors that may contribute to the selection of minority-owned and woman-owned firms for SBIR awards.

The SBIR program is administered in three phases, the first two of which are competitive and ranked, in part, based on how well the proposed project matches the agencies objectives. Typical Phase I projects establish technical feasibility or proof of concept in an 8-12 month period, and award amounts vary by agency, for example $100,000 for USDA projects to $225,000 for National Science foundation (NSF) projects. A typical Phase II project extends successful phase I projects, for example, supporting the scale-up of prototypes with dollar awards reaching $1M. Phase III is typically not funded, but agencies provide other commercialization support as the small businesses moves closer to brining the new innovation to market (however, some agencies may

provide commercialization support or funding under other programs). As of 2018, the program made approximately 154,000 awards to about 22,000 unique small businesses totaling $44 billion (SBIR, 2018).[2]

For agencies awarding R&D grants only, NSF, USDA, U.S Department of Energy (DOE), the topic areas are broad in nature and do not considerably vary year to year. Two other agencies, U.S. Department of Health and Human Services (HHS) and U.S. Department of Education (ED), award grants and contracts, and contracts are typically based on unique requests for applications (RFA) given an agency needs for a specific kinds of innovation, and do vary considerably year to year. The reaming six agencies, Department of Commerce (DOC), Department of Defense (DOD), Department of Homeland Security (DHS), Department of Transportation (DOT), Environmental Protection Agency (EPA), and National Aeronautics and Space Administration (NSAS), allocate award only through R&D contracts. The distinction between contracts and grants is relevant, as a typical small business can predict the topic areas in grant RFAs but is likely unaware of the topic nature of a contract RFA until the formal proposal call is released. Further, R&D contracts may present different commercialization paths for the resulting innovation compared to grants, as the contracting agency is the likely technology end user but this is not typically the case for grant making agencies.

SBIR, Minority-owned and Woman-owned Firms

[2] Values includes obliged amounts for 2015-2018. Additionally, the number of firms provided by SBA (about 77,500) includes multiple counts of the same firms as their measure does not account for firm awards in a previous year. The number of "unique firms" provided above, only counts a firms once in the life of the program regardless when the award was received. Mann, Loveridge, and Miller (2015) provided a more complex distribution of SBIR awards across firms and states.

We identify four recent studies that explicitly considered the relationship between firm-owner diversity and firms receiving SBIR awards[3]. In the first, Joshi, Inouye & Robinson (2017) considered how the diversity of awarding agencies (by demographic factors such as race and gender) influence the selection of minority-owned and woman-owned firms for SBIR (and Small Business Technology Transfer[4]) awards. Using Small Business Administration (SBA) data on SBIR awarded firms from 2001 to 2011 and the demographic make-up of awarding agencies, the authors found that as agency diversity increased so to do the phase II awards going to minority-owned and woman-owned firms. In the second study, Andersen, Bray & Link (2017) examined the success of woman-owned firms receiving SBIR awards through a specific agency, HHS. While no causal relationship was established based on other firm factors, they reported that woman-owned firms were at a disadvantage in terms of receiving SBIR awards from HHS. On the other hand, Scott, Scott & Link (2017) reported that the woman-owned control variable, one of several factors used in determining DOD awards, was not statistically significant. This implied that woman-owned firms were no different from other firms in terms of receiving SBIR awards from the DOD.

In the fourth study, Mann, Loveridge & Miller (2018) examined the distribution of phase I and II awards across U.S. regions while making considerations for different demographic factors and firm characteristics. The findings suggest that while firms in areas with higher shares of minority or woman firm ownership also received higher proportions of SBIR award counts, these awarded firms are not necessarily minority-owned or woman-owned firms. Further, firms in rural counties and high poverty areas are at a disadvantage in terms of award counts. Similar to the

[3] For a discussion on innovation creations, new firms, and access to knowledge consider Mann & Shideler (2015) and Lyons et al. (2018).
[4] This program is similar to SBIR, and directly incorporated universities into the R&D process. However, there are fewer federal agencies that participate in this program.

Joshi, Inouye & Robinson (2017) study, Mann, Loveridge & Miller (2018) also found a high amount of award variability to minority-owned and woman-owned based on agency, and in some cases woman-owned firms appeared to be at a disadvantage compared to other firm types in terms of award counts.

In an earlier work, Lerner (1999) conducted a comprehensive examination of firm-level metrics, and reported that SBIR awarded firms reported substantial increases in their sales and employment relative to non-awarded firms. On the other hand, SBIR awarded firms that were located outside high-tech clusters, did not received the same benefit from the award. The implications was that firms in areas with higher shares of poverty or disadvantaged persons/firms were not experiencing the same increases in sales and employment. This also suggested that the SBIR program may not be meeting one of its goals, the promotion entrepreneurship for socially and disadvantaged persons. To help encourage firms to participate in the SBIR program, several states established dollar matching program up to a certain dollar level. Lanahan (2016) found that states' matching programs positively impacted firms abilities to receive phase II awards from NSF, after successful completion of phase I projects. Lanahan & Feldman (2017) reported that state matching program may offset the lack of prior SBIR award experience, allowing less experienced firms to obtain awards at the same level as more experienced firms.

This study builds on the recent and growing body of literature that explicitly examines the relationship between firm owner diversity and SBIR award allocation. More specifically, we use a revealed-choice framework and construct a multinomial logistic regression model that includes a range of regional-level and state-level variables. Our goal is to identify regional-level factors that may impact the quality of SBIR proposals from minority-owned and woman-owned firms.

Data

The data used in this study are from the publicly available SBA database on SBIR awards, and include selected awarded firm information such as agency making the award, geographic location, number of employees and whether the firms operates in a HUBzone, is certified minority-owned or woman-owned. Data are for the years 2011 to 2015, and the specific range was selected to include data on the minority-owned and woman-owned identifiers. While data on these ownership variables appears in a few observations prior to 2004, the most accurate observations begin with the 2011 data (Dockum, 2018). Since there is roughly a 2- or 3-year lag on updating SBIR award on the SBA website, we limited the set to 2015.

Our regional analysis is at the county-level and we included a number of possible explanatory variables from the US Census American Community Survey (ACS), County Business Patterns (CBP), ED, Survey of Business Owners (SBO), and Federal Communications Commission (FCC), Bureau of Labor Statistics (BLS) the USDA. We also include two state-level data sets with venture capital (VC) and the state SBIR matching program information. ACS data is for 5-year estimates (percentage of science and engineering degrees, arts degrees, poverty, and per capital income), and the SBO data is for the year 2012 (percentage of minority-owned and woman-owned firms). ED, USDA and state matching programs data (take from the National institute of Health) were fixed values for the period of interest (number of exiting 4-year colleges/universities between 2011 and 2015; the 2013 rural-urban continuum code; and states with matching programs during the period, respectively). The FCC data (broadband household saturation above 80% and number of cell phone service providers one standard deviation higher

than the mean) are over the period 2011-2013[5]. County-level BLS (unemployment rate), CBP (share of high-tech firms based on the NSF designations), and state-level VC data (take from the NSF S&E indicators data set) are for the years 2011-2015. Additionally, we constructed a previous SBIR awards variable by matching firm names (or DUNS number where available) to lagged (1- to 5-year) versions of the SBIR data. Note that we did not include firms' phase I award that resulted in a phase II award. Finally, we constructed a spatially lagged variable for SBIR awards in neighboring counties, with a distance decay to 50 miles, and included both year and state-level fixed effects. After combining the various data, our model data included 23,784 observations.

Our primary variables of interest include awarding agency (indicators for one of the 10 agencies relative to DOD), knowledge spillovers (SBIR spillover), communication infrastructure (broadband and cellphone), and regional economic factors (poverty, per capita income, and unemployment). We also include a number of controls for firm-level factors that may reflect firms' baseline experience (size and prior SBIR awards), potential agglomeration effects (high tech firms, universities, and human capital), a geographic factor (rural versus urban), two relevant state factors (SBIR matching programs and VC), as well as state and year fixed-effects. Following prior literature, we anticipate agency variation with respect to firm type. We also expect that both the spillover term and communication infrastructure to be positively associated with form selection, and the regional economic factors to be negatively associated with award selection.

Methods

[5] Aryal et al. (2018) is the first example in the literature we were able to identify that uses this data in a regional model.

The revealed choice modeling framework takes advantage of the recent addition to the SBIR data of special case firms, namely HUBzone, disadvantaged (minority-owned) firms, and woman-owned firms[6]. Within the data, there are multiple cases in which the firms belong to two or more of the special case categories, thus, we included this as a separate category (combined). The framework assumes that the selections process is guided by a range of factors such as the specific agency priorities, award selection criteria, firm experience, and the general quality of a proposals (e.g., research feasibility)—which we assume may be reflected in part by some of the regional factors included in the model. Another factors in the selection process may include special considerations about the firms, specifically whether or not the firms is minority-owned or woman-owned. To develop this framework, consider that the award selection process includes input from a group of decision makers, for example a USDA phase I review panel. For simplicity, we will refer to this group as a selection committee and generalize the process across all agencies in that a selection committee is the unit at which the choice occurs. Thus, we define a selection committee's utility with a random utility function as:

$$S_{i,j} = \boldsymbol{x}'_{i,j}\boldsymbol{\beta}_j + \varepsilon_{i,j} \quad (9)$$

where selection committee *i*'s utility, $S_{i,j}$, is influenced by picking firm type *j* to receive an award, for $i = 1, \ldots, N$ and $j = 0, \ldots, 4$; $\boldsymbol{x}_{i,j}$ is a vector of other factors that may influence the selection of a particular firm type ($\boldsymbol{x}'_{i,j} = 0$ when a base firm is selected); $\boldsymbol{\beta}_j$ are the parameters estimated and $\varepsilon_{i,j}$ is the error term. For this approach to be plausible, we assume the error term is independently and identically (iid) distributed for all selection committees and has a Gumbel distribution. In doing so, the probability, *P*, that selection committee *i* chooses firm type *j* is (McFadden 1973):

[6] Mann 2018 provides another example of this application to secondary data.

(10) $$P(S_i \text{ chooses } j) = \frac{e^{x_i'\boldsymbol{\beta}_j}}{1+\sum_{k=1}^{j} e^{x_i'\boldsymbol{\beta}_j}}.$$

The resulting model is the familiar multinomial logit (MNL) model. Since the estimated parameters predict changes in the log-odds based on the values of the specific vector of independent variables, we also estimate the average partial effects (APE), $\boldsymbol{a}_j$, and their respective standard errors using the method described by Greene (2012):

(11) $$\boldsymbol{a}_j = P_j(\boldsymbol{\beta}_j - \sum_k^J P_k\boldsymbol{\beta}_k)$$

(12) $$\text{Var}[\boldsymbol{a}_j] = \boldsymbol{\Lambda V \Lambda}'$$

(13) $$\boldsymbol{\Lambda} = \{[\mathbf{1}(j = l) - P_l](P_j\boldsymbol{I} + \boldsymbol{a_j x}') - P_l(\boldsymbol{a}_l\boldsymbol{x}')\}.$$

Here, equation (12) is the delta method, P_j is the average probability of choice *j* and is estimated using the full data set evaluated at each observation, $\mathbf{1}(j = l)$ is equal to 1 when *j* and *l* are equal, otherwise it is 0, $\boldsymbol{V}$ is the variance-covariance matrix generated from the MNL parameter estimation, and $\boldsymbol{\Lambda}$ is a vector of the partial derivatives of each *j* set of marginal effects with respect to the $\boldsymbol{\beta's}$. Note that there are *j* – 1 columns of parameters generated from the estimation of equation (10), given one of the choices is used as the reference (in our case the base firm). However, there are *j* columns of APEs, as since $\boldsymbol{a}_0 = P_0(0 - \sum_k^J P_k\boldsymbol{\beta}_k) \neq 0$. Thus, the presentation of the APEs includes columns for minority-owned, woman-owned, and the base firms (white, male-owned), plus the combined and HUBzone firms.

Results

Summary statistics are divided into phase I and phase II awards, and shown in Table 1. Looking at the agency, DOD followed by HHS, make up about 60% of all proposals. Counties with SBIR awards have a high level of saturation in terms of households with broadband access (>80%) and

cell services providers (one standard deviation above the mean). It appears that on average, firms received about 20 prior phase I and II SBIR awards. However, other analysis (not shown) revealed that only about 20% of firms received past awards and there are only a handful that received 20 or more awards. Thus, there are a small number of firms skewing this result. The same is true with the number of employees, as a small number of firms have between 450-499 employees, while the majority reported having zero employees. Three other variables have relatively higher variation (i.e., mean > standard deviation; one indicator of skewed results) and include the SBIR spillover variable, number of 4-year universities, rural indicators, and state matching programs.

We tested our choice model for the independent of irrelevant alternatives (IIA) by estimating the full model (all five choices: minority-owned, woman-owned, combined, HuBzone, and base) and then one at a time dropping each of the choices and re-estimating the model. We used the Hausman-McFadden (1984) test (test statistic is X^2), where the null hypothesis is that the estimated parameter from paired-regressions (e.g., full model and a model with a dropped choice) are equal. Five different test statistics were generated (12.12, 11.98, 12.02, 11.13, and 11.72) and all were well below the critical value (324 at the 5% level of statistical significance). Thus, we fail to reject the null which implies that the SBIR decision makers make their choices of awardees based on firm ownership independently of other firm types.

We only include the APE results from the MNL regression as these are the basis of our results discussion. Further, our primary interest is on minority-owned and woman-owned firms, and how APEs may differ from the base (white, male-owned firms). APEs are interpreted as a 1 unit change in the variable leads to a corresponding percentage change (APE value) in the

probability that the firm type (minority-owned, woman-owned, combined, HuBzone, and base) would get selected for an SBIR award. The most obvious results are that several APEs are statistically significant for the phase I model, but only the combined firm type (some combination of firm types minority-owned, woman-owned, and HuBzone) has any APEs statistically significant in the phase II model. This general result implies that while regional factors may play a role influencing which firms received phase I SBIR awards (e.g., factors that may impact the quality of the proposal), other factors at the regional-level not included or firm-specific factors also not included in the models likely influence firms getting selected for a phase II SBIR awards.

Based on the above observation, we focus on the phase I results only. Similar to Joshi, Inouye & Robinson (2017) and Mann, Loveridge, & Miller (2018), we see evidence that there is some variation in terms of agency awards and firm types. The most significant is that the base firms are 19% less likely to get DOT SBIR awards relative to the references category, DOD. On the other hand, the probability is increased by 12% (compared to DOD) that a woman-owned firm gets an SBIR award from ED. For minority-owned firms, the largest agency APE in magnitude is for DOT, suggesting that minority-owned firms who submit phase I proposals to DOT are 6.9% more likely to receive DOT SBIR awards than DOD SBIR awards.

The results of the communication terms, broadband and cellphone saturation, are somewhat surprising (where negative and statistically significant) and not straightforward to interpret. The variable construction for broadband is an indicator for counties with more than 80% of households with broadband connections and for cellphones it is an indicator for counties with the number of service providers that are one standard deviation above the mean. Results may imply that minority-owned and woman-owned firms that receive SBIR awards positivity

benefit from the communication infrastructure in place (cellphone is only statistically significant for minority-owned firms). For example, this may be a chief source for collecting information about constructing SBIR proposals and doing research. An interpretation likely not plausible is that minority-owned and woman-owned firms that receive SBIR awards are in areas with higher levels of these communications technologies compared to the other three firm types, as the summary statistics for these two variables by firm type (table not shown) are nearly identical (vary by less than 1%). Thus, considering the results of other variables may help put the communication infrastructure into better context.

For minority-owned firms that received SBIR awards, the percentages of high-tech firms, minority-owned firms, and persons at or below the poverty-level are positive and statistically significant, whereas the percentages of the labor force with a degree in art and minority-owned firms, the unemployment rate, and rural indicator are all positive and statistically significant for woman-owned firms that got SBIR awards. With the exception of the percentages of high-tech firms (for minority-owned firms) and the percentages of the labor force with arts degrees (woman-owned firms), these results suggest that SBIR awarded minority-owned and woman-owned firms are more likely to be regions that face some type of economic challenge and/or potentially benefit in terms of getting awards by coming from such regions (e.g., higher rates of poverty, unemployment, reduced access to agglomeration economies).

Looking at the SBIR spillover term, it is positive and statistically significant for SBIR awarded minority-owned and women-owned firms and negative and statistically significant for SBIR awarded base firms. These results may help place some of the other variables discussed above, especially the communication infrastructure, in to context. For example, it appears that sources of information flowing from outside a minority-owned or woman-owned firm's county,

such as form the internet or other SBIR awarded firms, is important for these two firm types relative to the base firm type and, to a lesser extent, the combination and HUBzone firm types.

For woman-owned firms, both broadband and the spillovers are twice the magnitude of minority-owned firms. While the cellphone variable is only positive for minority-owned firms (about the same size as broadband for women-owned firms), the percentage of high-tech firms is positive and statistically significant for minority-owned firms. This suggests that minority-owned firms also get some benefit from in-county knowledge flows compared to woman-owned firms, where the percentage of high-tech firms is negative and statistically significant. The nature of the spillovers in conjunction with percentage of high-tech firms for minority-owned firms and labor force percentage with art degrees for woman-owned firms may also be related to the types of innovation projects that minority-owned and woman-owned pursue. For example, consider that minority-owned firms are slightly more likely to get DOT (6.9%) and NASA (2.1%) awards while woman-owned firms are more likely to get ED (12.0%) and slightly more likely to get NSF (2.9%) awards relative to DOD awards.

Looking at the base firms, some of the APE results reflect what one might expect in terms of typical innovation drivers. While the SBIR spillover and broadband variables are negative (and statistically significant), number of 4-year universities and percentage of high-tech firms are positive and statistically significant and the rural indicator and percentage of persons living at or below the poverty level are negative and statistically significant. Finally, the results of the firm size and prior phase II awards variables suggest that firm experience may is more important for the base firms compared to minority-owned and woman-owned firms. Contrary to prior literature, the state matching programs term in our model suggests that these programs do not necessarily off set the base firm experience.

Summary and Conclusion

The goal of this paper is to examine potential regional-level differences that influence minority-owned and woman-owned firms in terms of receiving SBIR awards. The motivation is borne out of investing the effectiveness of goal three from the broader SBIR program, i.e., to foster and encourage participation in innovation and entrepreneurship by socially and economically disadvantaged persons, as well as the authors' recent experience working with the USDA to encourage SBIR participation, especially by minority-owned and woman-owned firms. To achieve the study goal, we combined the publically available SBIR data with a number of other secondary data sources that include a range of regional variables, developed a revealed choice framework, and constructed multinomial logistic regression models.

There are three general findings from our results we highlight here. First, regional-level factors only appear to relevant, in the context of our choice framework—minority-owned, woman-owned, combined, operating in HUBzone, and base firms—for phase I awards. Thus, other factor, many of which may be internal to the firm, and not considered in our model are likely relevant for firm selection of phase II awards. For example, phase II awards have an emphasis on phase I success (reflecting the firm's research capabilities) and commercialization success (reflecting the firm's networking and other entrepreneurial capabilities). Second, knowledge flows and regional spillovers appear more important for minority-owned and woman-owned firms compared to the base firms (white, male-owned), while the base firms appear to capitalize more (or are more dependent on) other, more typical agglomeration effects within the residing firm's county. Third, there does appear some degree of variation in the agencies making SBIR awards to the different firm types. Prior literature suggests this may be a function of

agency demographic make-up, but it may also be related to the types of innovation projects pursued by minority-owned and women-owned firms.

This study has a number of limitations, and two are highlighted here. First, the data used to construct the choice model only reflects the firms who received awards. A better data set, such as one that includes information on firms that submitted proposals but not get awards, would provide more insight about regional influences on firm selection. Second, better data on awarded firm-specific characteristics would also be helpful. For example, our results imply that firm-specific characteristics are more relevant in understanding phase II award selection. Thus, having better information on a firm's R&D capacity as well as measures of is entrepreneurial and networking abilities, and access financial resources could help provide additional insights about minority-owned and woman-owned firms getting phase II awards.

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Table 1. Summary statistics

Variable	Mean	Std. Dev.	Mean	Std. Dev.
SBIR spillover	1.1416	1.9473	1.1546	1.9870
Agency				
USDA	0.0215	0.1451	0.0185	0.1346
NSF	0.0797	0.2708	0.0681	0.2519
DOC	0.0071	0.0842	0.0073	0.0852
ED	0.0068	0.0819	0.0076	0.0866
DOE	0.0735	0.2610	0.0755	0.2642
DOD	0.4601	0.4984	0.5156	0.4998
HHS	0.2254	0.4179	0.2022	0.4017
DHS	0.0110	0.1044	0.0127	0.1119
DOT	0.0060	0.0773	0.0072	0.0844
EPA	0.0069	0.0831	0.0053	0.0723
NASA	0.1020	0.3026	0.0802	0.2717
Broadband	0.9732	0.1614	0.9737	0.1600
Cell phone	0.9841	0.1251	0.9840	0.1256
Prior phase II	19.5192	46.4836	19.9601	46.9841
No. employees	37.6432	70.1689	37.7911	67.1341
No. 4-year universities	0.5090	1.0400	0.5020	0.9868
Pct. high-tech firms	0.2694	0.1635	0.2706	0.1637
Pct. sci & eng degrees	0.4272	0.0934	0.4256	0.0934
Pct. arts degrees	0.2294	0.0634	0.2291	0.0621
Pct. grad degrees	0.2266	0.1240	0.2237	0.1216
Pct. min.-own firms	0.2724	0.1623	0.2654	0.1622
Pct. wom.-own firms	0.3523	0.0343	0.3518	0.0342
Pct. poverty	0.1391	0.1070	0.1393	0.1076
Per capita income	39552	16437	39125	16032
Unemployment Rate	0.0649	0.0202	0.0643	0.0200
Rural indicator	0.0369	0.1884	0.0346	0.1828
State matching program	0.2859	0.4519	0.2986	0.4577
State VC per deal	6.8991	3.2982	6.8845	3.3209

Table 2. Average partial effects from multinomial logistic regression choice model

Variables	Phase I					Phase II				
	Minority	Woman	Combined	HUBzone	Base	Minority	Woman	Combined	HUBzone	Base
SBIR spillover	0.0022 *	0.0042 *	0.0003	-0.0018	-0.0049 *	0.0004	-0.0009	-0.0034	0.0012	-0.0051
Agency										
USDA	-0.0356 **	0.0152	-0.0003	0.0291 ***	-0.0083	0.0196	0.0527	0.0054	0.0199	-0.0085
NSF	-0.0017	0.0229 **	0.0120 ***	0.0287 ***	-0.0619 ***	-0.0131	-0.0277	0.0029	0.0204	-0.0633
DOC	-0.0151	-0.0354	-0.0226	0.0174	0.0556	-0.0062	-0.0548	-0.0042	0.0381	0.0569
ED	-0.0641	0.1204 ***	-0.0996	0.0301 ***	0.0131	-0.0001	0.1077	0.0134	0.0382	0.0134
DOE	-0.0082	-0.0962 ***	-0.0280 ***	0.0389 ***	0.0935 ***	-0.0159	-0.0721	-0.0234	0.0374	0.0956
HHS	-0.0209 ***	0.0009	-0.0301 ***	-0.0519 ***	0.1021 ***	-0.0187	0.0397	-0.0141 *	-0.0835	0.1044
DHS	0.0019	-0.0619 **	-0.0157	0.0197 *	0.0560	-0.0231	-0.1075	0.0094	0.0049	0.0572
DOT	0.0690 ***	0.1005 ***	0.0157	0.0075	-0.1927 ***	0.0770	0.1251	0.0363	-0.1327	-0.1971
EPA	0.0033	-0.0721 *	0.0066	0.0064	0.0558	0.0238	-0.0213	0.0092	0.0322	0.0571
NASA	0.0214 ***	-0.0331 ***	-0.0095 **	0.0096 **	0.0116	0.0068	-0.0286	-0.0126	0.0033	0.0119
Broadband	0.0357 **	0.0684 ***	-0.0180 ***	-0.0237 ***	-0.0623 **	0.0235	0.0121	-0.0280 **	-0.0255	-0.0637
Cell phone	0.0607 *	0.0454	-0.0316 ***	-0.0007	-0.0739	0.0077	-0.0769	-0.0347	-0.0196	-0.0755
Prior phase II	-0.0007 *	-0.0098 ***	-0.0004	-0.0004	0.0114 ***	-0.0002	-0.0084	-0.0001	-0.0004	0.0117
No. employees	-0.0003 ***	0.0002 ***	-0.0001 ***	-0.0001 ***	0.0003 ***	-0.0002	0.0002	-0.0001 *	0.0000	0.0003
No. 4-year universities	-0.0036	-0.0076 **	-0.0039 **	0.0032 **	0.0119 ***	-0.0077	0.0014	0.0005	0.0094	0.0122
Pct. high-tech firms	0.0666 ***	-0.0692 **	0.0074	-0.0886 ***	0.0838 **	0.0741	-0.0606	0.0238	-0.0740	0.0857
Pct. sci & eng degrees	-0.1435 ***	0.0767	-0.0330	0.0392	0.0606	-0.1660	0.0325	-0.0847 *	0.0056	0.0619
Pct. arts degrees	-0.1823 ***	0.2605 ***	-0.0200	-0.0091	-0.0491	-0.1296	0.1459	-0.0864 *	-0.0270	-0.0502
Pct. grad degrees	0.0215	0.0320	0.0331	-0.0746 ***	-0.0120	0.0437	0.1275	0.0734	-0.0797	-0.0123
Pct. min.-own firms	0.0895 ***	0.0732 *	0.0161	-0.0680 ***	-0.1108 **	0.0532	0.1381	0.0391	-0.1268	-0.1133
Pct. wom.-own firms	0.0794	-0.2078	-0.0052	0.1758 ***	-0.0422	0.2957	-0.3377	-0.0999	0.3577	-0.0431
Pct. poverty	0.0760 ***	-0.0969 **	0.0451 **	0.1165 ***	-0.1408 ***	0.0625	-0.1366	0.0899 **	0.1370	-0.1440
Per capita income	0.0000	0.0000	0.0000	0.0000 *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unemployment Rate	-0.3147 *	0.7656 ***	-0.0604	0.1381	-0.5286	-0.1772	0.5705	0.0921	-0.0622	-0.5407
Rural indicator	0.0307 **	0.0763 ***	-0.0175 *	0.0082	-0.0976 ***	-0.0010	-0.0331	-0.0306 *	0.0020	-0.0999
State matching program	-0.1466 **	0.2772	-0.0618 *	-0.0618 **	-0.0070	-0.2029	-0.1029	-0.1078	-0.0244	-0.0071
State VC per deal	-0.0015	0.0023	0.0004	0.0006	-0.0018	-0.0040	-0.0026	-0.0005	0.0003	-0.0018
R-squared	0.29					0.31				
AIC	20505					9456				
Log likelihood	-9920					-4396				
Number obs.	15981					7803				