On the economic performance of nascent entrepreneurs

By: Dora Gicheva, Albert N. Link

Gicheva, D., & Link, A. N. (2016). On the economic performance of nascent entrepreneurs. *European Economic Review, 86*, 109-117.

Made available courtesy of Elsevier: http://dx.doi.org/10.1016/j.euroecorev.2015.07.018

Abstract:

This paper assesses the R&D performance of nascent and established technology-based small firms that receive a Phase II R&D award from the U.S. Small Business Innovation Research (SBIR) program. Our empirical analysis is based on a two-stage selection probit model, which is used to estimate the probability of commercialization conditional on the Phase II project having not failed. Our model predicts, and our analysis confirms, that nascent firms are more likely to fail in their SBIR-supported R&D endeavors. Further, we find that nascent firms that do not fail have a higher probability of commercializing their developed technology.

Keywords: Entrepreneurship | R&D | Commercialization | Innovation | SBIR program

Article:

1. Introduction

Much of the recent economics literature on the economics of entrepreneurship has focused on the relationship between firm performance and firm size. Performance has generally been quantified in terms of employment and job growth, and size has been measured by number of employees or sales. Only a few of these studies (e.g., Link and Scott, 2012, Haltiwanger et al., 2013) have considered the age of the firm in their analyses.[1]

Job growth is certainly an important dimension of firm performance, whether it be growth in young or established firms, but so are other performance dimensions. One important dimension that has been overlooked is technology-based performance especially in new or nascent firms.[2] This void in the literature is noteworthy; public policy, in both the United States and in other industrialized nations, continues to focus on R&D- and subsequent technology/innovation-based economic growth while also emphasizing the importance of entrepreneurship in new firms as a driver of economic growth.[3]

Our focus in this paper is on the commercialization of new technology by nascent compared to established firms is an effort not only to expand the literature but also to address the need for a greater policy understanding of the nexus of entrepreneurship and technology-based growth.

The foundation for research on nascent entrepreneurship is over two decades old.4 Generally considered under this topic are studies on the motivations that guide the economic behavior of the founders of new firms compared to the owners/managers of more established firms, the factors that affect the discovery and exploitation of ideas that lead to new establishments, and the economic performance of newly founded firms compared to those that are more established. While the breadth of topics that have been considered under the rubric of nascent entrepreneurship is varied, the generally accepted definition of a nascent firm is narrow—one who starts a new endeavor such as a business or an organization.

The remainder of this paper is outlined as follows. In Section 2, we offer a theoretical framework for how one might study differences between nascent and established firms as related to their R&D-based performance. Our theory predicts that nascent firms are relatively more likely to fail in their R&D endeavors, but those nascent firms that succeed may be relatively more successful in commercializing their technologies than established firms. In Section 3, we describe the U.S. Small Business Innovation Research (SBIR) program project database that we use to operationalize the theoretical framework developed in Section 2. Also, in Section 3, we discuss the key variables considered in our empirical analysis and we present relevant descriptive statistics. Empirically, in Section 4, we employ a two-part selection probit model to estimate the probability of commercialization conditional on the SBIR-funded project having not failed. Our model in Section 2 predicts, and our analysis in this section confirms, that nascent firms are more likely to fail in their SBIR-supported R&D endeavors. Further, we find that nascent firms that do not fail have a higher probability of commercializing their developed technology. Section 5 concludes the paper with a summary of our findings and with brief remarks about their policy relevance.

2. A comparative theoretical framework

Our theoretical framework is based on the assumption that there is uncertainty in the ex-post-value of R&D endeavors (Yi) that firms undertake. Suppose that ex-ante, firm i knows that the value Y_i of a new R&D project has distribution, $F_i(Y)$, characterized by mean and dispersion parameters m_i and s_i, respectively.[5] Firms are either one of two types: nascent (i=0) or established (i=1).

$s_0 > s_1$

m_0

$m_0 > m_1$

$m_0 > m_1$

$\overline{Y}$ $m_0,\ m_1,\ s_0,\ s_1$ $\overline{Y}$

$F_0(\overline{Y}) > F_1(\overline{Y})$

There exists another threshold level, Y*, that determines commercialization; projects result in sales when Y>Y*. Then, conditional on not failing, the probability of commercialization, Pi is given by:

$$P_i = \frac{1-F_i(Y^*)}{1-F_i(\overline{Y})} \ .$$

$$F_0\left(\overline{Y}\right) > F_1(\overline{Y})$$

$$\frac{1}{1+\exp\left[-\left((\overline{Y}-m_0)/s_0\right)\right]} > \frac{1}{1+\exp\left[-\overline{Y}\right]} \ ,$$

$$\overline{Y} < -m_0/(s_0 - 1)$$

$$\frac{1+\exp\left((\overline{Y}-m_0)/s_0\right)}{1+\exp\left((Y^*-m_0)/s_0\right)} > \frac{1+\exp(\overline{Y})}{1+\exp\left(Y^*\right)} \ .$$

$$\overline{Y} = -1.1$$

$$F_0\left(\overline{Y}\right) > F_1(\overline{Y})$$

$F_0\left(\overline{Y}\right)$, $F_1(\overline{Y})$ $\overline{Y}$

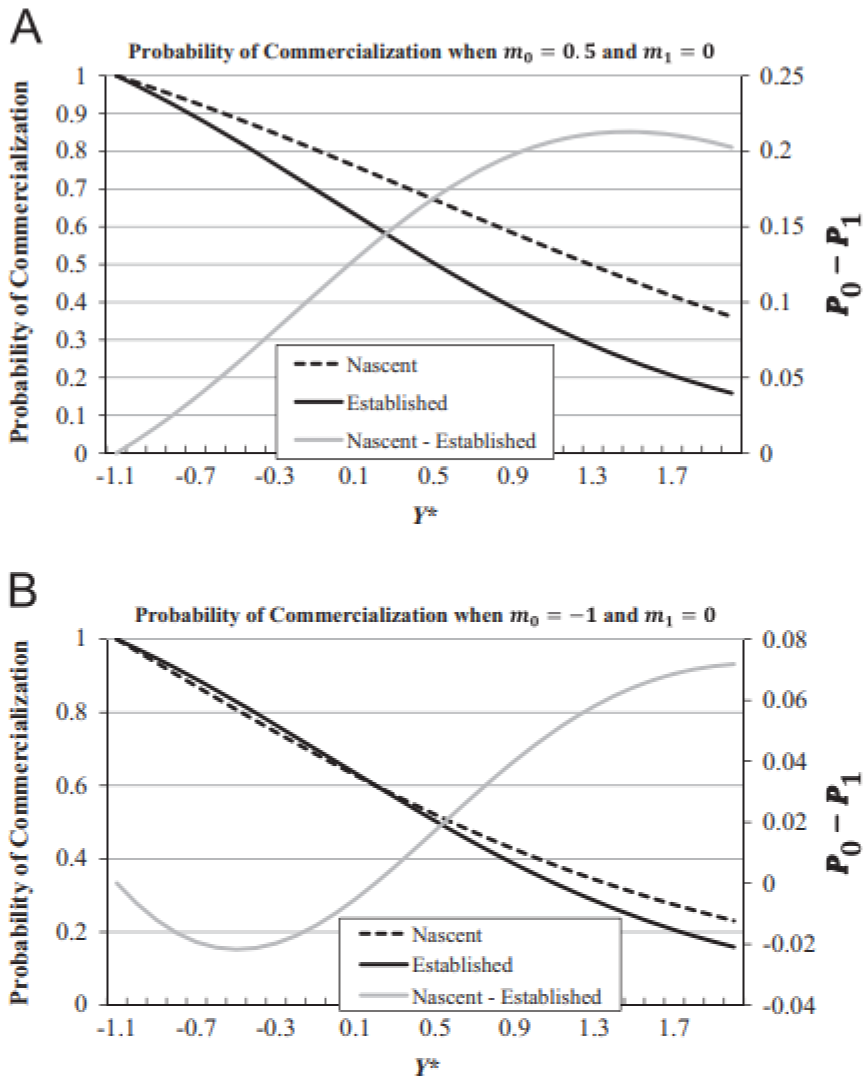

Fig. 1. Difference in the probability of commercialization conditional on not failing for nascent and established firms, probability of commercialization when $m_0=0.5$ and $m_1=0$, probability of commercialization when $m_0=-1$ and $m_1=0$.

In this paper we measure the project's value empirically as the probability of commercialization. We allow the unconditional mean, m, to depend on other factors in addition to whether the firm is nascent or not; these variables are described in Section 3. We estimate a probit model with sample selection, in which commercialization is only observed for the projects that did not fail:

$$notfail_i = (z_i\gamma + u_{2i} > 0) \tag{2}$$

and

$$commer_i = (x_i\beta + u_{1i} > 0 | u_{2i} > -z_i\gamma)\,. \tag{3}$$

u_{1i} u_{2i}

3. Database and descriptive statistics

The data used to operationalize the theoretical framework in Section 2 come from the U.S. National Research Council (NRC) database on Phase II SBIR projects.[7]

The SBIR program was created through the Small Business Innovation Development Act of 1982, Public Law 97-219, (the Act) to: (1) stimulate technological innovation, (2) use small business to meet federal R&D needs, (3) foster and encourage participation by minority and disadvantaged persons in technological innovation, and (4) increase private sector commercialization of innovations derived from federal R&D.[8] To meet these obligations at the time of the Act, each federal agency with an extramural research budget in excess of $100 million for fiscal year 1982 was to set aside 0.2% of its 1983 fiscal year extramural budget to support R&D in small firms (500 or fewer employees) for these purposes. The set aside amount was to increase to 0.6% in 1984, 1.0% in 1985, and not less than 1.25% in subsequent years. Through reauthorizations, the set aside slowly was increased to 2.50%; in 2012 it was legislated to increase annually up to at least 3.20% by 2017.[9]

The Act defined two types of SBIR awards. Phase I awards are small, originally not more than $50,000 over six months. These awards are to assist in the assessment of the R&D's scientific and commercial potential. Phase II awards are larger, originally not more than $500,000 over two years, and they are to bring about the development of the Phase I technology and ideally to bring it to commercialization. Through the various authorizations of the Act, the threshold amounts for Phase I and Phase II awards have increased to $150,000 and $1,000,000, respectively.

As part of the year-2000 reauthorization of the Act, Congress mandated that the NRC undertake an economic evaluation of the SBIR program and make recommendations for improvements. The NRC study was intended to inform the upcoming reauthorization in 2008. As part of the NRC study, a survey was administered in 2005 to a non-random sample of 6408 of the 11,214 Phase II project funded by the five largest agencies over the years 1992–2001.[10,11] There were 1916 responses. After deleting the non-randomly selected projects, the final sample of projects totaled 1878, as shown in Table 1, and this sample is random and representative of the SBIR program across all of the five agencies.[12]

Table 1 National Research Council Survey of Phase II awards.

Agency	**Phase II sample size**	**Respondents**	**Response rate**	**Random sample**
DoD	3055	920	30%	891
NIH	1678	496	30%	495
NASA	779	181	23%	177
NSF	457	162	35%	154
DOE	439	157	36%	161
	6408	1916		1878

Given the commercialization objective for Phase II projects funded through the SBIR program, we accordingly measure successful performance in such terms. Specifically, we measure commercialization dichotomously; the variable commer equals to 1 if the Phase II project was commercialized as of 2005, and 0 otherwise.

We define a firm conducting the Phase II project as being nascent, nascent equals 1, based on two conditions. The first condition is that the funded firm was founded because of the SBIR program and the second condition is that the number of previous Phase II awards it had received related to the funded technology was zero.[13] Otherwise, nascent equals 0.

Our empirical model takes the form of comparing the probability of commercialization between nascent and non-nascent firms′ projects, other factors being held constant. A key factor in the analysis is if the Phase II project failed, since commercialization is generally not observed for projects that did fail. Failure is defined in terms of the Phase II project being discontinued as of 2005, or not.14 In our empirical model, commercialization is conditional on the project having not failed, notfailed. The variable notfailed equals 1 if the Phase II project was not discontinued as of 2005, and 0 otherwise. Thus, our empirical model examines differences in the probability of commercialization of the Phase II SBIR-funded project between nascent and non-nascent entrepreneurial firms conditional on the project having not failed, other factors being held constant.

We estimate the probability of commercialization as a two-part selection model using maximum likelihood. Following Eqs. (2), (3), we estimate the probability that the Phase II project did not fail and, conditional on the project having not failed, we estimate the probability of commercialization. The variables used in the two stages are defined in Table 2 and descriptive statistics are presented in Table 3.

Table 2 Definition of the variables.

Category	Variable	Definition
Dependent variables		
	commer	=1 if the Phase II project was commercialized as either a product, process, or service technology; 0 otherwise
	Notfail	=1 if the Phase II project had not failed as of 2005; 0 otherwise
Independent variables		
	Nascent	=1 if the firm is nascent; 0 otherwise
Entrepreneurial experience		
	Found	Number of firm founders
	Breadthexp	Breadth of experience of the founders measured as the sum across all founders of recent private, university, government, and other employment
	Privexp	=1 if the recent employment of a founder was a private company; 0 otherwise
	Univexp	=1 if the recent employment of a founder was a university; 0 otherwise

	Govtexp	=1 if the recent employment of a founder was government; 0 otherwise
Research experience		
	Prevphll	Number of previous Phase II awards
	Prevrelphll	Number of previous Phase II awards related to the technology of the current Phase II award
Research resources		
	Univfac	=1 if university faculty were involved in the Phase II project; 0 otherwise
	Univeq	=1 if university equipment was used in the Phase II project; 0 otherwise
	Univtech	=1 if the technology for the Phase II project was developed at a university; 0 otherwise
Firm characteristics		
	Emp	Employees at the time of the Phase II award
	age	Age of the firm measured in years since being founded
Award characteristics		
	Years	Years since the Phase II award
	$award	Amount of the Phase II award (converted to 2005 dollars by the GNP deflator, $100K)
	addlfund	=1 if additional funding was received to support the technology developed during Phase II; 0 otherwise
	$addlfund	Cumulative amount of additional funding received to support the technology developed during Phase II (in 2005 dollars, $M)
	Ratio	($addlfund*10)/$award
Technology characteristics		
	Agency controls	Separate binary variables for the agency that funded the Phase II award

Table 3 Descriptive statistics.

	Project that did not fail (n=988)				**Project that failed (n=541)**		
Variable	**Mean**	**Std. dev.**	**Range**		**Mean**	**Std. dev.**	**Range**
commer	0.64	0.48	0/1		.	.	.
Nascent	0.12	0.32	0/1		0.16	0.37	0/1
Found	2.04	1.49	1-20		2.12	1.58	1-15
Breadthexp	1.23	0.45	1-3		1.19	0.44	1-3
Privexp	0.70	0.46	0/1		0.71	0.46	0/1
Univexp	0.37	0.48	0/1		0.34	0.47	0/1
Govtexp	0.08	0.26	0/1		0.09	0.28	0/1
prevphll	6.26	21.47	0-175		8.67	26.98	0-222

Prevrelphll	1.14	2.44	0-28		0.54	1.64	0-28
Univfac	0.26	0.44	0/1		0.21	0.41	0/1
univeq	0.13	0.33	0/1		0.14	0.35	0/1
Univtech	0.07	0.26	0/1		0.06	0.24	0/1
Emp	25.76	50.74	0-375		39.58	67.63	0-450
Age	17.38	11.18	5-105		20.57	10.86	5-105
Years	6.92	2.56	4-13		8.43	2.82	4-13
$award	8.23	3.28	1.1-54.3		7.73	4.31	0.9-84.0
Addlfund	0.73	0.45	0/1		0.24	0.43	0/1
$addlfund	1.61	6.96	0-106		0.38	3.57	0-65
Ratio	2.22	11.25	0-207		0.47	3.97	0-70
Agency controls	.	.	0/1		.	.	0/1

Of the 1878 projects in the NRC database, information on all of the variables in this table was available for only 1529 projects. To test for the representativeness of the smaller sample, we tested for differences in means (unequal variances) of commer, emp, age, and ratio. In no instance was the difference significant.

Some interesting patterns can be seen in Table 3 from a simple comparison of means between the groups of non-failed versus failed projects. Other factors not being held constant, projects that failed are more likely to be in nascent firms (nascent) that are older (age) and larger (emp); firms that have previously received more Phase II awards but fewer Phase II awards that are specifically related to the technology of the current project (prevphII and prevrelphII); firms that relied less on university faculty (univfac) as a research resource; and firms that were less able to attract additional funding to support the technology developed from the Phase II project (addlfund and $addlfund).

The variables that are included in the selection equation but are assumed not to have an effect on the probability of commercialization are univfac, univeq, univtech, prevphII, and prevrelphII. Our reasoning is that university-based research is of a basic nature and thus should affect technical success rather than market success. Regarding previous Phase II awards, the variable prevphII quantifies the per se SBIR research experience of the firm rather that its ability to complete its current R&D project; the variable prevrelphII quantifies the technologically-related research experience of the firm, which should affect the probability of the project not failing (and it does, as shown in Table 4), but not necessarily the market success of the current project that was funded in response to a unique agency request for proposals.[15]

Table 4 Results for the probability of selection; dependent variable is notfail n=1529.

Variable	Coefficient (robust standard errors in parentheses)
nascent	-0.074**
	(0.037)
Found	-0.007
	(0.009)
Breadthexp	0.119**
	(0.049)
privexp	-0.085*

	(0.050)
univexp	-0.080
	(0.052)
govtexp	-0.118*
	(0.063)
PrevphII	0.001
	(0.001)
PrevrelphII	0.041***
	(0.012)
univfac	0.050
	(0.033)
Univeq	-0.064*
	(0.038)
univtech	0.024
	(0.051)
Emp	-0.001***
	(0.0003)
$award	0.041***
	(0.009)
$\$award^2$	-0.001***
	(0.0003)
Agency control	yes

Average marginal effects from a two-part probit model with sample selection.
*** Significant at .01-level.
** Significant at .05-level.
* Significant at .10-level.

4. Econometric results

The two-part selection model that we estimate follows Eqs. (2), (3). The results corresponding to Eq. (2) for the probability that a Phase II project did not fail, notfail, are reported in Table 4. The coefficients are reported as average marginal effects. As predicted from our theoretical framework, nascent firms are more likely to fail than established firms, other factors being held constant. The estimated coefficient on nascent is negative and statistically significant at the five percent level suggesting that on average nascent firms are about 7 percentage points more likely to fail. Given that the failure rate in the sample is 35%, this means that all else equal, nascent firms are 20% more likely to have a failed project.

Regarding the entrepreneurial experience variables in the equation, firms with founders who have had more varied recent employment experiences, breadthexp, are less likely to be associated with Phase II projects that fail, but firms that have founders who have had only private sector experience, privexp, are more likely to be associated with Phase II projects that fail. The positive and significant coefficient on breadthexp follows from the theoretical arguments posited by Lazear (2005) and Leyden and Link (2015); the breadth of past experience is an antecedent to entrepreneurial success.[16]

Regarding research experience, experience with the technology in question, prevrelphII, appears to be more important in ensuring research success than per se experience with the SBIR program, prevphII. The positive and significant coefficient on prevrelphII coincides with the research of Jovanovic (1982) who argued that firms learn about their efficiency, in multiple dimensions, as they operate and gain business experience in a particular domain.

Regarding the use of university resources, access to university equipment, univeq, has a positive impact on the probability that the Phase II project will fail. This finding might be interpreted to mean that project success requires a broader and more in-depth understanding of the underlying technical foundation on which a Phase II project is based than can be gleaned from simply using more advanced technical equipment. Note that access to university faculty, univfac, has a positive impact on the probability that the Phase II project will not fail, although the estimated coefficient is only close to being marginally significant. Still, the economic interpretation of this finding is reasonable. University faculty are in general closer to the academic research literature as well as to basic research itself than firm researchers (Hall et al. 2003).[17]

The size of the firm that received the Phase II award, as measured by the number of employees at the time the Phase II proposal was submitted, emp, is inversely related to the probability of success of the project. Larger firms, measured in terms of employees, holding constant entrepreneurial experience, research experience, and access to university resources, are more likely to have their Phase II project fail. This finding might suggest that larger small firms are stretched thin and thus due diligence in any activity, including R&D which is characterized by uncertainty, might be lacking (Link and Wright, forthcoming).

The results for the probability of commercialization conditional on the project having not failed are in Table 5. We estimate three versions of Eq. (3) using different controls for additional funding, but the results are similar. The coefficients are again presented as average marginal effects on the conditional probability of success. We find that nascent firms have a greater probability of commercialization. The estimated coefficient on nascent is positive and significant. Conditional on the Phase II project not failing, the probability of commercialization is nearly 11% points higher for nascent firms.[18]

Table 5 Results for probability of commercialization conditional on the project having not failed; dependent variable is comer n= 1529; n uncensored = 988.

Variable	Coefficient (robust standard errors in parentheses)		
	(1)	(2)	(3)
Nascent	0.105**	0.108**	0.109**
	(0.047)	(0.047)	(0.047)
Found	-0.003	0.002	0.003
	(0.011)	(0.011)	(0.011)
breadthexp	0.016	0.008	0.010
	(0.059)	(0.059)	(0.059)
Privexp	0.005	0.009	0.007
	(0.060)	(0.059)	(0.059)
Univexp	-0.069	-0.075	-0.077
	(0.061)	(0.061)	(0.061)
govtexp	-0.054	-0.068	-0.069
	(0.078)	(0.076)	(0.076)
Emp	0.001*	0.00*	0.001*

	(0.000)	(0.000)	(0.000)
age	-0.007**	-0.008**	-0.008**
	(0.004)	(0.003)	(0.003)
age^2	0.00005	0.0006	0.00006
	(0.00004)	(0.00004)	(0.00004)
year	0.128***	0.127***	0.127***
	(0.038)	(0.037)	(0.037)
$year^2$	-0.006**	-0.006**	-0.006**
	(0.002)	(0.002)	(0.002)
addlfund	0.180***	-	-
	(0.033)		
$addlfund	-	0.003	
		(0.003)	
ratio	-		0.003
			(0.002)
$award	-0.004	-0.003	-0.002
	(0.010)	(0.010)	(0.010)
$award²	$-4x10^{-7}$	-0.00004	-0.0006
	(0.0003)	(0.0003)	(0.0003)
Agency controls	Yes	Yes	Yes
p	-0.639	-0.642	-0.605
	(0.407)	(0.424)	(0.283)

Average marginal effects for conditional probability of commercialization from a two-part probit model with sample selection.
*** Significant at .01-level.
** Significant at .05-level.
* Significant at .10-level.

The entrepreneurial and research experience variables are not significant in the commercialization equation of our statistical model as they are in the selection equation. Firm characteristics and award characteristics are significant. The probability of commercialization increases with firm size measured in terms of employment at the time the Phase II proposal was submitted, emp, whereas the probability of the Phase II project not failing decreases with firm size.

The probability of commercialization continually decreases with firm age, age; however, it increases for nearly 11 years since the time of the Phase II award, years.

Comparing across the three specifications in Table 5, the presence of additional funding rather than the dollar amount of additional funding to support the technology developed during the Phase II project increases the probability that the technology will be commercialized. Link and Scott (2012), building on Åstebro (2003), argue that when an entrepreneurial firm receives funding from outside investors at least two hurdles have already been cleared. The first hurdle is that the recipient firm was selected to be scrutinized for possible funding, and the second hurdle is that the firm was selected from among those scrutinized. Thus, it is intuitive that firms that have cleared both hurdles are more likely to commercialize their SBR-funded and outside investor-funded technology.

Finally, the size of the Phase II award, $award, is unrelated to the probability of commercialization.[19]

The results in Table 5 also suggest that the error terms in the failure and commercialization equations may not be correlated. The estimated coefficient of correlation ρ between the error terms in Eqs. (2), (3) is negative and equal to about −0.6 but not statistically significant in any of the specifications. Accordingly, the results do not change substantially if the commercialization equation is estimated as a simple probit.[20]

An alternative way to model commercialization is to estimate a duration model of the time between receiving the Phase II award and first commercialized sales (if any). Our motivation to parameterize the time to commercialization is based on the results in Table 5, which show that the probability of commercialization is highly sensitive to the length of time since the Phase II award was received, year. We estimate a Weibull survival model in which the event of interest is first commercialization.[21] We restrict the analysis to the 988 projects that did not fail. The hazard function is given by:

$$h(t) = \lambda t^{\lambda-1} e^{x\beta} \quad (4)$$

In Table 6 we report the coefficients, β, from the Weibull model in Eq. (4) with heteroskedasticity-robust standard errors. The signs and significance of the estimated coefficients mirror those in Table 5 so we can draw similar conclusions from the duration analysis. In particular, projects conducted by nascent firms are significantly more "at risk" of commercialization, as are smaller and younger firms. Receiving additional funding is associated with shorter time to commercialization, but the amount of such funding is not a determining factor. In addition, the parameter λ is estimated to be 1.4, which implies that the baseline commercialization hazard increases somewhat with time, consistent with the findings presented in Table 5.

Table 6 Results for duration model of the time to first commercialization n=988.

Coefficient (robust standard errors in parentheses)			
Variable	**(1)**	**(2)**	**(3)**
Nascent	0.399***	0.382***	0.385***
	(0.111)	(0.115)	(0.115)
Found	-0.014	-0.001	-0.001
	(0.028)	(0.027)	(0.027)
breadthexp	-0.011	-0.026	-0.023
	(0.164)	(0.162)	(0.162)
Privexp	0.157	0.164	0.157
	(0.158)	(0.157)	(0.157)
Univexp	-0.093	-0.105	-0.111
	(0.165)	(0.163)	(0.163)
Govtexp	-0.039	-0.112	-0.112
	(0.232)	(0.227)	(0.227)
emp	0.002**	0.002**	0.002**

	(0.001)	(0.001)	(0.001)
Age	0.029***	0.029***	0.029***
	(0.010)	(0.010)	(0.010)
Age^2	0.0002**	0.0002**	0.002**
	(0.0001)	(0.0001)	(0.0001)
Addlfund	0.446***		
	(0.105)		
$addlfund		-0.004	
		(0.004)	
Ratio			-0.001
			(0.003)
$award	0.007	0.005	0.005
	(0.028)	(0.028)	(0.029)
$\$award^2$	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Agency controls	yes	yes	yes
λ	1.409***	1.409***	1.408***
	(0.036)	(0.036)	(0.036)

Coefficients (unexponentiated) from a Weibull (1951) survival model of the time between Phase II award and first commercialization.
* Significant at .10-level.
*** Significant at .01-level.
** Significant at .05-level.

5. Conclusions

We have shown theoretically and empirically that nascent technology-based firms that receive a Phase II SBIR R&D award are more likely to fail when compared to established firms. However, those nascent firms that do not fail have a higher probability of commercialization when compared to established firms.

This paper represents the first systematic investigation into the R&D performance of nascent and established firms. And, our findings about the relative difference between the performance of nascent and established firms brings a new perspective to the literature on the economics of entrepreneurship. However, the uniqueness of our focus, and the fact that the empirical analysis is based on a unique set of project data that were publicly funded, necessitates that generalizations from our findings should be made with caution.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.euroecorev.2015.07.018.

References

Åstebro, Thomas, 2003. The return to independent invention: evidence of unrealistic optimism, risk seeking or skewness loving? Econ. J. 113 (484), 226–239.
Audretsch, David B., 1991. New firm survival and the technological regime. Rev. Econ. Stat. 73 (3), 441–450.
Davidsson, Per, 2006. Nascent Entrepreneurship: Empirical Studies and Developments (Foundation and Trends in Entrepreneurship). 2; 1–76.
Galbraith, Craig S., Ehrlich, Sanford B., DeNoble, Alex F., 2006. Predicting technology success: identifying key predictors and assessing expert evaluation for advanced technologies. J. Technol. Transf. 31 (6), 673–684.
Hall, Bronwyn H., Link, Albert N., Scott, John T., 2003. Universities as research partners. Rev. Econ. Stat. 85 (2), 485–491.
Haltiwanger, John, Jarmin, Ron S., Miranda, Javier, 2013. Who creates jobs? small versus large versus young. Rev. Econ. Stat. 95 (2), 347–361.
Hume, David, 1993. An Enquiry Concerning Human Understanding, 2nd ed. Hackett Publishing Co., Indianapolis originally 1748.
Jovanovic, Boyan, 1982. Selection and the evolution of industry. Econometrica 50 (3), 649–670.
Jung, Mijung, Lee, Yi-beck, Lee, Heesang, 2015. Classifying and prioritizing the success and failure factors of technology commercialization of public R&D in South Korea: using classification tree analysis. J. Technol. Transf. forthcoming.
Lazear, Edward P., 2005. Entrepreneurship. J. Labor Econ. 23 (4), 649–680.
Leyden, Dennis Patrick, Link, Albert N., 2015. Toward a theory of the entrepreneurial process. Small Bus. Econ. 44 (3), 475–484.
Link, Albert N., Scott, John T., 2010. Government as entrepreneur: evaluating the commercial success of SBIR projects. Res. Policy 39 (5), 589–601.
Link, Albert N., Scott, John T., 2012. Employment Growth from Public Support of Innovation in Small Firms, Kalamazoo. W.E. Upjohn Institute for Employment Research, MI.
Link, Albert N., Wright, Mike, 2015. On the Failure of R&D Projects. IEEE Trans. Eng. Manag. forthcoming.
Locke, John, 1979. An Essay Concerning Human Understanding, 2nd ed. Oxford University Press, Oxford originally 1690.
Mansfield, Edwin, Wagner, Samuel, 1975. Organizational and strategic factors associated with probabilities of success in industrial R&D. J. Bus. 48 (2), 179–198.
National Economic Council, 2011. Council of Economic Advisers, and Office of Science and Technology Policy . A Strategy for American Innovation: Securing Our Economic Growth and Prosperity. Washington, DC: The White House.
Reynolds, Paul D., White, Sammis B., 1992. Finding the nascent entrepreneur: network sampling and entrepreneurship gestation. In: Churchill, N.C., Birley, S., Bygrave, W.D., Wahlbin, C., Wetzel, W.E.J. (Eds.), Frontiers of Entrepreneurship Research, Babson College, Wellesley, MA, pp. 199–208.
Siegel, Donald S., Wessner, Charles W., 2012. Universities and the success of entrepreneurial ventures: evidence from the Small Business Innovation Research Program. J. Technol. Transf. 37 (4), 404–415.
Weibull, Waloddi, 1951. A Statistical Distribution of Wide Applicability. J of Applied Mechanics 18 (3), 293–297.

Notes

1. See Link and Scott (2012) for a summary of the economics literature related to firm age and employment growth, but their review does not emphasize nascent firms or nascent entrepreneurship per se.
2. In the aftermath of the Great Recession, the White House has focused on job growth and its antecedents (National Economic Council 2011, p. 22): "Entrepreneurship plays an essential role in generating innovation and stimulating U.S. economic growth. New firms account for most net job growth, and small businesses employ 30% of high-tech workers. Yet market obstacles limit entrepreneurship, as would-be entrepreneurs struggle to raise funding without an established reputation or without giving ideas away."
3. See for example the previous footnote 2 and National Economic Council (2011).
4. Davidsson (2006) attributes the first research paper on nascent entrepreneurship to Reynolds and White (1992).
5. In our empirical work we hold constant other firm and project characteristics that may affect the distribution F(Y).
6. Our empirical work is based on the normal distribution, but the logistic distribution, while taking a similar shape, offers the advantage of being analytically more tractable.
7. The National Research Council is part of the National Academies. See, ⟨http://www.nationalacademies.org/⟩.
8. A detailed history of the SBIR program is in Link and Scott (2010, 2012) and in Siegel and Wessner (2012).
9. Leyden and Link (2015) refer to the establishment of the SBIR program as an example of public sector entrepreneurship
10. Most of the 6408 projects were randomly selected, but the NRC added a number of non-randomly selected projects. Those added were very successful in terms or their commercialization accomplishments. These projects were added to the sample so that the NRC had successes to showcase to Congress. See Link and Scott (2012) for a detailed discussion of these projects.
11. These agencies were, in decreasing order of total funding amounts, the Department of Defense (DoD), the National Institutes of Health (NIH), the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and the National Science Foundation (NSF).
12. See Link and Scott (2010, 2012) for a detailed discussion of the data reduction process, the response rates by agency, and empirical documentation that selection bias is not present in the final sample of projects.
13. Having defined on the basis of the extant literature a nascent entrepreneur as one who starts a new endeavor such as a business or an organization, or a nascent business/organization as one just started, then a technology-based nascent entrepreneurial firm might reasonably be defined as one that pursues for the first time a new technology with the intent of bringing it to market.
14. Our definition of project failure includes projects that were discontinued for technical as well as market reasons. Link and Wright (forthcoming) have previously examined covariates with project failure of SBIR projects in terms of a firm's sources of research knowledge and not in terms of nascency. See also Galbraith et al. (2006) and Jung et al. (forthcoming). Relatedly, Link and Scott (2010) have previously estimated the

probability of commercialization of SBIR projects, by agency, in the absence of controls for project failure and in the absence of a consideration of nascency.

15. Inclusion of these variables in the probability of commercialization equation has virtually no effect. These results are not reported here but are available from the authors on request.
16. As an aside, to the extent that research success, that is having a research project not fail, is related to the creativity of the entrepreneur, then our findings echo the arguments of Locke (1979) and Hume (1993) who emphasized that the genesis of creativity is one's past experiences.
17. Hall et al. (2003) document this role of university faculty in research of joint ventures funded by the U.S. Advanced Technology Program
18. The probability of commercialization for established firms is 62.6%, and for nascent firms it is 74.6%.
19. This finding is not at odds with that of Mansfield and Wagner (1975) who showed that the level of R&D spending in firms during early stages was negatively correlated with the technical success of the project and thus of its ultimate commercialization.
20. These results are not reported here but are available from the authors on request.
21. The results are not particularly sensitive to the distributional assumption.