# On the economic impact of university proof of concept centers

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### Abstract:

University proof of concept centers (PoCCs) are an organizational innovation intended to improve the dissemination and commercialization of new knowledge. During the past 15 years, at least 32 university-affiliated PoCCs have been established at universities within the United States. Despite this recent growth, little systematic empirical research exists relating to the organization or impact of PoCCs. Analyzing data published by the Association of University Technology Managers, we find that universities affiliated with a PoCC enjoy a positive and statistically significant increase in the number of spinoffs established each year after adoption. While additional research is needed, our findings are consistent with the presumption that PoCCs may offer a promising new tool for regional and national economic development.

**Keywords:** proof of concept center | university technology transfer | entrepreneurship | startups | technology

# Article:

### Introduction

Since the passage of the University and Small Business Patent Procedures Act of 1980 (Public Law 96-517) in the United States, also known as the Bayh-Dole Act, there has been widespread and growing public-sector support of the transfer and commercialization of university-based research.<sup>1</sup> Toward this end, university proof of concept centers (PoCCs) are becoming an important vehicle for advancing technology commercialization. For example, in March 2010, the Obama Administration issued a Request for Information (RFI) in the *Federal Register* (75 (57): 14476):

The RFI seeks public comments on how best to encourage commercialization of university research ... [and] on whether PoCCs can be a means of stimulating the commercialization of early-stage technologies...

<sup>&</sup>lt;sup>1</sup> The transfer and commercialization of new knowledge is often framed in terms of a broader trend higher education whereby colleges and universities are more closely linked to the private sector and therefore economic outcomes. Relevant conceptual models in the literature include the scholarship of Bok (2003), Slaughter and Rhodes (2004), and Rothermael et al. (2007), among others.

Proof of concept centers gained broader recognition as a potentially important element of university technology infrastructure in the United States when President Obama announced in March 2011, as part of the Startup America initiative, the i6 Green Challenge.<sup>2</sup> A total of \$12 million was awarded to establish or expand PoCCs that have the potential to enhance the transfer and commercialization of technology and entrepreneurship in support of a green economy, increase U.S. competitiveness, and leverage job growth. Six organizations received public funding, all of which have an association with an academic institution.<sup>3</sup>

Proof of concept centers are established on the assumption that universities are a primary source of new knowledge and thus a critical component for regional economic development (Braunerhjelm et al. 2010). Recent research finds, however, that numerous policy, organizational, and cultural barriers exist to the dissemination and application of new knowledge created within universities (Phan and Siegel 2006; Rothermael et al. 2007; Hayter 2013).

A PoCC is an organizational innovation that specifically focuses on challenges associated with commercializing university technology, including lack of access to resources, services, and networks that support the development of university startups.<sup>4</sup> Despite the recent flurry of policy interest and activity, and despite the fact that the well-known University of California at San Diego's von Liebig Center and MIT's Deshpande Center have operated for over a decade (Gulbranson and Audretsch 2008), there remains a conspicuous void of systematic information about PoCCs *per se* as well as their economic impact.

As Bradley et al. (2013) suggest, this void of information is somewhat puzzling because policy makers in the United States, for example, continue to make reference to the importance of proof of concept as a key element in promoting university-based economic development and job growth. For example, the National Governor's Association (Sparks and Erin 2013, pp. 7–8) recently reported that this year Colorado's Governor Hickenlooper supported the Advanced Industries Accelerator Act to promote "technology commercialization, entrepreneurship and manufacturing in the advanced industries through proof-of-concept grants."

At a national level, U.S. Representative Collins from the state of New York introduced the Technology and Research Accelerating National Security and Future Economic Resiliency Act of 2013 (H.R. 2981). The Act proposed that each federal agency with a Small Business Technology Transfer (STTR) program establish a grants program to provide "early-stage proof of concept funding for translational research" at universities.

Proof of Concept Center for Green Chemistry Scale-up in Holland, Michigan; the iGreen New England Partnership; the Igniting Innovation (I2) Cleantech Acceleration Network in Orlando, Florida; the Louisiana Tech Proof of Concept Center in Ruston; and the Washington State Clean Energy Partnership Project.

<sup>&</sup>lt;sup>2</sup> Partners in this cooperative effort included the Department of Energy along with the Economic Development Administration, the Department of Agriculture, the U.S. Environmental Protection Agency, the National Science Foundation, the National Institute of Standards and Technology, and the U.S. Patent and Trademark Office. <sup>3</sup> The six organizations that received funding included the Iowa Innovation Network i6 Green Project in Ames; the

<sup>&</sup>lt;sup>4</sup> See Bradley et al. (2013) for a review of entrepreneurship and technology commercialization challenges that PoCCs are intended to address.

Through 2012, there are 32 active PoCCs in the United States that are affiliated with U.S. universities. By year of founding, there has been an increase in PoCCs since 2007; see Fig. 1.<sup>5</sup> The establishment of PoCCs might have been a university response to the overall economic downturn in the United States that began in December of that year; the Startup America initiative was indeed designed to spur economic activity.



**Fig. 1.** Establishment of U.S. University Proof of Concept Centers, 2001–2012. *Source*: Figure 2 in Bradley et al. (2013)

The purpose of this paper is to expand on the preliminary analysis in Bradley et al. (2013; see Table 1 therein) and investigate, yet still in an exploratory manner, the economic impact associated with PoCCs on the dimension of university technology transfer, namely the formation of university startups. University startups, defined as a company or firm started by a university faculty member based on his/her university-based research, are recognized in the academic and professional literatures for their contributions to technology commercialization, employment, and regional economic dynamism. Specifically, we quantify the trajectory of the number of university-based startups associated with the establishment of a university PoCC. If the PoCC is a successful infrastructural element of a university's innovation system, then its presence should have a positive impact on, among other things, the number of university-based startups.

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Impact of PoCC on the number of startups	Number of universities	Change in the mean of the mean number of startups per year	Mean of the mean number of startups per year prior to the PoCC	Mean of the mean number of startups per year after the PoCC				
Increase in startups	19	3.6	4.3	7.9				
Stayed the same	4	_	3.4	3.4				
Decrease in startups	6/29	-1.8	5.0	3.2				

<b>Table 1.</b> Impact of a proof of concept center on university	sity startups
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<sup>&</sup>lt;sup>5</sup> These 32 PoCCs are fairly evenly distributed throughout the United States as shown in Fig. 1. Based on U.S. Census Bureau regions, 7 are in the West, 9 in the Midwest, 10 in the Northeast, and 6 in the South.

In Section II we describe our data set and offer descriptive evidence that, on average, university startups have increased after the PoCC was established. We complement that general finding by estimating econometrically the impact of a PoCC on the number of university startups through a regression model that controls for other related factors. Finally, In Section III we briefly summarize our findings and emphasize the importance for future research related to PoCCs.

### Database and analysis of university startups

Associated with the 32 active PoCCs are 76 universities; 7 of the 32 PoCCs are associated with multiple universities as described in Bradley et al. (2013). The Association of University Technology Managers (AUTM) maintains a database on universities with technology transfer offices or, as is becoming the more common name, offices of innovation and/or commercialization.<sup>6</sup> We were able to identify 39 university contributors to the AUTM database for which sufficient information was voluntarily reported to AUTM over time—the maximum number of years of data, if data are provided each year to AUTM, is from 1996 through 2012—from which we could begin to explore the economic impact of PoCCs.

Data were available to calculate the mean number of startups per year before and after the formation of the PoCC for 29 of the 39 universities. We calculated these means using the same number of years before the establishment of the PoCC as after the creation of the PoCC.<sup>7</sup> The sample was delimited from 39 to 29 if at least 2 years of startup information was not available both before and after the establishment of the PoCC.

Table 1 shows that in 19 of 29 instances, the mean of the mean number of startups per year after the establishment of the PoCC was greater than the mean of the mean number of startups per year before the establishment of the PoCC. For those 19 instances, the mean of the mean number of startups increased by 4.3 per year before the PoCC compared to 7.9 per year after the PoCC. For the 6 instances of decrease, the mean of the mean number of startups before the PoCC was 5.0 per year compared to 3.2 after the PoCC. There are four instances where the mean number of startups before and after the establishment of the PoCC was the same.

To explore, in greater detail, the impact of PoCCs on the number of university startups we pooled all relevant AUTM data on the 39 universities associated with a PoCC and estimated the following regression model:

$$StartUp_{i,t} = f(Size_{i,t}, PoCC_{i,t}, \mathsf{Effects})$$
(1)

where *StartUp* is the number of university startups at university *i* in year *t*; *Size* is the size of the technology transfer office at university *i* in year *t* as measured by the licensing revenue, in \$2009M, of the office in that year; *PoCC* is a binary variable equaling 1 for the year in which the PoCC was established at university *i*, and 0 otherwise; and **Effects** is a vector of university-

<sup>&</sup>lt;sup>6</sup> See, <u>http://www.autm.net/Home.htm.</u>

<sup>&</sup>lt;sup>7</sup> For example, for a PoCC was started in 2008, the mean number of startups before the creation of the PoCC was calculated using the number of startups in 2004 through 2007 even if startup data were available prior to 2004; and the mean number of startups after the creation of the PoCC was calculated using the number of startups in 2009 through 2012, for 2012 being the last year of available data.

specific binary variables accounting for fixed effects not otherwise captured by the model. Descriptive statistics on *Size* and *PoCC* are in Table 2.

Variable	Mean	Standard deviation	Range
Size	14.672	43.989	0-636.65
PoCC	0.4183	0.4937	0/1

**Table 2.** Descriptive Statistics on the variables in Eq. (1)

Size measure in \$2009M

Our estimated results from Eq. (1) are reported in Table 3. Ordinary least squares results are reported for ease of interpretation along with negative binominal results. Also, to account for a possible non-linear size effect, *Size* is also measured in logarithmic terms (*lnSize*). Clearly, the estimated coefficient on *PoCC* is positive in all specifications and statistically significant.

Variable	Ordinary least	squares results	Negative binomial results	
	(1)	(2)	(3)	(4)
Size	0.0196 (0.0109)***	_	0.0048 (0.00093)***	_
lnSize	_	2.1161 (0.4666)***	_	0.2675 (0.0411)***
PoCC	2.6693 (0.8624)***	2.6149 (0.9262)**	0.4744 (0.0780)***	0.3984 (0.0787)***
Effects	Yes	Yes	Yes	Yes
intercept	-0.8159 (2.7809)	0.5791 (1.8489)	0.1696 (0.2818)	0.1799 (0.1923)
$\mathbb{R}^2$	0.5222	0.4464	_	_
Log likelihood	_	_	-1131	-1120
Alpha	_	-	0.2829 (0.0340)***	0.2697 (0.0334)***

**Table 3.** Estimated regression results from Eq. (1) (standard errors in parentheses; n = 528)

\*\*\* Significant at the 0.01-level; \*\* significant at the 0.05-level

The estimated coefficient on *PoCC* in column (1) in Table 3 shows that, holding constant the size of the university's technology transfer office and university-specific effects, universities have, on average, nearly 2.7 more spinoffs after their affiliation with a PoCC than before. In other words, across our sample of 39 universities, all of which became associated with a PoCC at some point in time as quantified by the data, there is systematic evidence that university startups increased after the university became affiliated with a PoCC.

# **Concluding observations**

To the best of our knowledge ours is the first systematic study of a dimension of the economic impact of a PoCC on the technology transfer of knowledge to the private sector through university startups. As such, one should be cautious in generalizing from our exploratory findings, as robust as they are. And certainly, university startups are only one metric through which the impact of a PoCC can meaningfully be measured, but it might be the most readily available metric for one to use to conduct a similar investigation in other countries.

Caveats aside, there is suggestive evidence, at least in the United States, that PoCCs are growing in importance as a policy tool to encourage commercialization of university research. As such, PoCCs have the potential to become an important infrastructural element of a university's innovation system and perhaps that of a region or even a nation. Further, variations in the mean number of startups, including observable declines, among individual universities that have adopted PoCCs suggests that other structural, cultural, and policy factors may affect program efficacy. More research is certainly needed on this topic to inventory PoCCs across nations to facilitate more systematic analyses of economic impacts.

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