Small Bus Econ
DOI 10.1007/s11187-017-9882-6

How does agency workforce diversity influence Federal R&D funding of minority and women technology entrepreneurs? An analysis of the SBIR and STTR programs, 2001–2011

Amol M. Joshi · Todd M. Inouye · Jeffrey A. Robinson

Accepted: 23 February 2017

Abstract US Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs provide Federal research and development (R&D) grants to technology ventures. We explore how grantor demographic diversity explains why demographically diverse grantees experience different odds for successfully transitioning from initial to follow-on R&D grants. We empirically analyze 52,126 Phase I SBIR/STTR awards granted by 11 Federal agencies (2001–2011). We find a positive association between agency workforce diversity and Phase II funding for Phase I grantees, but minority and women technology entrepreneurs are less likely to receive this funding than their non-minority and male counterparts. Agencies valuing workforce ethnic diversity or leveraging gender homophily positively influence the likelihood of women technology entrepreneurs obtaining Phase II funding. We discuss evidence-based implications for policy and practice.

A. M. Joshi (✉)
College of Business, Oregon State University, Corvallis, OR, USA
e-mail: amol.joshi@oregonstate.edu

T. M. Inouye
College of Business, Niagara University, Niagara, NY, USA
e-mail: tinouye@niagara.edu

J. A. Robinson
Rutgers Business School, Rutgers University, New Brunswick, NJ, USA
e-mail: jrobinson@business.rutgers.edu

Keywords Entrepreneurship · Economics of minorities · Economics of gender · Technological innovation · R&D

JEL classifications L26 · J15 · J16 · O32 · O38

1 Introduction

Economic development, defined here as improving the quality of life of a population by increasing the local, regional, and/or national levels of infrastructure development, job creation, income, and wealth, is an important issue affecting the long-term global competitiveness of every country. A substantial body of research suggests that innovation drives economic growth (e.g., King and Levine 1993; Grossman and Helpman 1993; Romer 1990, 1994). In the USA, the Federal government seeks to achieve national economic development goals via multiple policy interventions. These include research and development (R&D) tax credits, intellectual property rights protection, government procurement, and government-sponsored R&D programs administered by agencies that direct funding and resources to support entrepreneurial and inventive activity (Gilbert et al. 2004). Since the 1970s, two types of policies dominate the formulation and execution of US Federal economic development efforts: *equitable distribution* (equity) and *innovation production*. In this study, we explore patterns of entrepreneurial activity associated with the intersection and implementation of these policies by Federal agencies.

Equitable distribution policies allocate a percentage of Federal procurement contracts to socioeconomically

disadvantaged individuals and to places in need of business development and job creation (Cheav 2013). These policies generally provide contracting preferences to qualified entrepreneurs or to small businesses in qualified locations. Examples include the Small Business Administration's (SBA's) 8(a) Program and Historically Underutilized Business Zone (HUBZone) Program (Jones 2007; Miller 1999; Robinson 2007).

Innovation production policies stimulate and encourage R&D processes that lead to new innovations. These policies typically fund and support entrepreneurs and technologies that drive the formation and growth of new ventures and the overall economic development of cities, states, and regions (Lanahan 2015; Lanahan and Feldman 2015; A. M. Joshi 2014). Notable examples include various R&D initiatives of the US Department of Defense (DOD) and the National Science Foundation (NSF), such as the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs. SBIR is among the most successful and best-known Federal R&D initiatives (Audretsch 2003; Audretsch et al. 2002; Cooper 2003; Lerner 2000; Link and Ruhm 2009, 2011; Link and Scott, 2010; Wessner 2000). In this study, we empirically examine the managerial and policy consequences of SBIR and STTR for technology entrepreneurs seeking R&D funding.

We illustrate the economic impact and strategic importance of these programs via Qualcomm, a pioneering innovator funded by SBIR and recently inducted into the SBIR Hall of Fame.[1] Qualcomm is a worldwide wireless and communications chip licensor and producer. SBIR grants supported early prototyping and R&D commercialization efforts that catalyzed the initial product introductions and eventual market successes for this firm. Qualcomm transformed its 12 original Federal SBIR grants and government R&D contracts into a dominant industry position by establishing a new wireless communications standard called Code Division Multiple Access (CDMA). Seeded with $1.4 million in SBIR awards in 1987–1990, over the next 20 years, Qualcomm grew to $11 billion in annual revenues, $80 billion in market capitalization, 17,500 employees, and invented more than 13,000 patents.[2] The wealth created by Qualcomm alone is more than double of what US taxpayers invested in SBIR and STTR since inception.

As the 2014 Congressional testimony excerpt below shows, these R&D programs are a vital part of the US economic policy, especially for minority and women technology entrepreneurs:

> The SBIR and STTR programs do more than just provide grants and contracts. These programs stimulate the STEM-driven economy, as well as support people considering academic careers in a wide range of STEM fields. This is a critical pillar of our national competitiveness.
>
> The 11 agencies that participate in the programs have awarded over 145,000 grants totaling about $38 billion to American small businesses. In 2012, the SBIR and STTR programs provided about $2.5 billion directly into the hands of small businesses nationwide, and nearly a quarter of that money was awarded to women-owned, minority-owned, or HUBZone-located small businesses.
>
> The SBA's role in both of these programs is to provide programmatic and policy oversight on these programs. … It must be noted that while there is only one SBIR program, it is operated 11 different ways, depending on the focus of its agency's missions, directives, and goals.
>
> Javier Saade, Associate Administrator, Office of Investment and Innovation, SBA
> Hearing before the Committee on Small Business, US House of Representatives
> 113th Congress, July 23, 2014

The essential fact that US small businesses received 145,000 research grants totaling $38 billion via SBIR and STTR but that the 11 different participating Federal agencies operate these programs in 11 different ways raises an intriguing set of questions. How do key operational differences across the Federal agencies participating in the SBIR and STTR programs affect the R&D funding outcomes for different types of firms? In particular, since minority-owned, women-owned, and HUBZone-located small business received nearly 25% of all SBIR and STTR funds in 2012 (as noted by Javier Saade), are there any potential advantages or disadvantages that these businesses face? If so, what agency-level operational differences drive these possible effects? Beyond the obvious factors associated with the size and scope of a given Federal agency (measured in terms of its

[1] https://www.sbir.gov/about-tibbetts-awards
[2] https://www.sbir.gov/success-story/qualcomm-inducted-sbir-hall-fame

total budget allocated to SBIR and STTR grants), we argue that the diversity of the agency's workforce is a salient factor, especially for minority-owned and women-owned small businesses. Using Federal data on the race, ethnicity, and gender of the employees of grantor agencies participating in SBIR and STTR as well as SBA data on the follow-on funding outcomes (Phase II) for initial grantees (Phase I), we conduct empirical analyses. We answer the following research question: *How does agency workforce diversity influence Federal R&D funding of minority and women technology entrepreneurs?*

We organize our study as follows. First, we provide an overview of the SBIR and STTR programs for innovation production. Second, we propose exploratory hypotheses about minority and women technology entrepreneurs. We explain how the workforce diversity of the different Federal agencies participating in SBIR and STTR may influence the funding outcomes for different types of firms seeking follow-on research grants from these agencies. Third, we describe our research methods and data. We specify our regression models and conduct our empirical analyses. Fourth, we present our results and main findings. Fifth and finally, we interpret our evidence and discuss the implications for scholars, managers, and policymakers. We conclude by summarizing our study's contributions and directions for future research.

2 Innovation production programs

By examining the SBIR and STTR programs, our study answers the call in the literature to expand the spectrum of small business research with regard to the source of governmental funding and its impact on firm development and strategy (Elston and Audretsch 2011). The purpose of SBIR and STTR is to bridge the research funding gap or "valley of death" in the technology development life cycle (Wessner 2000). This is the critical transition point where basic research requires additional funding to progress, yet the unproven technology presents too large a risk for commercialization (Ford et al. 2008). SBIR and STTR are highly competitive grant-based programs enabling small businesses to develop and potentially commercialize technology that is in line with current Federal R&D needs.

2.1 SBIR program

The SBA oversees the implementation of SBIR for all 11 participating Federal agencies. The DOD is the largest agency with over $1 billion annually set aside for SBIR.[3] The SBA recognizes that participating agencies differ greatly in culture and mission and, as a result, allows each agency the flexibility to administer its own program as outlined in the SBIR Policy Directive.[4] Programs such as Fast-Track[5] and the Transition Assistance Program[6] are DOD-specific examples of an agency benefiting from operational flexibility in administration.

The SBIR program is structured into three phases.[7] The objective in Phase I is to establish the technical merit, feasibility, and commercial potential of the R&D and to determine the quality of performance of the small business. The purpose of the Phase II award is to further develop the R&D efforts from Phase I and to ideally end up with a commercial product, service, or process. If a Phase II awardee needs to continue Phase II work towards commercialization, some agencies such as the National Institutes of Health (NIH), a part of Health and Human Services (HHS), provide a follow-on Phase IIB award which helps to build relations with third-party investors and overcome Federal regulatory barriers that are specific to the nature of the product. Phase III is not funded by SBIR, but Federal agencies may use other funds to assist in commercialization of R&D results from Phases I and II, if the government intends to make use of it in the future.[8] (See Appendix A, Table 5 for a comparison of the SBIR and STTR programs).

2.2 Small business technology transfer (STTR) program

The STTR program is largely modeled after the SBIR program with a few noteworthy distinctions. For instance, although the defined mission of the STTR program is identical to the SBIR program, the stated goals are somewhat different. While both programs aim to "Stimulate technological innovation as their top priority," STTR also seeks to "Foster technology transfer through cooperative R&D between small businesses and research institutions" as its next highest priority.[9] To

[3] http://www.acq.osd.mil/osbp/sbir/about/index.shtml
[4] https://www.sbir.gov/sites/default/files/sbir_pd_with_1-8-14_amendments_2-24-14.pdf
[5] http://www.acq.osd.mil/osbp/sbir/sb/resources/deskreference/04_fast.shtml
[6] http://www.dawnbreaker.com/defense/navy-tap.php
[7] http://sbir.gov/about/about-sbir
[8] SBA SBIR Policy Directive February 24, 2014
[9] https://www.sbir.gov/about/about-sttr#sttr-mission

meet this requirement, the small business must establish a formal intellectual property agreement with a partnering research institution during the first two phases of funding. This enables two-way knowledge transfer, with the research institution providing technological expertise and the firm providing commercialization expertise. The anticipated culmination of this knowledge sharing is increased technological innovation derived from Federal R&D funds.

The original impetus for creating the STTR program was a growing recognition among Federal policymakers that although the USA is a leader in conducting basic scientific research, many foreign rivals appear more able to commercialize new technologies resulting from this basic research (Ford et al. 2008). By fostering collaboration between small business managers and researchers, STTR is designed to reliably fund and accelerate the exchange of ideas thereby facilitating the commercialization of promising technology (Baron 1993). This partnering approach bridges the gap between researchers with the technical expertise required to pursue scientific advances and managers with the business acumen needed to drive the commercialization of possible applications based on these advances. The small business firm eligibility requirements and three-phase program structure of the STTR program are similar to the SBIR program.[10] (See Appendix A, Table 5 for additional details on both programs.)

3 Exploratory hypotheses

Our hypotheses are based on two core premises. First and foremost, when grantors decide to fund the transition from Phase I to Phase II awards, scientific value, technical merit, market feasibility, and commercial potential are the main selection criteria. The diversity (race, ethnicity, and gender) of the Phase I grantee firm's owners are not explicitly considered in the selection. Second, each grantor Federal agency's actual operational effectiveness in executing its policy and program mix is affected by the diversity (race, ethnicity, and gender) of its workforce. In other words, unlike prior studies, our hypotheses assume that the demographic diversity of grantors (Federal agencies) is an important explanatory factor for why demographically diverse grantees (minority and women technology entrepreneurs) may experience different odds for success in obtaining follow-on R&D funding. We proceed by first observing NIH, a remarkably diverse agency participating in SBIR and STTR. Next, we establish baseline hypotheses. We then posit two mechanisms, *valuing workforce diversity* and *leveraging homophily*, which may explain differences in funding outcomes for minority and women technology entrepreneurs across Federal agencies. We develop hypotheses for these grantor-related diversity mechanisms.

3.1 Patterns at the National Institutes of Health

Our analysis of the SBIR and STTR programs suggests considerable variation may exist across Federal agencies in the level of commitment and potential effectiveness in working with minority and women business owners. For instance, in a recent study, NIH explores the participation of women and minorities in SBIR and STTR during 2004–2014 (Gansler and Shivakumar 2015). NIH reviewed each stage of its programs, from initial application to Phase II and beyond, and found that only 3% of the applications were from minority-owned firms and 13% were from woman-owned firms. These numbers speak to the lower number of women and minorities in science, engineering, technology, and mathematics (STEM) fields and to the underlying pipeline issues therein (i.e., the long-term development of a diverse pool of STEM talent in the USA). The NIH study also finds that the number of successful Phase I awards decreased over time, indicating an increasingly high level of competitive intensity among all small businesses seeking Federal R&D grant funding (Gansler and Shivakumar 2015).

Our study focuses on the transition from Phase I to Phase II and the specific factors that influence the transition odds of successful Phase I awardees. As evidenced by Chapter 6 of the NIH report (Gansler and Shivakumar 2015), the agency is especially proactive in addressing challenges affecting the participation of women and minorities in SBIR and STTR. As of 2015, NIH exemplifies several distinctive agency-level practices within the Federal government:

1. NIH explicitly acknowledges the current situation in terms of the underrepresentation of women and minorities among the SBIR/STTR applicant pool and grant recipients.

[10] https://www.sbir.gov/about/about-sttr#sttr-mission

2. NIH formally requires detailed tracking of SBIR/STTR outreach efforts as mandated by the 2011 SBIR/STTR Reauthorization Act.
3. NIH purposefully allocates human and financial resources to conduct more effective promotion and outreach programs.
4. NIH regularly invests in partnerships that create expanded access for women and minorities via STEM pipeline initiatives.

Since we are particularly interested in the transition from Phase I to Phase II of minority-owned and woman-owned small businesses, we focus our initial hypotheses on their chances of transition success. We build on prior studies (Gicheva and Link 2013, 2015), while offering a broader explanation of disadvantage for minority and women technology entrepreneurs. We attempt to establish a basic likelihood of transition for minority-owned and woman-owned businesses that have already received initial Phase I grants and then receive follow-on Phase II grant awards in either the SBIR or the STTR program. Our baseline hypotheses are as follows:

H1a: For minority-owned businesses, the likelihood of transition from Phase I to Phase II in SBIR and STTR programs will be lower compared to non-minority-owned small businesses.
H1b: For woman-owned businesses, the likelihood of transition from Phase I to Phase II in SBIR and STTR programs will be lower compared to non-woman-owned small businesses.

3.2 Mechanisms influencing transition likelihood

The NIH example indicates how workforce diversity at the Federal agency-level may influence the successful transition of minority-owned and woman-owned businesses from Phase I to Phase II in SBIR and STTR. The 18,000-person workforce of NIH is exceptionally diverse (58% female and 42% minority employees),[11] and this diversity may shape differences in grantee transition rates across grantor Federal agencies operating SBIR and STTR programs. We believe that this variation may be due to the involvement of a more diverse team in critical interactions with minority and women technology entrepreneurs. We posit that racial/ethnic and gender diversity enhance the overall approachability and accessibility of a Federal agency's workforce. Diversity thereby facilitates the sharing of vital, tacit knowledge that is essential in crafting competitive proposals which may be more likely to be favorably evaluated by external reviewers and internal decision-makers and result in a successful transition from Phase I to Phase II.

3.2.1 Agencies valuing workforce diversity

Our first grantor-related diversity mechanism is *agencies valuing workforce diversity*. This is a function of greater direct agency outreach to minority-owned and woman-owned businesses and increased visibility of minority and female employees. Simply stated, if an agency employs a more diverse workforce, this may drive more outreach to minority and women technology entrepreneurs. There may also be more accessibility, approachability, and visibility in the initial grant applicant recruitment process and during the subsequent, but equally critical period of technical assistance.

There is a significant literature on the value of this kind of diversity in organizations. In a classic review of the topic, Williams and O'Reilly (1998) describe the many approaches to thinking about diversity and its influence on group dynamics and organization performance. Recent studies make the business case for a diverse workplace and describe under what conditions workplace diversity impacts performance (Kochan et al. 2003; A. Joshi et al. 2011). We believe these dynamics are present on two levels in the administration of the SBIR and STTR awards and that a diverse agency workplace may influence the success of minority-owned and woman-owned businesses. First, agencies with more demographic diversity may be more committed to engaging in outreach to diverse firms. These agencies may also have a more diverse group of employees providing the technical assistance and outreach for their programs. Diverse workplaces may also leverage this diversity climate for higher organizational performance (McKay et al. 2008). Second, when organizations value diversity, they may be more inclusive and open in their decision-making and resource allocation processes.

An established stream of literature describes how more diverse workplaces may directly benefit in terms of better decision-making outcomes when making important decisions (e.g., Elsass and Graves 1997; Jackson et al. 1995; Lau and Murnighan 1998; Richard 2000). There are also studies that demonstrate how non-diverse

[11] https://www.edi.nih.gov/data/demographics

individuals are disadvantaged in pay and performance processes evaluated by non-diverse groups (Jackson and Joshi 2004; Jackson et al. 2003; A. Joshi et al. 2006; A. Joshi and Roh 2009). Williams and O'Reilly (1998) describe the connection between demographic diversity and group performance as generally positive for creative tasks. Therefore, we argue that Federal agency workforce diversity will tend to increase the success of minority-owned and woman-owned businesses in the SBIR and STTR programs because the increased diversity of the agency will reinforce the agency's capabilities in identifying, managing, cultivating, and otherwise interacting with these firms. As the number of managers and employees who visibly represent and value diversity increases, we would expect them to influence decision-making and how resources are distributed to the various programs and inclusivity initiatives targeted at increasing the number of minorities and women engaged in technological innovation. Thus, our second set of hypotheses explores grantor-related diversity factors that may be influential in improving the successful transition from Phase I to Phase II of SBIR and STTR programs for minority and women technology entrepreneurs, as shown below:

H2a (agencies valuing workforce gender diversity):
Federal agency workforce gender diversity positively influences minority-owned small businesses' likelihood of transition from Phase I to Phase II in SBIR and STTR programs.
H2b (agencies valuing workforce racial/ethnic diversity):
Federal agency workforce racial/ethnic diversity positively influences woman-owned small businesses' likelihood of transition from Phase I to Phase II in SBIR and STTR programs.

3.2.2 Agencies leveraging homophily

Our second grantor-related diversity mechanism is *agencies leveraging homophily*, which we conceptualize as a specialized case of the *agencies valuing workforce diversity* rationale presented earlier. An established research stream substantiates the performance-boosting effect of ties among people with similar backgrounds (Borgatti and Cross 2003; McPherson et al. 2001; Stuart and Sorenson 2007; Rauch and Trindade 2002; Kariv et al. 2009). Earlier work also presents evidence for a generally positive association among co-ethnic or same-gender members of shared networks related to entrepreneurial endeavors (Aldrich 1989; Aldrich and Waldinger 1990). If women and minority technology entrepreneurs engage with Federal agency employees who are similar in race, ethnicity, or gender to themselves, their engagement may be more productive and helpful than if there is no homophily (McPherson et al. 2001; Rauch and Trindade 2002; Kalnins and Chung 2006). When the relational conditions that precede information exchange are positive, there may be more information exchange and more successful interactions (Borgatti and Cross 2003). For SBIR and STTR implementation, outreach to underrepresented groups of entrepreneurs may be enhanced if these same groups are also incorporated in a Federal agency's workforce. Hence, we propose the following hypotheses for same-group matching on minority status and on gender, respectively:

H3a (agencies leveraging racial/ethnic homophily):
Federal agency workforce racial/ethnic diversity positively influences minority-owned small businesses' likelihood of transition from Phase I to Phase II in SBIR and STTR programs.
H3b (agencies leveraging gender homophily):
Federal agency workforce gender diversity positively influences woman-owned small businesses' likelihood of transition from Phase I to Phase II in SBIR and STTR programs.

4 Methods and data

4.1 Data sources and collection

Our empirical analysis utilizes variables constructed from three nationwide online databases provided by the SBA[12] and a fourth government-wide online database provided by the Federal Office of Personnel Management (OPM).[13] We denote these four databases as (1) *Award Listing*, (2) *Company Listing*, (3) *Annual Reports*, and (4) *Workforce Diversity*, respectively. We describe the contents and our usage of these databases in Appendix B, Table 6, Data Sources, and Data

[12] See https://www.sbir.gov/sbirsearch/firm/all for the Award Listing and Company Listing databases. The Annual Reports database is available at https://www.sbir.gov/awards/annual-reports.
[13] See https://www.opm.gov/policy-data-oversight/diversity-and-inclusion/federal-workforce-at-a-glance/ for the OPM database.

Collection. We extract an initial sample of 69,771 awards (52,286 Phase I and 17,485 Phase II) granted to 14,658 unique firms for the SBIR and STTR programs during 2001–2011. See Table 1 for a snapshot of the entire initial sample combining the four SBA databases.

Note that our comprehensive nationwide initial sample represents 69,771 out of 157,528 total awards or 44% of all Federal small business research grants awarded and includes 52% of all firms that participated in the SBIR and/or STTR program since inception. After an extensive database validation and cross-checking process (See Appendix B, Table 6), we exclude 160 awards (0.3% of Phase I) from our sample due to missing or incomplete records. We use the resulting final sample of 52,126 Phase I awards in our regression analyses.

4.2 Variables

Dependent variable Our unit of analysis is the award. Our dependent variable TRANSITION equals 0 if there is no subsequent Phase II award granted for the original focal SBIR or STTR Phase I award and equals 1 if there is a subsequent Phase II award granted.

Explanatory variables We define explanatory variables at the agency and firm levels. First, using the *Workforce Diversity* database, we compute two time-varying variables to capture aggregate grantor-related demographic diversity for each agency, for each year 2001–2011: AGENCY_MINORITY and AGENCY_GENDER. We measure AGENCY_MINORITY as the total percentage (on a scale from 0 to 100) of minority employees from the OPM's diversity categories in a Federal agency's workforce by year as reported in the *Workforce Diversity* database 2001–2011.[14] We measure AGENCY_GENDER as the percentage (on a scale from 0 to 100) of female employees in a Federal agency's workforce by year as reported in the *Workforce Diversity* database 2001–2011. The average values of these variables are plotted for each agency and the Federal Government (GOVT) in Fig. 1.

Next, from the *Annual Reports* database, we determine the total dollar amount of funding allocated to the granting agency's Phase II awards in the relevant program (SBIR or STTR) in the same calendar year that the original focal Phase I award was granted to the firm. This total dollar amount is a proxy for the granting agency's potential future budget or *supply of funds* during the timeframe when the firm may be eligible to apply for a Phase II award. We compute the variable AGENCY_P2FUNDING as the base 10 logarithm of this total dollar amount.

At the firm level, we also include P1AMOUNT10K to represent the amount of SBIR or STTR Phase I funding associated with the focal award (measured in terms of tens of thousands of dollars). The variable P1AMOUNT10K not only reflects the granting Federal agency's original assessment of the technical merit of the proposal, it also accounts for the competitive intensity or *demand for funds* at the time the initial grant was awarded. This is because a firm that applied for and received Phase I funding at the same time as many other competitors might be allocated a lower amount of an agency's fixed allocation of funding and therefore face a larger number of eligible competitors for future Phase II grants than a firm that received a larger amount of Phase I funding.

We also define two explanatory variables related to firm ownership status which capture the demographic diversity of grantees. This information is generally collected and used by the SBA to determine eligibility for Federal contracting programs but is not explicitly considered as a selection factor in making Phase I or Phase II award decisions in the SBIR or STTR programs. MINORITY equals 1 if the firm is minority-owned, and equals 0 otherwise.[15] GENDER equals 1 if the firm is woman-owned and equals 0 otherwise.[16]

Control variables We incorporate control variables to account for relevant factors which may influence the likelihood of successfully transitioning a SBIR or STTR award from Phase I to Phase II. We include two time-varying covariates to represent these factors: (1) STATE_ENTRATE is the state-level Kauffman Index of Entrepreneurial Activity[17] and (2) STATE_CLUSTER is the state-level economic strength of the regional industry clusters present (Delgado et al. 2014).[18] To account for unobserved heterogeneity associated with the SBIR

[14] For 2001–2009, the OPM's diversity categories were Black, Hispanic, Asian/Pacific Islander, and Native American. For 2010–2011, the OPM redefined these categories to Black, Hispanic, Asian, American Indian/Alaskan, and Native Hawaiian/Pacific Islander. This recategorization does not affect our measure, since either set of categories captures the respective percentages of minority or non-White employees in the Federal Agency.

[15] https://www.sba.gov/content/minority-owned-businesses

[16] https://www.sba.gov/content/women-owned-small-business-program

[17] http://www.kauffman.org/microsites/kauffman-index

[18] http://clustermapping.us, Institute for Strategy and Competitiveness, Harvard Business School

Table 1 SBIR and STTR awards and transition rates

Summary of overall Phase I and Phase II awards and transition rates 2001–2011					
By agency	Phase I awards	Phase II awards	Share of phase I awards	Transition rate	Share of phase II awards
DHS	471	74	0.9%	15.7%	0.4%
DOC	403	135	0.8%	33.5%	0.8%
DOD	25,397	10,437	48.6%	41.1%	59.7%
DOE	3628	1270	6.9%	35.0%	7.3%
DOT	178	29	0.3%	16.3%	0.2%
ED	423	67	0.8%	15.8%	0.4%
EPA	662	67	1.3%	10.1%	0.4%
HHS	12,153	2581	23.2%	21.2%	14.8%
NASA	4112	1771	7.9%	43.1%	10.1%
NSF	3817	810	7.3%	21.2%	4.6%
USDA	1038	243	2.0%	23.4%	1.4%
Other	4	1	0.0%	25.0%	0.0%
Total	52,286	17,485	100.0%	33.4%	100.0%
By program					
SBIR	46,418	15,660	88.8%	33.7%	89.6%
STTR	5868	1825	11.2%	31.1%	10.4%
total	52,286	17,485	100.0%	33.4%	100.0%
By firm type					
Minority					
0 (non-minority)	48,513	16,312	92.8%	33.6%	93.3%
1 (minority)	3773	1173	7.2%	31.1%	6.7%
Total	52,286	17,485	100.0%	33.4%	100.0%
Gender					
0 (male owned)	47,051	15,804	90.0%	33.6%	90.4%
1 (female owned)	5235	1681	10.0%	32.1%	9.6%
Total	52,286	17,485	100.0%	33.4%	100.0%

and STTR awards in our sample, we add dummy variables for the AGENCY granting the focal award, the YEAR the focal award was received, and the STATE in which the firm receiving the focal award was located.

4.3 Model specification

We analyze our sample using a binary logistic regression model presented in the series of equations described below. We follow the overall approach of Allison (1999) and Hoetker (2004, 2007) for the comparison of coefficients across groups. We begin with a general model to illustrate key methodological considerations and then explain how our specified model for this study addresses these considerations. First, suppose that the general dependent variable is $y_i = 1$ when a binary outcome occurs and is $y_i = 0$, when it does not occur. Now, further suppose that y equals 1 only when an unobserved, continuous variable y^* exceeds a threshold μ that is also unobserved. As shown in Eq. 1:

$$y_i = \begin{cases} 1 \text{ if } y_i^* > \mu \\ 0 \text{ if } y_i^* \leq \mu \end{cases} \quad (1)$$

We also assume there exists a linear relationship between y^*, the vector of observed covariates, $\boldsymbol{x_i}$, and the independent random disturbance, ε_i.

$$y_i^* = \boldsymbol{x_i}\boldsymbol{\alpha} + \varepsilon_i \quad (2)$$

For this latent variable model, the values for the variance and mean of y^* and the threshold μ cannot be estimated. To construct a logit model, we assume that

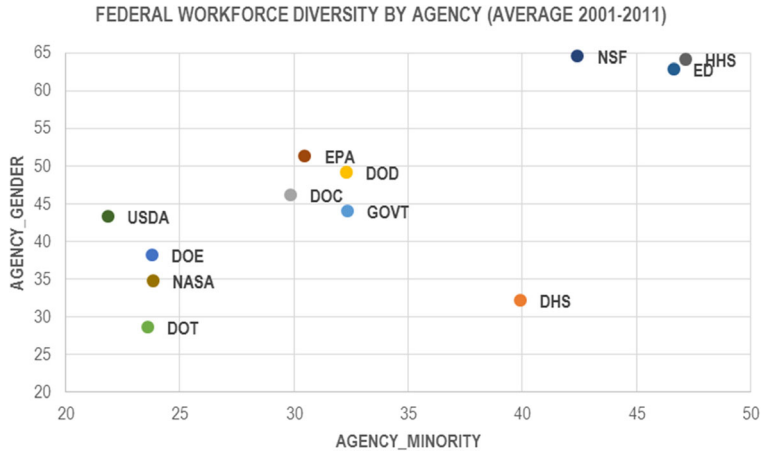

Fig. 1 Federal workforce diversity

the residual variation, ε_i, has a logistic distribution and a fixed variance, and we add the parameter σ to represent the standard deviation of ε_i. We obtain

$$\log\left(\frac{p_i}{1-p_i}\right) = \boldsymbol{x_i\beta}, \quad \text{where}\,\beta = \frac{\alpha}{\sigma} \tag{3}$$

Note that Eq. 3 has at least three important implications for our study. First, even if we obtain the estimated values of the β coefficients (Eq. 3), we are unable to determine the true effect of the α coefficients in the linear latent variable model (Eq. 2), because σ is unobserved (Allison 1999). Second, if the logit model (Eq. 3) is used to compare coefficients across groups, then the existence of the same single error term, ε_i, imposes the same residual variation σ on both groups (Hoetker 2004, 2007). Third, if small differences in residual variation σ indeed exist across groups with α coefficient values that are exactly the same (Eq. 2), this may result in large differences in the estimated β coefficients obtained using the logit model (Eq. 3) (Hoetker 2007). Because our research design tests hypotheses for differential effects of minority vs. non-minority-owned firms as well as woman-owned vs. non-woman-owned firms, we must explicitly address the possibility of differing residual variation across our focal groups of interest.

Resolving the issues arising from the preceding models requires an alternative specification in which the residual variation parameter σ may vary across groups. Since we have no basis to assume that the firms of minority or female business owners in our sample have the same unobserved residual variation as firms of their non-minority or male counterparts, we allow σ to vary. The proposed approach involves making a testable assumption that true values of the α coefficient are the same across groups, while the residual variation parameter σ differs across these groups (Hoetker 2004, 2007; Allison 1999). We then reformulate the model as follows:

$$y_i^* = \beta_0 + \beta_1 G_i + \textstyle\sum_{j>1}\beta_j x_{ij} + \sigma_i\varepsilon_i, \text{where} \tag{4}$$

$$G_i = \begin{cases} 0 & \text{for group 0} \\ 1 & \text{for group 1} \end{cases}, \text{and}\,\sigma_i = \frac{1}{1+\delta G_i}, \delta > 1$$

In Eq. 4, for group 0, when the residual variation σ is set to 1, a positive value of δ (delta) > 0, implies that group 1 has less residual variation σ than group 0. In contrast, a negative value of δ (delta) < 0, means that group 1 has a larger residual variation σ than group 0. As a final step, we combine Eq. 4 with Eq. 3 and obtain (Hoetker 2004, 2007; Allison 1999)

$$y_i = \log\left(\frac{p_i}{1-p_i}\right) = \left(\beta_0 + \beta_1 G_i + \textstyle\sum_{j>1}\beta_j x_{ij}\right)(1+\delta G_i) \tag{5}$$

In Eq. 5, by substituting our dependent variable, TRANSITION for y_i, and our focal group of interest, either MINORITY or GENDER, for G_i, we may estimate a binary logit model. To complete the model, we include all of our remaining and previously defined explanatory and control variables corresponding to the elements of the vector of observed covariates, $\boldsymbol{x_i}$. To later correctly compare coefficients across groups, we further specify either MINORITY or GENDER as the focal G_i in a given model while the other variable remains a part of vector $\boldsymbol{x_i}$.

5 Results

5.1 Descriptive statistics and correlations

As summarized in Table 1, overall, 33.4% of Phase I awards transition to Phase II. The transition rates are similar across the SBIR (33.7%) and STTR (31.1%) programs. The DOD share of Phase I awards is 48.6%, and its share of Phase II awards is 59.7%. The DOD transition rate is 41.1%, second highest among all agencies. NASA's 7.9% share of Phase I awards is the third largest, and its 43.1% transition rate is the highest. In contrast, the transition rates for two other agencies with large shares of Phase I awards, HHS (23.2%) and NSF (7.3%), are substantially lower, with both at 21.2%. However, as shown in Fig. 1, HHS and NSF employ workforces that are far more diverse in terms of race, ethnicity, and gender than NASA or DOD. In fact, during our study timeframe, nearly two thirds of all HHS and NSF employees were women. Table 1 also generally supports both H1a and H1b by indicating lower transition rates for minority-owned (MINORITY = 1) and women-owned (GENDER = 1) grantees.

Table 2 summarizes the descriptive statistics and correlations for the key variables of interest in our study. In terms of ownership status, among Phase I award recipients in our sample, 7.1% are minority-owned firms and 10.2% are women-owned firms. The average Phase I award amount received is $114.7 K. The average value of AGENCY_MINORITY is 32.7 and AGENCY_GENDER is 44.9 for the awards in our sample. This means that the likelihood that a randomly selected employee from the Federal agency associated with any given award in our sample is a member of a US minority racial or ethnic group is 32.7%. The likelihood that a randomly selected employee of the Federal agency associated with any given award is female is 44.9%. The bivariate correlation between AGENCY_MINORITY and AGENCY_GENDER is 0.917 ($p < 0.01$), which indicates that there is a large and significant relationship between the total percentage of minority employees in a Federal agency's workforce and its total percentage of female employees. This is not surprising given the long-term emphasis within the Federal government on increasing the participation of historically underrepresented groups including minorities and women in the workforce. As noted earlier in our graphical depiction of the composition of the Federal workforce shown in Fig. 1, agencies such as the NSF and HHS, in particular, have high levels of AGENCY_MINORITY and AGENCY_GENDER. Nonetheless, to carefully isolate the effects of AGENCY_MINORITY from AGENCY_GENDER, we conduct two separate sets of logistic regression analyses so that these overlapping explanatory factors are not included in the same models.

No pair of variables in any of our models has a correlation greater than 0.40 ($p < 0.01$), which is the correlation between MINORITY and GENDER. We check multi-collinearity diagnostics and find that the average variance inflation factor (VIF) values for the variables in our models is 1.14, and no variable exceeds 1.23, indicating that multi-collinearity is not an issue.

Table 2 Descriptive statistics and correlations

	Variable	MEAN	S.D.	1	2	3	4	5	6	7	8	9
1	TRANSITION	0.326	0.469	1								
2	AGENCY_MINORITY	32.649	7.447	−.161[a]	1							
3	AGENCY_GENDER	44.870	11.463	−.180[a]	.917[a]	1						
4	AGENCY_P2FUNDING	8.296	0.620	.112[a]	.024[a]	−.197[a]	1					
5	MINORITY	0.071	0.257	−.015[a]	.104[a]	.080[a]	.049[a]	1				
6	GENDER	0.102	0.303	−.011[a]	.101[a]	.057[a]	.087[a]	.400[a]	1			
7	P1AMOUNT10K	11.470	10.497	−.011[b]	.302[a]	.277[a]	.050[a]	.084[a]	.091[a]	1		
8	STATE_ENTRATE	0.306	0.089	.001	−.026[a]	−.035[a]	−.013[a]	.017[a]	.036[a]	.032[a]	1	
9	STATE_CLUSTER	0.463	0.121	−.008	−.026[a]	−.032[a]	.019[a]	−.010[b]	.016[a]	−.015[a]	.331[a]	1

[a] Correlation is significant at the 0.01 level (2-tailed)

[b] Correlation is significant at the 0.05 level (2-tailed)

5.2 Logit models for baseline hypotheses

We specify a binary logistic regression model with TRANSITION as the dependent variable, and all of the previously described explanatory and control variables included. As summarized in Table 3, Model 1, we first analyze all Phase I awards (2001–2011) for all firms including AGENCY_MINORITY as a baseline model (McFadden's pseudo $r^2 = 0.083$, $N = 52{,}126$). In Model 1, we find AGENCY_MINORITY to be positive and significant ($p < 0.01$) with an odds ratio of 1.10. This indicates that a 1-point unit increase in the level of AGENCY_MINORITY is associated with 10% higher odds of TRANSITION for all firms in our sample. We also find AGENCY_P2FUNDING to be positive and significant ($p < 0.01$), with an order of magnitude increase in the granting agency's funding allocation for Phase II awards increasing a firm's odds of a successful TRANSITION by 23%. The amount of funding a firm received in its initial Phase I grant, P1AMOUNT10K, is positively and significantly ($p < 0.01$) related to the odds of a successful TRANSTION as well. Each $10K unit increase in the amount of Phase I funding received increases the odds of receiving a Phase II follow-on grant by nearly 1.7%. We note that the coefficients of MINORITY and GENDER are both negative in Model 1, but only MINORITY is significant ($p < 0.05$). These findings lend support to H1a (lower TRANSITION likelihood for minority-owned firms) but do not support H1b (lower TRANSITION likelihood for woman-owned firms).

Similar to Model 1, in Model 2 (McFadden's pseudo $r^2 = 0.082$, $N = 52{,}126$) as shown in Table 3, we find AGENCY_GENDER to be positive and significant ($p < 0.01$) with an odds ratio of 1.08. This indicates that each 1-point gain in the level of AGENCY_GENDER is associated with 8% higher odds of TRANSITION. We also find similar effects in Model 2 for AGENCY_P2FUNDING and P1AMOUNT10K as in Model 1. Both are positive and significant ($p < 0.01$). An order of magnitude increase in the agency's allocation for Phase II awards increases a firm's odds of a successful TRANSITION by 23%. Each $10K increase in the amount of Phase I funding received increases the odds of receiving a Phase II follow-on grant by about 1.6%. In Model 2, as in Model 1, the coefficients of MINORITY and GENDER are both negative, but only MINORITY is significant ($p < 0.01$). Again, these findings support H1a (lower TRANSITION likelihood for minority-owned firms) but do not support H1b (lower TRANSITION likelihood for woman-owned firms). We will conduct further tests of statistical significance in the next step to confirm and expand upon these initial findings for the different types of firms.

5.3 Logit models for valuing workforce diversity and leveraging homophily hypotheses

Following the approach outlined in our earlier model specification (Sect. 4.3), we estimate the residual variation for the focal groups of interest in our study, MINORITY and GENDER. We analyze models 1 and 2 using the *Stata complogit* function developed and recommended by Hoetker (2007).[19] For Model 1, we obtain $\delta = -0.27$ ($p < 0.01$) for MINORITY and $\delta = -0.16$ ($p < 0.01$) for GENDER. These parameter estimates for δ indicate that the residual variation for minority-owned firms is 27% greater than for non-minority-owned firms, and it is 16% greater for women-owned firms than non-women-owned firms. For Model 2, the values of $\delta = -0.22$ ($p < 0.01$) for MINORITY and $\delta = -0.13$ ($p < 0.05$) for GENDER indicate that the residual variation is 22 and 13% higher, respectively. All of the δ values obtained provide evidence that there may be a significant difference in the unobserved variation for our groups of interest.

Based on this evidence, Hoetker (2004, 2007) recommends applying Allison's (1999) test to determine if at least one of the covariates significantly differs between groups and to then identify the specific covariate. The test is conservative, yet powerful, while relying on minimal assumptions (Hoetker 2004, 2007). We conduct this test by again utilizing the *Stata complogit* function. We evaluate the effects of the covariate AGENCY_MINORITY with respect to MINORITY (Model 5, H3a) and GENDER (Model 4, H2b). We also evaluate the effects of the covariate AGENCY_GENDER with respect to MINORITY (Model 3, H2a) and GENDER (Model 6, H3b). This enables us to ascertain any differential effects between groups of grantees (MINORITY = 0 vs. 1 and GENDER = 0 vs. 1) associated with differences in diversity among grantors at the agency level (AGENCY_MINORITY and AGENCY_GENDER). The results for models 3 through 6 are presented in Table 4.

[19] See http://fmwww.bc.edu/RePEc/bocode/c/complogit.html for function description.

Table 3 Logit models for baseline hypotheses

	Coefficients	Odds ratios	Coefficients	Odds ratios
Model:	Model 1		Model 2	
Hypothesis:	H1a		H1b	
Variables	TRANSITION	TRANSITION	TRANSITION	TRANSITION
Grantor (agency-level)				
AGENCY_MINORITY	0.0977***	1.1026***		
	(0.0095)	(0.0105)		
AGENCY_GENDER			0.0754***	1.0783***
			(0.0101)	(0.0109)
AGENCY_P2FUNDING	0.2058***	1.2285***	0.2067***	1.2296***
	(0.0306)	(0.0376)	(0.0306)	(0.0376)
Grantee (firm-level)				
MINORITY	−0.1001**	0.9047**	−0.1381***	0.8710***
	(0.0435)	(0.0393)	(0.0432)	(0.0376)
GENDER	−0.0218	0.9784	−0.0423	0.9585
	(0.0377)	(0.0369)	(0.0376)	(0.0361)
P1AMOUNT10K	0.0165***	1.0167***	0.0159***	1.0160***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Controls				
STATE_ENTRATE	0.2058	1.2286	0.2209	1.2472
	(0.1987)	(0.2441)	(0.1986)	(0.2478)
STATE_CLUSTER	0.1369	1.1468	0.1235	1.1314
	(0.1577)	(0.1808)	(0.1575)	(0.1782)
AGENCY fixed effects	Included	Included	Included	Included
STATE fixed effects	Included	Included	Included	Included
YEAR fixed effects	Included	Included	Included	Included
Constant	−5.8449***	0.0029***	−6.7496***	0.0012***
	(0.3924)	(0.0011)	(0.5331)	(0.0006)
N	52,126	52,126	52,126	52,126
McFadden's pseudo r^2	0.0826	0.0826	0.0818	0.0818
Degrees of freedom	76	76	76	76
Chi^2	5490	5490	5438	5438
Log likelihood	−30,483	−30,483	−30,509	−30,509

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

In Table 4, we see that the direct effects of the variables AGENCY_MINORITY, AGENCY_GENDER, AGENCY_P2FUNDING, and P1AMOUNT10K are all positive and significant ($p < 0.01$) for all models 3–6 as well as the earlier models 1–2 in Table 3. We see that the direct effect of MINORITY is negative and significant across all models 3 through 6. Recall that MINORITY is also negative and significant in the previous models 1 and 2 for our baseline hypotheses. Based on these findings, we claim H1a is supported. The direct effect of GENDER is negative across all models 1 through 6, but significant only in models 3 through 6. Since the negative effect of GENDER is significant only in the presence of full interactions, but not in the direct models, we claim partial support for H1b. Our findings suggest that overall, when compared to their counterparts, minority-owned and

Table 4 Logit models for valuing workforce diversity and leveraging homophily hypotheses

Mechanism	Agencies valuing workforce diversity		Agencies leveraging homophily	
Diversity:	*Gender*	*Racial/ethnic*	*Racial/ethnic*	*Gender*
Model:	Model 3	Model 4	Model 5	Model 6
Hypothesis:	H2a	H2b	H3a	H3b
Variables	TRANSITION	TRANSITION	TRANSITION	TRANSITION
Grantor (agency-level)				
AGENCY_MINORITY		0.1125***	0.1137***	
		(0.0102)	(0.0103)	
AGENCY_GENDER	0.0874***			0.0875***
	(0.0109)			(0.0109)
AGENCY_P2FUNDING	0.2039***	0.2032***	0.2026***	0.2051***
	(0.0309)	(0.0307)	(0.0309)	(0.0308)
Grantee (firm-level)				
MINORITY	−0.5189**	−0.1602***	−0.7645**	−0.1880***
	(0.2372)	(0.0460)	(0.3025)	(0.0468)
Interaction: MINORITY × AGENCY_MINORITY			0.0163	
			(0.0105)	
Interaction: MINORITY × AGENCY_GENDER	0.0058			
	(0.0062)			
GENDER	−0.0776*	−0.8556***	−0.0688*	−0.4749**
	(0.0404)	(0.2267)	(0.0403)	(0.1849)
Interaction: GENDER × AGENCY_MINORITY		0.0254***		
		(0.0075)		
Interaction: GENDER × AGENCY_GENDER				0.0094**
				(0.0047)
P1AMOUNT10K	0.0169***	0.0168***	0.0177***	0.0163***
	(0.0013)	(0.0013)	(0.0013)	(0.0012)
Controls				
STATE_ENTRATE	0.2101	0.1999	0.1904	0.2182
	(0.2010)	(0.1992)	(0.2011)	(0.1999)
STATE_CLUSTER	0.1239	0.1307	0.1385	0.1146
	(0.1596)	(0.1583)	(0.1599)	(0.1586)
AGENCY Fixed Effects	Included	Included	Included	Included
STATE Fixed Effects	Included	Included	Included	Included
YEAR Fixed Effects	Included	Included	Included	Included
Constant	−7.2323***	−7.6891***	−7.6987***	−7.2683***
	(0.6789)	(0.6477)	(0.6638)	(0.6661)
N	52,126	52,126	52,126	52,126
Degrees of freedom	77	77	77	77
Chi^2	4500	4360	4437	4415
Log likelihood	−30,502	−30,473	−30,472	−30,504

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

women-owned firms have a lower likelihood of successfully transitioning from Phase I to Phase II in SBIR and STTR.

In Model 3, the interaction effect of MINORITY with AGENCY_GENDER is positive, but not significant, which does not support H2a. In contrast, in Model 4, we see that the interaction between GENDER and AGENCY_MINORITY is positive and significant ($p < 0.01$). Hence, our findings support the notion that grantor agencies *valuing workforce ethnic diversity* seem to positively influence the likelihood of Phase I to Phase II transition occurring for grantees that are women-owned firms.

In Model 5, the interaction effect of MINORITY with AGENCY_MINORITY is positive but not significant. This does not support H3a. However, in Model 6, the interaction between GENDER and AGENCY_GENDER is positive and significant ($p < 0.05$), which supports H3b. Thus, we find evidence that grantor agencies *leveraging gender homophily* appear to positively influence the likelihood of Phase I to Phase II transition occurring for grantees that are women-owned firms. In summary, three of our six exploratory hypotheses (H1a, H2b, and H3b) are supported and one (H1b) is partially supported.

6 Discussion and conclusion

In this study, we investigate R&D funding patterns of minority and women technology entrepreneurs through the lens of Federal innovation production policy. A key finding is that the likelihood of a Phase II transition for all Phase I awardees is increased by about 10 and 8% for every 1% increase in racial/ethnic and gender diversity, respectively, at the agency-level. This is a clear indication that Federal agency workforce diversity matters and is generally beneficial to all firms. Both small business grantees and policymakers alike may utilize this information as grantor agencies move towards or achieve diversity at varying rates. If stimulating greater innovation production is a primary goal for the Federal government, then promoting agency-level workforce diversity is a strategy supported by our empirical findings. It is also in the best interests of the Federal government to encourage all firms to consider agency workforce diversity profiles prior to grant proposal submission.

In addition, the amount of Phase II agency funds available and the amount of funding awarded are also economically significant predictors of the likelihood of transition. For each order of magnitude increase in agency Phase II funding, the likelihood of transition by Phase I awardees in the agency's portfolio increases by approximately 23%. For every $10K received in a Phase I award, the likelihood of transition to Phase II increases by approximately 1.7%. These results indicate that the supply of Phase II funding allocated at the agency-level and the amount of Phase I funding previously granted at the firm-level are meaningful indicators of successful progression through SBIR and STTR.

Our overall results imply a positive development pathway unfolding for agencies which seek to further diversify their workforce. Agencies valuing workforce diversity (racial/ethnic and gender) may invest and allocate part of their budgets to internal diversity initiatives and external outreach efforts designed for minority and women technology entrepreneurs, thereby enriching their talent pool. Agencies tapping into this diverse talent pool by leveraging homophily (racial/ethnic and gender) may improve their organizational performance in innovation. Homophily may enable and expand access to inventive ideas and technologies sourced from a more diverse range of suppliers, including minority-owned and women-owned small businesses. To the extent that the agency's innovation output increases over time along with its performance, its total budget allocation may also increase accordingly. The positive web of reinforcement linked to diversity and innovation may thus be further enhanced for grantors and grantees.

6.1 Managerial implications

While our study has many implications for government policy, our hypotheses and related results center around the practical implications for minority-owned and women-owned small businesses. First, we consistently find that minority-owned small businesses that are Phase I awardees have between a 9.5 and 12.9% lower likelihood of transition than non-minority-owned small businesses (H1a supported). This appears to occur even though race or ethnicity is not explicitly considered as selection criteria during the grant application process. Our finding is consistent with other recent studies on minority qualification processes which identify systematic disadvantages for minorities across multiple settings as well as internal studies conducted by Federal agencies (Gansler and Shivakumar 2015). Bates and Robb (2015:

1717) find that minority business owners are penalized when applying for bank loans outside of minority neighborhoods despite the "bankers claim to colour-blind evaluation criteria to all small-business loan applicants irrespective of firm location." Sen (2014) finds that black and female judicial nominees are more likely to be given lower ratings by the American Bar Association, which then increases the likelihood that their nominations will fail despite the lack of any significant differences in judicial performance between those with high or low ratings. While participating Federal agencies do factor in the competency of the Principal Investigator, we do not claim any systematic discrimination or bias within SBIR and STTR programs. We do, however, find that other factors indirectly related to minority-owned firms are likely to affect transition outcomes.

With a main result that minority-owned firms are less likely to transition than non-minority-owned firms, one may ask how this might change when a minority-owned small business applies for Phase II funding at a diverse versus a non-diverse agency. We find that valuing gender diversity (H2a) and leveraging ethnic homophily (H3a) at the Federal agency-level is positively but not significantly related to the transition likelihood for minority-owned firms. This means that if a minority technology entrepreneur applies for Phase II funding at a diverse agency, they are neither more nor less likely to secure funding than if the agency is less diverse. Therefore, we do not claim that any indirect relationship driven by the overall level of diversity or homophily exists between minority ownership status and agency diversity. However, this also means that a diverse workforce does not appear to be a significant barrier to securing Phase II funding for minority-owned small businesses. It is possible that general workforce diversity or homophily may cancel out or counteract some negative effects attributed to minority-owned small businesses. There may also be other unobservable factors negatively affecting transition which are not fully captured in our models (see Tables 3 and 4).

Women-owned small businesses are another historically underrepresented and underresearched group. We find that women technology entrepreneurs encounter negative odds for transition from Phase I to Phase II (H1b is partially supported), but that these effects are significant only in the full interaction models (see Table 4). Gender is also not explicitly taken into account during the evaluation process for SBIR and STTR, and it is possible that the effects of agency-level diversity are driving the results in this case. What this means is that all else being equal, a woman technology entrepreneur is less likely to secure Phase II funding when taking into account the indirect effects associated with a grantor agency's diversity.

The interaction effects between women-owned small businesses and agency diversity characteristics differ from that of minority-owned small businesses and may be of more practical use for entrepreneurs. We find that a Federal agency valuing workforce ethnic diversity (H2b supported) and leveraging gender homophily (H3b supported) positively influences the likelihood of transition for women technology entrepreneurs. Workforce diversity at the agency-level was found to be positive but not significantly related to minority-owned firms successfully transitioning (H2a and H3a not supported), so the practical implications for women-owned firms are clear. These small businesses have a critical choice to make when determining from which agency to seek Phase I funding. A more diverse agency workforce profile may offer a higher likelihood of securing Phase II funding because of the supporting mechanisms in place. For the firms in our study, women technology entrepreneurs do not appear to be as consistently disadvantaged in comparison to minority technology entrepreneurs in terms of achieving successful transitions to Phase II awards. Grantees who are women-owned small businesses do appear to be more broadly and more beneficially impacted by the presence of grantor agencies with diverse workforces.

6.2 Policy implications

Our most relevant and impactful finding for policymakers is that the general level of diversity (racial, ethnic, and gender) within grantor agencies exhibits a consistently positive and highly significant relationship with the likelihood of successful transition from Phase I to Phase II for all grantee firms. This means that all else being equal, Phase I awardees are more likely to obtain follow-on Phase II funding if the granting agency is more diverse. Phase II funding is critical because it bridges the private R&D funding gap between proof-of-concept and commercialization. If policymakers aim to achieve higher commercialization rates and thereby strengthen the national system of innovation, a heretofore overlooked lever might be unpacking how Federal agency workforce diversity may be enhanced going forward. Future research may start by delving deeper into the program administration of already diverse

agencies such as HHS (NIH), ED, and NSF. Such work may uncover best practices for directly increasing workforce diversity as well as harnessing the power of cognitive diversity in the grant review process.

In our background research for this study, we conducted informal in-person discussions with a cross-section of staff members directly involved in various aspects of the SBIR and STTR programs administered at several NASA Research Centers.[20] While the actual demographic composition of NASA's workforce indicates that it is less diverse compared to other large Federal agencies[21] (see Fig. 1), the current perceived commitment of its senior leaders to diversity is substantially higher.[22] Nominated in 2009 by President Barack Obama, NASA's 12th and current Administrator is Maj. Gen. Charles Frank Bolden, Jr., (USMC-Ret.), a former space shuttle astronaut, distinguished military commander, experienced small business enterprise CEO, and the first African-American to lead the agency.[23] Under Bolden's leadership, NASA has consistently been ranked as the top Federal agency in terms of its culture of innovation.

Through our discussions with NASA employees, we observed that NASA actively engages in a number of outreach programs with minority-serving educational institutions. This effort has intensified in the Bolden era. The agency recently announced $47 million in investments in minority-serving universities in 2015.[24] To the extent that researchers at these institutions are presently developing technologies of benefit to NASA, such outreach efforts may create an expanded pool of partner institutions for future SBIR and STTR applicants to engage in R&D collaboration. This pool may also be comprised of a greater share of minority-owned firms.

NASA's recent promotion of diversity and outreach actions may lead to a subtle but discernible influence on future funding outcomes for private sector applicants. By systematically evaluating past levels of diversity at NASA and other agencies, and then measuring how this affects the chances of subsequent Phase II award funding, we offer evidence that NASA may indeed be on the right path. Our results imply that NASA's current employee diversity efforts are likely to reshape the trajectory of its future SBIR and STTR program funding outcomes for different types of small business firms. More specifically, a higher level of workforce diversity at NASA over time may enhance its innovation performance. Among Federal agencies, NASA ranks remarkably high in terms of its culture of innovation, and our findings suggest that NASA's innovation output may increase along with its workforce diversity efforts.

Policymakers may also be interested in our finding that the amount of funds allocated to respective agencies in the year the Phase I award was granted is a steadfastly positive and significant predictor of the likelihood of a successful transition to Phase II. While it may not be surprising to find that Phase I awardees are more likely to transition to Phase II awards when the granting agency has more funds available, the differential impact of these funds may be somewhat more surprising. Funds from SBIR and STTR tend to have a disproportionately larger impact on minority-owned and women-owned small businesses than other types of firms. This implies that sustained funding of SBIR and STTR programs is vital for supporting minority and women technology entrepreneurs, who may have limited access to alternative means of financing their technology ventures and commercializing their innovations.

6.3 Conclusion

Our study offers insight into how Federal workforce diversity influences R&D funding outcomes for minority and women technology entrepreneurs in the SBIR and STTR programs. In some situations, underrepresented small business owners may have a higher likelihood of transitioning to Phase II if the grantor agency they are seeking follow-on funding from employs a more diverse workforce. In general, a diverse workforce at the agency-level is beneficial to all Phase I awardees and is aligned with current Federal initiatives. We underscore that agency workforce diversity appears to mitigate some inherent disadvantages that minority and women technology entrepreneurs face in the R&D funding process. In an era where diversity is becoming more embraced by organizations, it

[20] A member of our co-author team was an invited participant in a special NASA event held at the team member's university. With advanced planning and NASA's permission, our team member scheduled and met individually with appropriate representatives from 8 Research Centers and 2 Mission Directorates.

[21] The one notable exception in NASA's demographic diversity is that it does have a sizable Hispanic workforce compared to other large Federal agencies and the overall U.S. government. Most of NASA's major facilities are located in Florida, Texas, and California, which are states with large Hispanic populations relative to the rest of the U.S. NASA employees attributed the apparent success in recruiting Hispanic employees to the agency's ability to build long-term relationships with universities located near NASA centers.

[22] This is also supported by the results of the 2012 Federal Employee Viewpoint Survey. For more details, see: https://intern.nasa.gov/content/news/press-releases/BPTW13_CaseStudiesReport.pdf

[23] https://www.nasa.gov/about/highlights/bolden_bio.html

[24] http://www.nasa.gov/press-release/nasa-awards-research-grants-for-minority-serving-institutions

is critical to acknowledge that underrepresented groups still face substantial barriers to overcome and that policymakers can continue to drive progress in this area.

Armed with these empirical findings as well as future research on this important topic, scholars are better prepared to inform policymakers and administrators on the best practices for agency management and hiring. Researchers are now also better equipped to guide aspiring entrepreneurs in the pursuit of appropriate Federal funding sources and technology commercialization paths to achieve their market entry and new product introduction goals. Especially for first-time applicants, the SBIR/STTR grant process is often a daunting challenge. It is our hope that the results of this study shed some light on the realities of applying for Federal R&D funding with regard to historically underrepresented groups and offer evidence-based solutions to potentially strengthen our national system of innovation.

Acknowledgements We would like to express our sincere appreciation and gratitude to Tim Bates, Bill Bradford, Rob Seamans, Alicia Robb, and Maryann Feldman for their helpful insights and valuable feedback on earlier versions of this paper. We also thank our fellow participants in two Kauffman Minority Entrepreneurship Conferences held in San Francisco and Anaheim in 2016. This research is funded in part by the Ewing Marion Kauffman Foundation and the Rutgers Center for Urban Entrepreneurship & Economic Development. The contents of this publication are solely the responsibility of the authors.

Appendix A.

Table 5 Summary and comparison of SBIR and STTR programs

Elements	SBIR Program	STTR Program
Mission	*To support scientific excellence and technological innovation through the investment of Federal research funds in critical American priorities to build a strong national economy.*	
Stated goals	• Stimulate technological innovation • Meet Federal R&D needs • Foster and encourage participation in innovation and entrepreneurship by socially and economically disadvantaged persons • Increase private-sector commercialization of innovations derived from Federal R&D	• Stimulate technological innovation • Foster technology transfer through cooperative R&D between small businesses and research institutions • Increase private sector commercialization of innovations derived from Federal R&D
Agency eligibility	Federal agencies with extramural R&D budgets greater than $100 million are required to allocate 2.8% of their R&D budget to SBIR	Federal agencies with extramural R&D budgets that exceed $1 billion are required to reserve 0.3% of their budget to STTR.
Federal agencies (grantors)	• Dept. of Agriculture (USDA) • Dept. of Commerce (DOC) • Dept. of Defense (DOD) • Dept. of Education (ED) • Dept. of Energy (DOE) • Dept. of Health and Human Services (HHS) • Dept. of Homeland Security (DHS) • Dept. of Transportation (DOT) • Environmental Protection Agency (EPA) • National Aeronautics and Space Administration (NASA) • National Science Foundation (NSF)	• Dept. of Defense (DOD) • Dept. of Energy (DOE) • Dept. of Health and Human Services (HHS) • National Aeronautics and Space Administration (NASA) • National Science Foundation (NSF)
Timelines and Award Phases	• Phase I: normally not to exceed 6 months and $150,000 • Phase II: normally not to exceed 2 years and $1 million	• Phase I: normally not to exceed 1 year and $150,000 • Phase II: normally not to exceed 2 years and $1 million
Business Eligibility	Must be a for-profit business located in the USA. Must be majority owned and controlled by one or more US citizen(s) and/or permanent resident(s). May have no more than 500 employees	
Principal Investigator	51% or more of the PI's time is spent as an employee of the small business concern.	

Table 5 (continued)

Elements	SBIR Program	STTR Program
(PI) Rules		Minimum 10% of PI's time is spent on STTR project as an employee of the small business concern.
Subcontracts	• Subcontracts must not exceed 33% of total Phase I or 50% of total Phase II.	• Required to subcontract at least 30% of total award to institutional partner. • The small business concern must perform a minimum of 40% of the effort. • The remaining 30% may be attributed to either organization or an additional third party.
Scope of Funds	• Funds must be used entirely in USA. • Part of the research must take place in the small business concern.	• Funds must be used entirely in USA. • Part of research must take place in the small business concern as well as the institutional partner.
Initial Start Date and Original Legislation	• 1982—Authorized by Small Business Innovation Development Act (P.L. 97–219)	• 1992—Authorized by Small Business Research and Development Enhancement Act of 1992 (P.L. 102–564, Title II)
Timeline of Follow-on Legislation	• 1986—Amendment of Original 1982 Act (P.L. 99–443) • 1992—Small Business Research and Development Enhancement Act of 1992 (P.L. 102–564, Title I) • 2000—Small Business Innovation Research Program Reauthorization Act of 2000 (P.L. 106–554) 2012—National Defense Authorization Act of 2012 (P.L. 112–81)	• 1997—Small Business Reauthorization Act of 1997 (P.L. 105–135) • 2001—Small Business Technology Transfer Program Reauthorization Act of 2001 (P.L. 107–50) • 2012—National Defense Authorization Act of 2012 (P.L. 112–81)
Sources	• https://www.sbir.gov/about/about-sbir#sbir-program • https://grants.nih.gov/grants/policy/nihgps/html5/section_18/18.5_small_business_innovation_research_and_small_business_technology_transfer_programs.htm • https://sbir.nih.gov/faqs#subcontracts-sec1 • https://www.sbir.gov/tutorials/program-basics/tutorial-5#	

Appendix B.

Table 6 Summary of data sources and data collection procedures

Database and source	Description of database contents
Award listing (SBA)	Contains the phase (I or II), year, agency, agency tracking number, funding amount, award title, abstract, contract, solicitation topic code, company name, DUNS,[25] address, contact name, and ownership status (minority-owned, woman-owned) for all awards (112,506 Phase I and 45,022 Phase II) from the SBIR (1983–2016) and STTR (1994–2016) programs. We collect the entire population of 157,528 Federal small business research grants awarded from the inception of both programs to the present.
Company listing (SBA)	Captures the company name, DUNS, address, contact name, and ownership status (minority-owned, woman-owned) of all firms that received at least one SBIR Phase I award during 1983–2016 or at least one STTR Phase I award during 1994–2016. This represents the known population of firms that have ever participated in the SBIR or STTR programs as award recipients at any time during the history of either program. We collect the full set of 28,164 firms receiving at least one Phase I award.
Annual reports (SBA)	Aggregates agency-level data regarding the total number of proposals submitted, the total number of Phase I and Phase II awards granted, and the total funding allocated, by year for the SBIR program

Table 6 (continued)

Database and source	Description of database contents
	(1990–2013) and STTR (2000–2013), respectively. This database summarizes essential implementation differences across agencies over time. We collect this data for all Federal agencies and years for the SBIR and STTR programs.
Workforce diversity (OPM)	Describes the demographics of the Federal workforce in terms of the race, ethnicity, and gender of government employees by agency and by year. This data is presented in two formats. The Federal Office of Personnel Management (OPM) is also required to annually report to Congress on progress under the Federal Equal Opportunity Recruitment Program (FEORP).[26] We access the 2001–2011 data published in PDF form. We then digitize the text content of the FEORP reports using optical character recognition (OCR) processing software. After digitization, we consolidate the reports into a single, uniform dataset.

Database cross-check and consolidation procedures for SBA databases

1. We remove any duplicate entries found in the *Awards Listing* database and replace any revised awards with the corrected entries found in the same database.
2. We standardize variants of company names within the *Awards Listing* and *Company Listing* databases separately and then across both databases collectively, to disambiguate and identify unique firms. Wherever possible, we rely on the DUNS as a database index key to correctly and precisely match unique firms.[27] We also account for changes in firm names, addresses, and ownership status.[28]
3. Third, we exclude all firms that did not receive any SBIR or STTR Phase I or Phase II awards during 2001–2011, which is the focal timeframe of our study.[29]
4. Fourth, using the assigned agency tracking number as a unique identifier for each award as well as the content of the award title, abstract, contract, solicitation topic code, company name, DUNS, and address, we apply a combinatorial text pattern matching algorithm to systematically link each Phase II award with one and only one originating Phase I award.[30]
5. Fifth, as part of this matching process, we exclude all SBIR or STTR Phase I awards made after 2011. We assume that any SBIR or STTR Phase I award from 2011 or earlier without a corresponding linked Phase II award by 2014 did not transition from Phase I to Phase II during its timeframe of eligibility. This reduces the possibility of right-censoring our data and enables us to later apply a logistic regression analysis to evaluate the binary outcome of transitioning from a SBIR or STTR Phase I to a corresponding Phase II award. As a result of this five-step process, we extract a sample of 69,771 awards (52,286 Phase I and 17,485 Phase II) granted to 14,658 unique firms for the SBIR and STTR programs during 2001–2011.

[25] A DUNS or Dun & Bradstreet number is a 9-digit unique identifier for each physical location of a business. Number assignment is free for all businesses required to register with the Federal government for contracts or grants. For details, see: https://www.sba.gov/contracting/getting-started-contractor/get-d-u-n-s-number .

[26] The report is prepared in compliance with the law (5 U.S.C. 7201 and 5 CFR Part 720, Subpart B) and contains information on the representation of minorities within the Federal Government and best practices of Federal agencies. For details, see https://www.opm.gov/policy-data-oversight/diversity-and-inclusion/reports/#url=Federal-Equal-Opportunity-and-Recruitment-Program .

[27] Note that the Federal government only required grant recipients and contractors to obtain a DUNS starting in 2003, so not all firms in the sample have a valid DUNS. If a DUNS is not available, then we use a combination of company name, address, agency tracking number, contract, and award title to search for a possible match.

[28] To resolve changes in firm names, addresses, and ownership status, we utilize self-reported data provided by firm representatives. This data is updated via the Federal System for Award Management (SAM) and searchable online in the SBA's Dynamic Small Business Search (DSBS) database. See https://www.sam.gov/portal/SAM/##11 .

[29] The years 2001–2011 span the time period after enactment of the SBIR Program Reauthorization Act of 2000, but before the start of the SBIR/STTR Reauthorization Act of 2011, which mandated major policy changes in the administration of these programs across participating Federal agencies. By focusing exclusively on this period, we are able to eliminate the introduction of major new policy directives as an alternative explanation for the observed effects. This timeframe represents a period of increased public disclosure from Federal agencies in providing accurate workforce composition and diversity data which is essential for this study.

[30] Our algorithm enabled us to automatically link approximately 94% of the Phase II awards to their originating Phase I awards. We matched the remaining 6% by manually searching and checking additional databases on the awarding agency websites. We excluded 160 awards from our sample due to missing or incomplete records.

References

Aldrich, H. E. (1989). Networking among women entrepreneurs. *Women-Owned Businesses, 103*, 132.

Aldrich, H. E., & Waldinger, R. (1990). Ethnicity and entrepreneurship. *Annual Review of Sociology*, 111–135.

Allison, P. D. (1999). Comparing logit and probit coefficients across groups. *Sociological Methods & Research, 28*(2), 186–208.

Audretsch, D. B. (2003). Standing on the shoulders of midgets: The US Small Business Innovation Research program (SBIR). *Small Business Economics, 20*(2), 129–135.

Audretsch, D. B., Link, A. N., & Scott, J. T. (2002). Public/private technology partnerships: Evaluating SBIR-supported research. *Research Policy, 31*(1), 145–158.

Baron, J. (1993). The small business technology transfer (STTR) program: converting research into economic strength. *Economic Development Review, 11*(4), 63.

Bates, T., & Robb, A. (2015). Has the community reinvestment act increased loan availability among small businesses operating in minority neighbourhoods? *Urban Studies, 52*, 1702–1721.

Borgatti, S. P., & Cross, R. (2003). A relational view of information seeking and learning in social networks. *Management Science, 49*(4), 432–445.

Cheav, V. (2013). Programs of parity: current and historical understandings of the small business Act's section 8 (a) and HUBZone programs. *DePaul Business and Commercial Law Journal, 12*, 477.

Cooper, R. S. (2003). Purpose and performance of the Small Business Innovation Research (SBIR) program. *Small Business Economics, 20*(2), 137–151.

Delgado, M., Porter, M. E., & Stern, S. (2014). Clusters, convergence, and economic performance. *Research Policy, 43*(10), 1785–1799.

Elsass, P. M., & Graves, L. M. (1997). Demographic diversity in decision-making groups: the experiences of women and people of color. *Academy of Management Review, 22*(4), 946–973.

Elston, J. A., & Audretsch, D. B. (2011). Financing the entrepreneurial decision: an empirical approach using experimental data on risk attitudes. *Small Business Economics, 36*(2), 209–222.

Ford, B. K., Sander, E., Shino, K. J., & Hardin, J. M. (2008). SBIR and STTR programs: the private sector, public sector and university trifecta. *Journal of Research Administration, 39*(1), 58–77.

Gansler, J., & Shivakumar, S. (2015). *SBIR/STTR at the National Institutes of Health*. Washington, D.C: The National Academies of Sciences, Engineering and Medicine.

Gicheva, D., & Link, A. N. (2013). Leveraging entrepreneurship through private investments: does gender matter? *Small Business Economics, 40*(2), 199–210.

Gicheva, D., & Link, A. N. (2015). The gender gap in federal and private support for entrepreneurship. *Small Business Economics, 45*(4), 729–733.

Gilbert, B. A., Audretsch, D. B., & McDougall, P. P. (2004). The emergence of entrepreneurship policy. *Small Business Economics, 22*(3–4), 313–323.

Grossman, G. M., & Helpman, E. (1993). *Endogenous innovation in the theory of growth*. Cambridge: National Bureau of Economic Research.

Hoetker, G. P. (2004). Confounded coefficients: extending recent advances in the accurate comparison of logit and probit coefficients across groups. *Available at SSRN 609104*.

Hoetker, G. P. (2007). The use of logit and probit models in strategic management research: Critical issues. *Strategic Management Journal, 28*(4), 331–343.

Jackson, S. E., & Joshi, A. (2004). Diversity in social context: a multi-attribute, multilevel analysis of team diversity and sales performance. *Journal of Organizational Behavior, 25*(6), 675–702.

Jackson, S. E., May, K. E., & Whitney, K. (1995). Understanding the dynamics of diversity in decision-making teams. *Team effectiveness and decision making in organizations,* 204, 261.

Jackson, S. E., Joshi, A., & Erhardt, N. L. (2003). Recent research on team and organizational diversity: SWOT analysis and implications. *Journal of Management, 29*(6), 801–830.

Jones, S. R. (2007). Supporting urban entrepreneurs: law, policy, and the role of lawyers in small business development. *Western New England Law Review, 30*, 71.

Joshi, A. M. (2014). Innovation policy. In: *The Palgrave Encyclopedia of Strategic Management* (pp. 5). Basingstoke: Palgrave Macmillan.

Joshi, A., & Roh, H. (2009). The role of context in work team diversity research: a meta-analytic review. *Academy of Management Journal, 52*(3), 599–627.

Joshi, A., Liao, H., & Jackson, S. E. (2006). Cross-level effects of workplace diversity on sales performance and pay. *Academy of Management Journal, 49*(3), 459–481.

Joshi, A., Liao, H., & Roh, H. (2011). Bridging domains in workplace demography research: a review and reconceptualization. *Journal of Management, 37*(2), 521–552.

Kalnins, A., & Chung, W. (2006). Social capital, geography, and survival: Gujarati immigrant entrepreneurs in the US lodging industry. *Management Science, 52*(2), 233–247.

Kariv, D., Menzies, T. V., Brenner, G. A., & Filion, L. J. (2009). Transnational networking and business performance: ethnic entrepreneurs in Canada. *Entrepreneurship and Regional Development, 21*(3), 239–264.

King, R. G., & Levine, R. (1993). Finance, entrepreneurship and growth. *Journal of Monetary Economics, 32*(3), 513–542.

Kochan, T., Bezrukova, K., Ely, R., Jackson, S., Joshi, A., Jehn, K., et al. (2003). The effects of diversity on business performance: report of the diversity research network. *Human Resource Management, 42*(1), 3–21.

Lanahan, L. (2016). Multilevel public funding for small business innovation: A review of US state SBIR match programs. *The Journal of Technology Transfer, 41*(2), 220–249.

Lanahan, L., & Feldman, M. P. (2015). Multilevel innovation policy mix: a closer look at state policies that augment the federal SBIR program. *Research Policy, 44*(7), 1387–1402.

Lau, D. C., & Murnighan, J. K. (1998). Demographic diversity and faultlines: the compositional dynamics of organizational groups. *Academy of Management Review, 23*(2), 325–340.

Lerner, J. (2000). The government as venture capitalist: the long-run impact of the SBIR program. *The Journal of Private Equity, 3*(2), 55–78.

Link, A. N., & Ruhm, C. J. (2009). Bringing science to market: Commercializing from NIH SBIR awards. *Economics of Innovation and New Technology, 18*(4), 381–402.

Link, A. N., & Ruhm, C. J. (2011). Public knowledge, private knowledge: the intellectual capital of entrepreneurs. *Small Business Economics*, *36*(1), 1–14.

Link, A. N., & Scott, J. T. (2010). Government as entrepreneur: Evaluating the commercialization success of SBIR projects. *Research Policy*, *39*(5), 589–601.

McKay, P. F., Avery, D. R., & Morris, M. A. (2008). Mean racial-ethnic differences in employee sales performance: the moderating role of diversity climate. *Personnel Psychology, 61*(2), 349–374.

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: homophily in social networks. *Annual Review of Sociology, 27*, 415–444.

Miller, K. L. (1999). Moving from the racial battleground to the economic common ground. *Small & Emerging Business Law, 367*, 374.

Rauch, J. E., & Trindade, V. (2002). Ethnic Chinese networks in international trade. *Review of Economics and Statistics, 84*(1), 116–130.

Richard, O. C. (2000). Racial diversity, business strategy, and firm performance: a resource-based view. *Academy of Management Journal, 43*(2), 164–177.

Robinson, J. A. (2007). Urban entrepreneurship: patterns and policy. *Western New England Law Review, 30*, 103.

Romer, P. M. (1990). Endogenous technological change. *The Journal of Political Economy, 98*(5), S71–S102 Part 2: The Problem of Development: A Conference of the Institute for the Study of Free Enterprise Systems.

Romer, P. M. (1994). The origins of endogenous growth. *Journal of Economic Perspectives, 8*(1), 3–22.

Sen, M. (2014). How judicial qualification ratings may disadvantage minority and female candidates. *Journal of Law and Courts, 2*(1), 33–65.

Stuart, T. E., & Sorenson, O. (2007). Strategic networks and entrepreneurial ventures. *Strategic Entrepreneurship Journal, 1*(3–4), 211–227.

Wessner, C. W. (2000). *The Small Business Innovation Research program: an assessment of the Department of Defense fast track initiative*. Washington, DC: National Academy Press.

Williams, K. Y., & O'Reilly III, C. A. (1998). A review of 40 years of research. *Research in Organizational Behavior, 20*, 77–140.