Technology-based state growth policies: the case of North Carolina's Green Business Fund

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Abstract:

US technology-based initiatives at the state level continue to emphasize regional economic development and job growth. Many are now also focused on green technologies. This paper describes one such green program, the North Carolina Green Business Fund. Based on an analysis of 24 funded R&D projects in 2008 and 2009, we find that 59 new full-time equivalent jobs were created in the short run through this program. We also find that those organizations that can attract greater additional financial support for their research generate more jobs. Lastly, we find that university involvement in these projects tempers job losses among projects discontinued early as well as job growth among those that commercialized their technologies. We cautiously offer, because of limited data, recommendations to states with similar programs to create structures to advise technology-based research organizations about sources of additional financial resources.

Keywords: R and D | North Carolina Green Business Fund | technology-based research

Article:

Introduction

US technology-based initiatives at the state level are not a new phenomenon for stimulating regional economic development, in general, and job growth, in particular. Such initiatives can be traced at least to the post-World War II development of science and research parks. For example, Stanford Research Park in California was founded in 1951 and Research Triangle Park in North Carolina was founded in 1959. Regional economic development and job growth were explicit goals of these and other similar ventures.[1]

More recently, states have adopted more focused policies. As Eisinger (1988, p. 6) pointed out:

> The 50 states and many of their communities are in the process of fashioning, with varying degrees of vigor and coherence, separate little industrial policies, self-conscious

[1] For a discussion of the economics of science and research parks, see Link and Scott (2007).

> attempts to foster selected industries judged to provide comparative local advantage or to be critical to the local economic future.

And, as Wessner (2013 p. 11, p. 14) noted:

> Since the early 1990s, a number of states have increasingly viewed support for innovation clusters as a leading policy tool for fostering the international competitiveness of local industries ... Most—albeit not all—state and regional cluster initiatives seek to build on existing *local industrial competencies* [emphasis added] and natural resources to establish industries of the future rather than creating those industries entirely from scratch.

Most recently, many state practices have focused on green technologies as they built on "local industrial competencies". For example, in 2009 the National Governor's Association convened a roundtable to discuss best practices in promoting green jobs and green industries.[2]

The purpose of this paper is to describe one such green program, the North Carolina Green Business Fund. From a narrow perspective, this paper could be viewed as simply an assessment of this particular regional growth policy; but from a more general perspective, we believe that it foretells the types of entrepreneurial initiatives to be seen across states and the imperative that each will face from a public accountability perspective; that is, regional scientists will be called upon to provide insight into the regional impacts associated with this use of state moneys to pursue technology-based growth.

The remainder of the paper is outlined as follows. In Sect. 2, the North Carolina experience is overviewed from an institutional perspective. In Sect. 3, we describe the job growth attributable to the Green Business Fund, and we offer an empirical look at factors associated with job growth across organizations that received R&D support from the Fund. We do not find that the size of the R&D grant is statistically related to job growth, but the amount of additional investments the organization received to support its project is. Also, involvement of a university in the funded project decreases job losses if the project is prematurely discontinued; involvement also decreases employment gains in organizations for which the developed technology is commercialized. The paper concludes in Sect. 4 with remarks about the limitations of the study and, subject to those limitations, how our model and findings might still be useful as a guide to the assessment of similar programs in other states.

North Carolina's Green Business Fund

The North Carolina General Assembly approved the creation of the North Carolina Green Business Fund (hereafter, the Fund) in 2007 "to encourage the expansion of small- to medium-size businesses with less than 100 employees to help grow a green economy in the State".[3] According to Dr. John Hardin, Executive Director of the North Carolina Board of

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[2] See: http://www.nga.org/cms/home/nga-center-for-best-practices/meeting--webcast-materials/page-eet-meetings-webcasts/col2-content/main-content-list/green-economy-state-roundtable.html.

[3] As stated in the General Statute 143B-437.4: "The NC Green Business Fund is established as a special revenue fund in the Department of Commerce. ... The Department of Commerce shall make grants from the Fund to private businesses with less than 100 employees, nonprofit organizations, local governments, and state agencies to

Science and Technology (hereafter, the Board) which is staffed by the Office of Science and Technology within the state's Department of Commerce:[4]

> When then Lieutenant Governor Beverly Perdue proposed to the General Assembly the NC Green Business Fund her argument for it was that it would leverage North Carolina's economy by creating jobs through innovation, and it would also benefit the environment.

North Carolina is not unique in establishing such a growth initiative. Our independent data collection efforts through 2013 yielded information on 20 green or sustainability technology grants programs, similar to the Fund, in 10 states besides North Carolina.[5] See Fig. 1.[6]

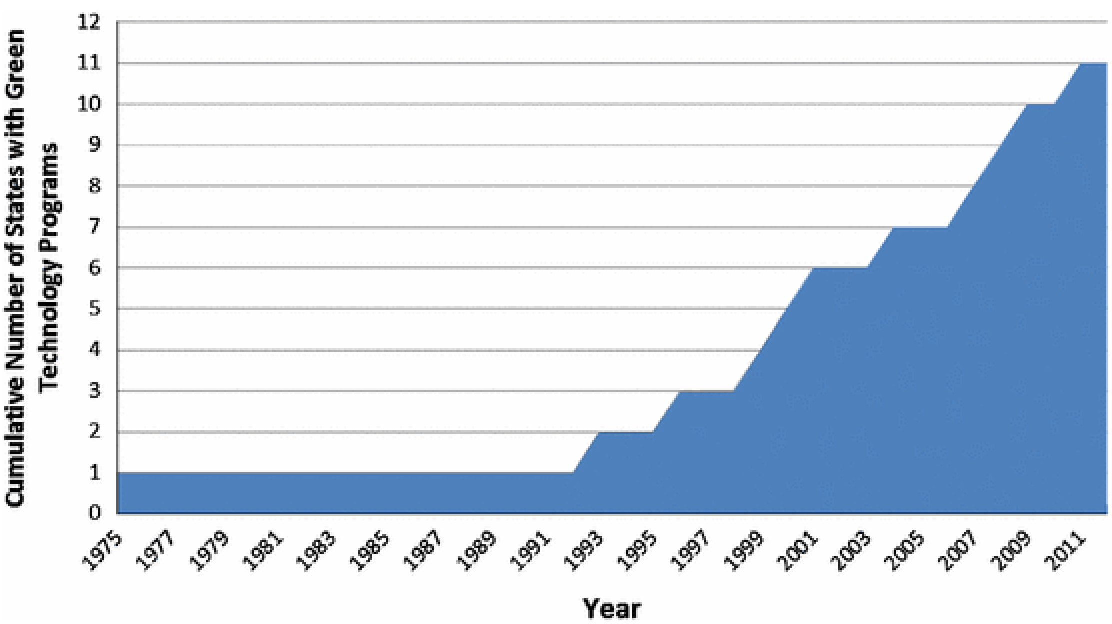

Fig. 1. Cumulative number of states with Green Technology Programs. *Note*: From 1975 to 2001 New York was the only state with a similar green technology program. It was sponsored by NYSERDA. *Source*: Primary data for the construction of this figure are available from the authors

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encourage the expansion of small- to medium- size businesses with less than 100 employees to help grow a green economy in the state. Moneys in the NC Green Business Fund shall be used for projects that will focus on the following three priority areas ... [t]o encourage the development of the biofuels industry ... [t]o encourage the development of the green building industry ... [and to] attract and leverage private-sector investments and entrepreneurial growth in environmentally conscious clean technology and renewable energy products and businesses".

[4] According to Hardin, the primary debate in the General Assembly about the Fund was whether it should be a grants program or a loan program. Although the US economy entered into the so-called Great Recession in late 2007, there is no legislative evidence that the Fund was established in anticipation of the state's pending economic downturn.

[5] To the best of our knowledge, no other states have conducted an assessment of their programs. That said, Yi (2013) provides empirical evidence at the metropolitan level of job creation from suitability incentive programs.

[6] Detailed information about these other programs is available from the authors on request.

The North Carolina State Legislature allotted $1,000,000 to the Fund for both FY 2008 and FY 2009.[7] Of the 85 applications received in response to the FY 2008 solicitation, 13 were selected to receive an award; for the FY 2009 solicitation, 14 organizations received R&D grants.[8]

An economic framework to describe this R&D grants program, which built on "local industrial competencies," is shown in Fig. 2. Simply, the R&D award from the state to an existing organization expands its level of their own R&D investments and orients those investments, per the application guidelines, into green technologies.[9] The vertical axis in Fig. 2 measures the marginal rate of return to investments in R&D and the horizontal axis measures the level of R&D spending. RD_0 is the optimal level of R&D for the organization represented by the figure. Receipt of an R&D grant from the Fund lowers the organization's marginal cost as shown by the downward arrow. As the organization's marginal cost of conducting R&D decreases, it increases its level of R&D investments along its marginal return schedule to level RD_1, a level sufficient for it to pursue the funded R&D project.

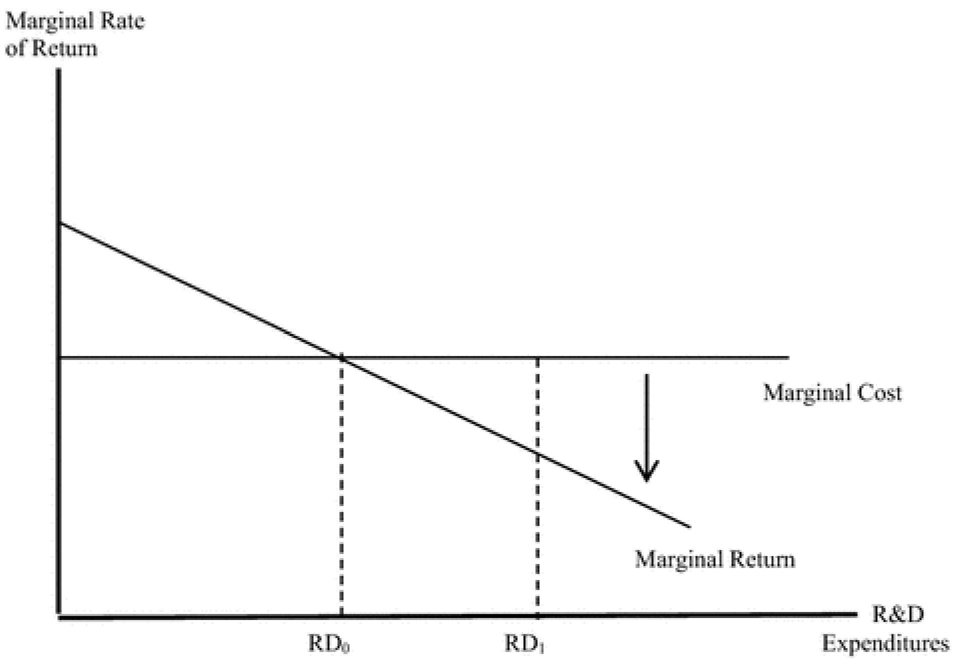

Fig. 2. Economic framework to describe the impact of the Green Business Fund

The Board collected information on all organizations at the time of their application and then follow-on survey information from the grant recipients in 2012.[10] Of the 27 organizations that received R&D support over the two solicitations, 24 completed or partially completed the

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[7] In FY 2010 and FY 2011, allocations came from the American Recovery and Reinvestment Act (ARRA) of 2009. After 2011, the state did not have the financial resources to continue the Fund.
[8] A description of each organization that received an award is available in Hall (2014).
[9] Leyden and Link (2015) refer to such a program as an example of public sector entrepreneurship.
[10] The General Assembly in North Carolina periodically and systematically reviews agencies, divisions, and programs financed by state government. This Continuation Review Program is intended to assist the General Assembly in determining whether to continue, reduce, or eliminate funding. As part of that review, the state's Office of Science and Technology systematically collected survey information from the organizations funded in FY 2008 and FY 2009 (Hardin 2012).

survey. This represents an 89 percent response rate. Of the 24 recipient organizations, 21 are private companies and 3 are public organizations. Sample selection bias is always an issue when survey data are analyzed. Based on application data, there are no statistical differences between the population of funded organizations (n = 27) and the survey sample (n = 24) in terms of the size of the grant, the age of the organization, or the level of employment at the time of the award.[11]

Analysis of the NC fund data

The specific survey question that motivated our empirical analysis in this paper relates to the number of full-time equivalent jobs that were created in the funded organization as a result of receiving (i.e., attributable to) the Fund award.[12] Our emphasis on jobs comes not only from a stated purpose of the R&D grants program but also from a national movement of states creating such programs to stimulate job growth, as discussed above.

Attribution of performance is always an important issue to consider when conducting an assessment or an evaluation of a public sector program, especially a grants program. We are assuming full attribution; we justify this assumption from the manner, in which the key survey question about job growth is phrased (see footnote 12).

As shown in Table 1, job or employment growth created through projects supported by the Fund differs depending on whether the recipient is a private company or a public organization. For the 21 private companies, 2.7 new full-time equivalent employees were created, on average, compared to <1, on average, in the 3 public organizations. Relative to the amount of the award, on average six new jobs were created among the private companies for each $100,000 of grant money and on average <1 new job was created for the same amount of grant money among the public organizations.

Table 1. Descriptive statistics related to full-time equivalent employment growth attributable to NC Green Business Fund grants

	All organizations (*n* == 24)			**Private companies (*n* == 21)**			**Public organizations (*n* == 3)**		
	Mean	**SD**	**Range**	**Mean**	**SD**	**Range**	**Mean**	**SD**	**Range**
Employ	2.46	4.04	0–16	2.71	4.26	0–16	0.67	1.15	0–2
Employ per Award ($1000)	0.05	0.09	0–0.33	0.06	0.10	0–0.33	0.007	0.01	0–0.02

Derivable from Table 1 is that the Fund, that is these 24 funded organizations, accounted for 59 new full-time equivalent new jobs in the short run (i.e., as of 2012), assuming full attribution. On the one hand, one can approximate from an aggregate average that there were about 30 new jobs per $1,000,000 of grant funding attributable to the NC Fund: 59 new jobs per $2,000,000. On the other hand, one can approximate from an average of averages that there were about 50 new jobs per $1,000,000 of award funding attributable to the Fund: 0.05 new jobs per $1000 from Table 1.

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[11] These results are available from the authors on request. The lack of sufficient degrees of freedom in the data set did not allow for a more systematic analysis of response bias.

[12] The survey question read: "How many jobs did your organization create with the NC Green Business Fund Grant? You may record fractions of full-time equivalent effort".

Regardless, this range of approximate per dollar new jobs is in line with the Link and Scott (2012a) estimate that the Small Business Research (SBIR) programs in the US Department of Defense, the National Institutes of Health, NASA, and the US Department of Energy can be credited with an average of about 42 new jobs per $1,000,000 of award funding.

We also investigated organizational differences in the number of new jobs created as a result of an organization receiving an R&D grant from the Fund. Specifically, we considered the following model:

$$Employ_i = f(\mathbf{X}, \mathbf{Z}), i = 1\text{–}24 \tag{1}$$

where $Employ_i$ is the number of new full-time equivalent employees in the ith funded organization as of 2012 that are directly attributable to the project supported by the Fund. **X** is a vector of project-specific characteristics, and **Z** is a vector of organization-specific characteristics.

Consideration of variables to include in vectors **X** and **Z** comes from the academic literature on employment growth, especially the research on employment growth in small, technology-based companies that received grants from the SBIR program to develop and commercialize new technologies (Link and Scott 2012a, b, 2013), and from related literature as noted below.

Three variables were considered for **X**. The first variable is the amount of the grant, *Grant* ($1000), and the second and third variables relate to the status of the project as of 2012 as described below.

The variable *Grant* controls for the financial resources available to the organization from the state to undertake the project. The Board's survey in 2012 also asked each organization about the status of their project. The response choices offered on the survey were: project discontinued, *Disc*; project still underway; commercialization of the technology from the project is underway; or the technology has been commercialized, *Comm*. The variables *Disc* and *Comm* control for the success of the project, given the resources available.[13] Each of these two variables equals 1 if it describes the status of the project, and 0 otherwise.

Two variables are also considered for **Z**. The first variable is the additional funding that the organization received during its conduct of the NC Fund funded project (e.g., personal funds, internal business funds, angel investor funds, venture capital, or SBIR support), *AddInvest* ($1000);[14] the second variable is a binary variable equaling 1 if a university was involved in any way with the project (e.g., university faculty or equipment), and 0 otherwise, *Univ*.[15]

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[13] We have insufficient observations in our dataset to control for all four status categories.

[14] Hayter (2013) found that the commercial success, and thus possibly employment growth, of university spin-offs is greater if the spin-off has received additional investments from venture capitalists. Relatedly, to the extent that additional investments in company projects leverage the company's ability to generate scale economies or to increase capital intensity, or both, Audretsch (1995) has shown that these impacts will affect growth and thus presumably new job creation.

[15] Regarding the university variable, Rappert et al. (1999) and Johansson et al. (2005) find that in the case of faculty entrepreneurs, those who continued to maintain strong ties to universities benefit through access to university expertise, use of equipment and instruments, and by keeping abreast of university research. Further, Westhead and

The variable *AddInvest* also controls for the financial resources available to undertake the project, and it is independent of the amount awarded by the state (see the correlation matrix in Table 3 below).

The variable *Univ* controls for non-financial resources available to the organization. These non-financial resources either could represent additional human capital if university faculty are involved in the project or could represent additional technical capital if university equipment is involved. Survey responses did not distinguish between access to university faculty or to equipment.[16]

Definitions of these variables are in Table 2, a correlation matrix is in Table 3, and descriptive statistics on the variables are in Table 4.[17]

Table 2. Definition of the variables

Variable	Definition
Employ	Number of new full-time equivalent employees in the funded organization that are directly attributable to the project supported by the NC Fund as of 2012
Grant	Dollar amount of the NC Fund award in $1000
Disc	A binary variable equal to 1 if the funded project was discontinued as of 2012, and 0 otherwise
Comm	A binary variable equal to 1 if the technology from the NC Fund project has been commercialized as of 2012, and 0 otherwise
AddInvest	Dollar amount of additional funding that the organization received during its conduct of the NC Fund funded project in $1000
Univ	A binary variable equal to 1 if a university was involved in any way with the project, and 0 otherwise
AddInvest/Grant	Ratio of additional investment dollars to NC Fund grant dollars

Table 3. Correlation matrix of the variables

	Employ	***Grant***	***Disc***	***Comm***	***AddInvest***	***Univ***	***AddInvest/Grant***
Employ	1.000						
Grant	−0.259	1.000					
Disc	−0.293	0.310	1.000				
Comm	0.485*	−0.266	−0.263	1.000			
AddInvest	0.437*	−0.014	−0.178	0.138	1.000		
Univ	−0.221	0.396*	0.103	−0.103	−0.285	1.000	
AddInvest/Grant	0.513*	−0.061	−0.200	0.186	0.983*	−0.357	1.000

* 0.05 level or better of significance

Storey (1994, 1997) find that small firms located in science parks that have relationships with universities have a higher survival rate than those firms without such a relationship.

[16] The inclusion of this variable complements Lendel's (2010) argument that one regional growth augmenting product of a university is the transfer of existing know-how through university–industry partnerships.

[17] As noted in footnote 3, the Fund was established "[t]o encourage the development of the biofuels industry ... [t]o encourage the development of the green building industry ... [and to] attract and leverage private-sector investments and entrepreneurial growth in environmentally conscious clean technology and renewable energy products and businesses." However, based on descriptions of the funded projects there was significant overlap of these activities within a given organization's R&D project, and thus, segmentation of the organizations into so-called technology areas as independent variables was not possible.

If the financial resources available to a company or an organization proxy the scale and scope of the funded project, then greater resources should be associated with a larger number of new jobs created. Thus, we hypothesize that *Grant* and *AddInvest* will enter Eq. (1) positively, other factors held constant, but the impact these resources have on organizational activities, employment in particular, may eventually decline.

The concept of diminishing returns to any resource is fundamental to economic theory; see Arrow (1962a, b). In addition, Link and Scott (2012a, b, 2013) showed that the impact of additional financial resources beyond the initial SBIR award had a positive but diminishing impact on employment growth over time.[18]

Failed projects, *Disc* = 1, are hypothesized to have created fewer jobs than the more successful projects that have already been commercialized, *Comm* = 1, other factors held constant.

Finally, the net impact on new jobs growth when an organization collaborates with a university, *Univ* = 1, on an R&D project is unclear. On the one hand, because universities by their nature are involved in research toward the basic end of an R&D spectrum, their involvement (faculty involvement in particular) might push collaborative projects in that direction and thus impede short-run job growth because commercialization is slowed. On the other hand, when organizations collaborate with universities to help with the technology development, the inclusion of university resources (equipment in particular) might indemnify the project from technical failure and thus increase the likelihood of commercialization and hence employment growth.

The regression estimates in column (1) of Table 5 consider these variables.[19] Also, considered is the interaction of university involvement, *Univ* = 1, with projects that were discontinued as of 2012, *Disc* = 1, and with those that had commercialized as of 2012, *Comm* = 1. These interaction terms are introduced into the model specifically to control for possible alternative influences of collaborations with a university by project status.

The results in column (1) indicate that the amount of the NC Fund grant, *Grant*, does not have a statistically significant effect on employment growth, but the presence of additional investments from non-NC Fund sources, *AddInvest*, does. However, the size of the latter effect is small. A $1 million increase in additional investments would be needed to create almost one (0.9 to be precise) new jobs. In comparison, the results in column (2) indicate that the impact of additional

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[18] Related more specifically to the academic literature, Åstebro (2003, p. 237) argued that small, entrepreneurial companies face difficulties in attracting external research support because of "information asymmetries, moral hazard and coordination problems." One might reasonably conclude that by the time that a company is able to attract additional investments, two hurdles have been cleared. The first hurdle is that the outside investor had already allocated time and resources to scrutinize the project under question, and the second hurdle is that the funded project had been chosen from among all those scrutinized. Following this logic, one might reasonably expect that causation runs from the receipt of additional investments to an increase in the probability of commercialization to employment growth. Link and Ruhm (2009) confirmed this hypothesis using SBIR data. However, our data are insufficient to pinpoint when the organization received the additional investments relative to when its project was commercialized. It should be noted that the correlation between *AddInvest* and *Comm* in Table 3 is positive, but it is not significant.
[19] The survey asked organizations to report the number of new jobs attributable to the Fund as the number of full-time equivalent employees, thus when *Employ* > 0 it can be considered as a continuous variable rather than a count variable.

investments, in logarithms, is statistically significant implying that its effect on employment growth is positive, but diminishing.[20]

Table 4. Descriptive statistics of the variables used to estimate Eq. (1), $n = 24$

	Mean	SD	Range
Employ	2.46	4.04	0–16
Grant ($1000)	68.75	21.12	18–100
Disc	0.21	0.41	0/1
Comm	0.21	0.41	0/1
AddInvest ($1000)	632.46	1622.53	0–6500
Univ	0.50	0.51	0/1
AddInvest/Grant	9.61	23.23	0–83.33

The results in column (1) also show that collaboration with a university, *Univ*, does not have an independent significant impact on employment growth; rather, university involvement has a significant impact on employment growth depending on the status of the funded project.

More specifically, university involvement decreases job losses in those projects that are eventually discontinued. Absent university involvement (*Disc* = 1, *Univ* = 0 and *Univ**Disc* = 0), employment losses would be nearly 29 jobs (i.e., 28.97 jobs). But, when the company or organization had relied on the resource base of a university in the potential development of its technology before the project was discontinued, job losses would be smaller. Numerically, a discontinued project (*Disc* = 1) that involved a university (*Univ* = 1 and *Univ**Disc* = 1) is, on average, likely to have lost only about two employees (−28.97+1.08+25.97=−1.92) from the time the funded project began. Perhaps when a company or organization interacts with a university, it will gain insight into the likelihood that the project will be successful or unsuccessful sooner than if it continued with the R&D on its own.[21]

However, university involvement in these projects is like a two-edged sword. Employment growth among those companies and organizations that have commercialized their technology and that have interacted with a university is less than if the company or organization had not involved the university. Numerically, employment growth in a company or organization with a commercialized project (*Comm* = 1) that involved a university (*Univ* = 1 and *Univ**Comm* = 1) will have, on average, created just over one new job (i.e., 1.20 new jobs), other factors held constant (6.74+1.08−6.62=1.20). But, had the university not been involved (*Comm* = 1, *Univ* = 0, and *Univ**Comm* = 0), on average about seven new jobs (i.e., 6.74 new jobs) would have been created. Perhaps university expertise increased the efficiency of, as well as shortened, the technology development process so that the company or organization could pursue commercialization with fewer new employees than would otherwise have been the case. This same pattern of university effects is reported in column (2) of Table 5.

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[20] Because some values of *AddInvest* equal 0—see Table 4—the logarithm of *AddInvest*, *lnAddInvest*, is undefined. We arbitrarily set *lnAddInvest* to 0, and we accordingly included in this model a control variable, *Control*, equal to 1 for those instances when *lnAddInvest* was set to 0, and 0 otherwise.
In other specifications, *AddInvest* and $AddInvest^2$ were considered as regressors, but the quadratic term was not significant. These results are available from the authors on request.
[21] Link (1996) and Hall et al. (2001) showed that this was the case among research joint ventures funded by the Advanced Technology Program (ATP) within the National Institute of Standards and Technology (NIST).

Table 5. Regression estimates from Equation (1), *n* = 24 (standard errors) dependent variable, *employ*

Variable	(1)	(2)	(3)
Grant	−0.023	–	–
	(0.044)		
lnGrant	–	−1.58	–
		(2.26)	
Disc	−28.97	−17.71	−22.08
	(1.53)***	(1.44)***	(1.41)***
Comm	6.74	6.11	6.67
	(2.56)***	(2.46)**	(2.47)***
AddInvest	0.0009	–	–
	(0.0005)*		
lnAddInvest	–	1.09	–
		(0.62)*	
Univ	1.08	0.67	1.03
	(2.05)	(2.01)	(1.96)
*Univ*Disc*	25.97	14.71	18.64
	(1.53)***	(1.44)***	(1.41)***
*Univ*Comm*	−6.62	−4.93	−6.43
	(3.82)*	(3.81)	(3.75)*
Control	–	3.30	–
		(3.91)	
AddInvest/Grant	–	–	0.068
			(0.035)**
Intercept	1.80	2.48	0.21
	(3.07)	(8.82)	(1.47)
Pseudo R2R2	.1456	.1678	.1520
Tobin's sigma	3.51	3.33	3.44
	(0.65)***	(0.61)***	(0.64)***
χ^2 (df)	16.21 (7)	18.69 (8)	16.92 (6)
Log likelihood	−47.56	−46.33	−47.21

The results in column (3) come from removing the variables *Grants* and *AddInvest* from the regression model and including instead the ratio of additional investment dollars to the grant amount, *AddInvest/Grant*. What is important from the results in column (3), compared to the results in columns (1) and (2), is one, additional investments in absolute terms and in relative terms are a key resource in generating employment growth and two, with or without university involvement commercialized projects are associated with greater employment growth than projects that are discontinued or are at other stages of completion.

Several other variables were considered in alternative specifications of Eq. (1). The age of the organization, as of 2012, was included in the model, but it was not significant in any of the specifications. *A priori*, we hypothesized that an age variable would have a positive yet decreasing impact on employment growth. Our reasoning was that, following Evans (1987), companies will use their resources more efficiently over time, and thus, associated employment growth will increase, but then it will decrease with age.

Lastly, we considered a binary variable equal to 1 for private companies and 0 for public organizations on the basis of our observations about employment in each as shown in Table 3. However, this variable never entered any specification significantly.

Concluding remarks

Albeit that the number of projects funded by the Fund over FYs 2008 and 2009 is small, the statistical findings in Table 5 are nevertheless robust and are of possible policy consideration. Specifically, if states that invest in green or sustainability technology programs similar to the NC Green Business Fund are doing so to promote, among other things, employment growth, then our findings support the suggestion that they consider complementary activities to ensure that funded projects do in fact reach commercialization sooner rather than later. Perhaps a vehicle for doing this is to help small firms develop networks through which funded organizations can effectively identify and attract additional financial support.

Returning to the small sample size of funded projects analyzed herein, and setting aside the fact that our statistical findings are robust, it will likely be the case that others' analyses of state or even regional technology-based growth policies will also face data limitations. That, we believe, is characteristic of such investigations. But, as we illustrate, a rigorous analysis and meaningful recommendations are possible.

One observation that was apparent from our previous study of the SBIR program—a federal set aside program to assist small firms develop new technologies—is that most small technology-based companies, especially those that are developing a first technology, are ignorant about sources of additional financing either to complete the development of the technology or to cross the valley of death and commercialize. State or even university-based offices that can act as honest brokers in matching companies with external funding sources might be a vehicle to accomplish such a goal. Whereas states have Manufacturing Extension Programs (MEPs) to assist companies with their manufacturing needs, a parallel structure could be created at the state level to meet investment financing needs. If such a structure were internalized at the university level, its success might help to ensure commercialization success but, as our findings show, at the expense of employment growth.

As reasonable as these recommendations might seem, it is important to emphasize that they stem from an exploratory empirical investigation of one program with a limited number of awardees observed over a limited number of years. Thus, these recommendations are offered cautiously. However, in the absence of additional years of program data for North Carolina or from other similar state programs, our model could be viewed as a template for other states to follow and our finding might be viewed as the best available information for the structured planning of new green technology programs.

As other researchers investigate similar grants programs in other states, and if their findings complement ours, then other funding programs might benchmark against our empirical conclusions.

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