

Research Productivity and Economic Impacts of the University of Florida Clinical and Translational Science Institute (UF CTSI)

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Executive Summary

The University of Florida Clinical and Translational Science Institute (UF CTSI) founded in 2008 is the academic hub for clinical and translational science throughout the University and the State of Florida. The mission of the UF CTSI is to improve human health by strengthening the university's ability to conduct clinical and translational research. Currently, more than one thousand researchers are associated with the CTSI and benefit from the services and resources provided by the institute.

Productivity Impacts

This study uses individual research records on external funding, and the number and quality of publications, and follows a quasi-experimental approach to estimate the effects of CTSI's association on research productivity. The main findings of the analysis are the following:

- 1) Association with the CTSI has on average an effect of \$168 thousand on the amount of grants awarded. That is, as a result of their association with the CTSI, researchers attract significantly larger grants. The impact comes mainly from attracting federal grants, new grants, and the ability of researchers to attract a greater number of grants, around 0.73 more than non-CTSI researchers on average.
- 2) A longer association with the CTSI has a larger effect on external funding. For researchers associated for more than five years, the effect is 41.4 percent higher, from \$168 to \$239 thousand.
- 3) The results indicate that the association with the CTSI enhances research productivity by providing valuable services and resources to researchers.

Regional Economic Impacts

The expenditures of the UF CTSI and the associated increase in external funding attracted by CTSI researchers contribute to the regional economy of Alachua County and the State of Florida through the creation of jobs and earnings, through the purchases of products and services from local industries, and the corresponding household spending. Between 2008 and 2016,¹

- 1) The CTSI total average annual economic contribution to Alachua County was \$214.2 million in output, creating 1,225 jobs with earnings of \$67.3 million, and \$115.6 million on value-added.
- 2) The annual economic contribution to the State of Florida was \$293.4 million in output, 2,034 jobs created with earnings of \$100.4 million, and a valued-added of \$163.1 million.
- 3) On average, \$1 million of CTSI's operating expenditure supported \$13 million in additional external funding, and supported 131 jobs in Alachua County and 217 in Florida.

¹ Dollar amounts are in constant June 2016 dollars.

1. Introduction

The University of Florida Clinical and Translational Science Institute (UF CTSI) founded in 2008 is the academic hub for clinical and translational science throughout the University, and increasingly throughout the State of Florida. The mission of the institute is to improve human health by accelerating the translation of scientific discoveries into practical applications and practices for the diagnosis, treatment, prevention, and cure of human diseases.

The UF CTSI is a function-based organization advancing translational science through the supply of services and resources to facilitate health research in any disease area and to advance knowledge. In particular, the institute's service center provides a wide range of services and resources to assist in 1) designing a study, 2) navigating regulations, 3) conducting research, 4) managing data and software, 5) recruiting participants, and/or 6) using translational technologies. The institute has 10 programs that serve as vehicles for the provision of services for research teams.²

The activities of the UF CTSI are diverse and span many departments. Between 2009 and 2015, the number of investigators associated with the CTSI grew from 50 to 1164.

In 2013, the Bureau of Economic and Business Research (BEBR) conducted an assessment of the impact of the UF CTSI on research productivity and the regional economy for the period between 2008 and 2012.³ The current study uses the most recent data available to estimate the effect of CTSI association on research productivity using a quasi-experimental approach and updates the regional economic impacts to 2016.

The rest of the document is as follows. Section 2 describes the methodology and reports the impacts on external funding using a quasi-experimental approach known as difference-in-differences. Section 3 presents the total regional economic impacts of the UF CTSI to Alachua County and the State of Florida from 2008 to 2016. The last section concludes.

2. Impact on Research Productivity

2.1 Data

The individual records on external funding comes from the University of Florida Division of Sponsored Research. The data used to estimate the impacts on external funding cover the years between 2002 and 2015. This data set includes the total amount awarded, the prime sponsor type (federal, private, and state), the academic unit and college of the principal investigator, among other information.

² The *Biomedical Informatics, Biostatistics, Epidemiology and Research Design, Community Engagement and Research, Communication and Dissemination, Implementation Science, Participant and Clinical Interactions, Pilot Awards, and Regulatory Knowledge and Support* programs develop infrastructure, resources, methods and services for translational research. The *Personalized Medicine Program* is preparing UF Health and the state to be leaders in genomic medicine. The *Translational Workforce Development Program* organizes and delivers career development opportunities. More information about the UF CTSI is available at <https://www.ctsi.ufl.edu/>.

³ Dewey and Schaub (2013) "The Economic Impact of the University of Florida's CTSI". The report is available at <https://www.ctsi.ufl.edu/research-initiatives/completed-projects/economic-impact-analysis/>

2.2 Methodology

Consider the non-CTSI researchers as a control group and the CTSI researchers as the treatment group, where the treatment is defined to be the association with the UF CTSI to benefit from its services and resources. In the absence of random assignment, treatment and control groups are likely to differ in many ways, and as a result, the simple comparison of treatment and control groups will not necessarily uncover the effect of associating with the CTSI. In fact, both groups of researchers, CTSI and non-CTSI are not identical. For example, in terms of external funding, figure 2.1 shows that even in the absence of the CTSI, years between 2002 and 2008, the researchers that eventually associated with the CTSI (CTSI researchers) attracted more external funding than those who remained unassociated. To adjust for the fact that the two groups of researchers were not the same in the pre-treatment period (before the establishment of the UF CTSI), a quasi-experimental approach called difference-in-differences (DD) is followed.

The difference-in-differences method mimics an experimental design using observational data. The method compares the difference in outcomes after and before the intervention for individuals affected by the treatment (CTSI researchers) to the same difference for unaffected individuals (non-CTSI researchers). The DD causal parameter can be estimated using the following regression equation:

$$Y = \alpha + \beta_1 \times CTSI + \beta_2 \times CTSA + \gamma_{DD}(CTSI \times CTSA) + \mathbf{X}'\boldsymbol{\delta} + \varepsilon$$

Where Y denotes the outcome of interest (grants, or publications), $CTSI$ denotes the status as a CTSI researcher ($CTSI$ equals one if a researcher is associated with the CTSI and is zero otherwise), $CTSA$ denote the post-treatment period ($CTSA$ equals one for all the years after 2009), the vector \mathbf{X} denotes other control variables, and ε is an error term accounting for other factors affecting the outcome. The coefficient on the interaction term, γ_{DD} , is the causal effect of interest.⁴ Among the control variables included in the regression are time effects to capture temporal changes in the outcomes that are common to all researchers, and college effects to control for the differing outcomes in each college. The analysis focuses on researchers in the UF Health Science Center.⁵

2.3 Results

Table 2.2 reports the main results regarding external funding. For each outcome, different time periods were considered when estimating the model for robustness. The binary variable $CTSI$ was modified accordingly.

First, in terms of external funding, when looking into the period between 2005 and 2012 (four years before and four years after the creation of the UF CTSI), and thus taking only into account the researchers associated with the CTSI by 2012, their association with the CTSI has an effect of \$168 thousand on the amount of grants awarded. That is, as a result of their association with the institute, researchers attracted greater amounts of money, and that impact comes mainly from federal grants, new grants, and the ability

⁴The coefficient of the interaction term is $\gamma_{DD} = \{E[Y|CTSI = 1, CTSA = 1, X] - E[Y|CTSI = 1, CTSA = 0, X]\} - \{E[Y|CTSI = 0, CTSA = 1, X] - E[Y|CTSI = 0, CTSA = 0, X]\}$. That is, the difference between post- and pre-CTSI for CTSI researchers minus the difference between post- and pre-CTSI for non-CTSI researchers.

⁵ The Health Science Center comprises the colleges of Dentistry, Medicine, Nursing, Pharmacy, Public Health and Health Professions, Veterinary Medicine, the College of Medicine (Jacksonville), and Health Affairs, the PHHP/COM Integrated Programs, and the Health Science Center (Jacksonville).

of researchers to attract a greater number of grants, around 0.73 more than non-CTSI researchers. Moreover, when considering the time period between 2002 and 2015 and only the researchers who have been associated for five years and more, the effect on external funding increases by 41.4 percent, from \$168 thousand to \$238.8 thousand. This implies that longer exposure to the services and resources of the institute has an escalating effect. As a robustness check, the model was estimated again using the whole period, from 2002 to 2015, but considering the researchers associated with the CTSI by 2015. Similar results were found as reported in the last three columns of table 2.2.

Table 2.2. UF CTSI Impact on External Funding

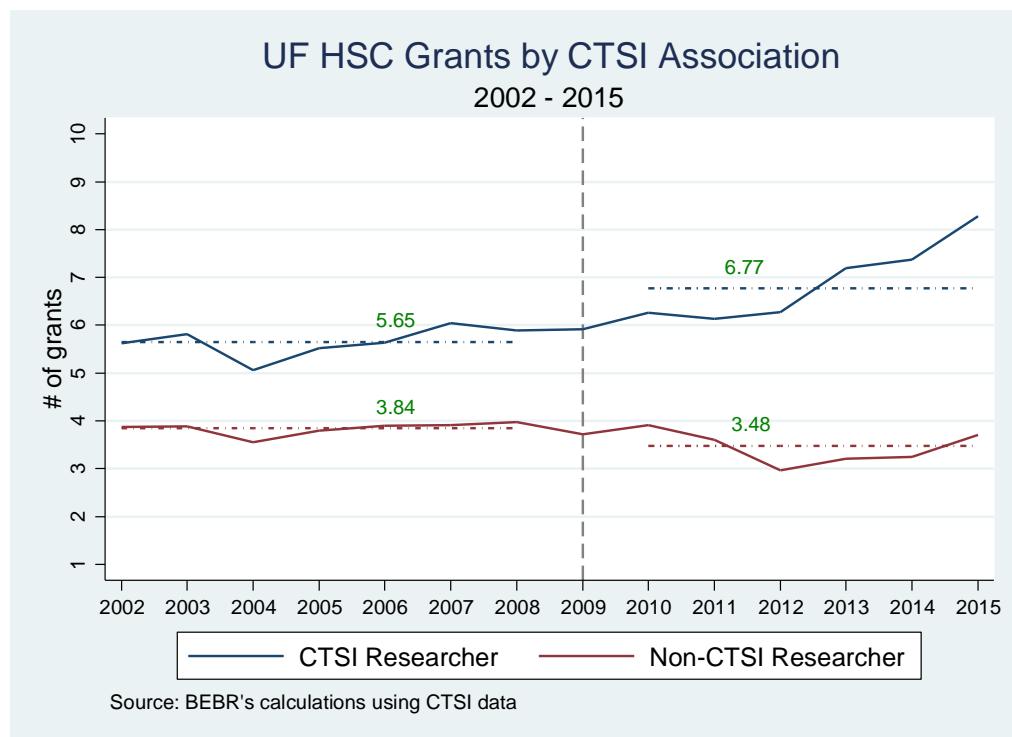
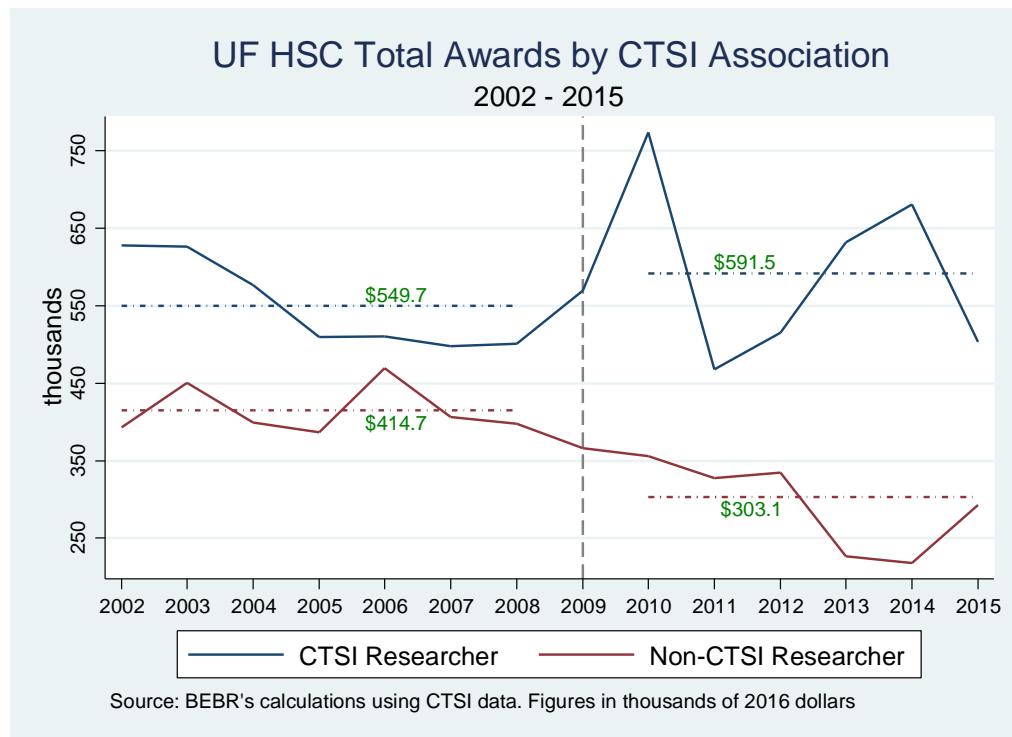
Specifications:	CTSI 2012			CTSI 5 year +			CTSI 2015		
	estimate	std. err	p. value	estimate	std. err	p. value	estimate	std. err	p. value
Outcomes:									
Awarded (\$)	167,989 *	77,059	0.057	238,775 **	93,096	0.030	155,004 *	68,862	0.051
Federal (\$)	190,415 **	78,620	0.042	293,373 **	123,406	0.041	244,848 **	105,210	0.045
Private (\$)	88,275 **	34,196	0.030	-3,783	10,517	0.727	-8,800	10,496	0.424
FL State (\$)	-51,985	34,997	0.176	37,129	40,400	0.385	-57,834	37,310	0.160
New (\$)	114,720 *	53,124	0.059	190,237 ***	76,622	0.035	130,687 **	56,920	0.047
# Grants	0.76 **	0.27	0.020	2.47 ***	0.65	0.004	1.43 **	0.58	0.035
Period	2005 - 2012			2002 - 2015			2002 - 2015		

Each cell contains the difference-in-differences coefficient, γ_{DD} , each coming from a separate regression. Each regression includes year, college, and their interaction fixed effects. Standard errors are clustered at the college level. * p<.1; ** p<.05; ***

The difference-in-differences method amounts to a comparison of changes across the two types of investigators, CTSI and non-CTSI researchers. The causal parameter, γ_{DD} , presumes that, in the absence of services and resources supplied by the UF CTSI, the control group trend (non-CTSI researchers' performance) is what we should have expected to see in the treatment group (CTSI-researchers). This assumption is known as the *common trends assumption*, and can be tested when longer pre-treatment data is available by comparing the trends between the two groups. Figures 2.1 and 2.2 provides evidence on this assumption. Figure 2.1 shows that the number of grants moved almost in parallel in the two groups between 2002 and 2008, and similarly for the amounts awarded with the exception of the year 2006.

To summarize, the evidence indicates that CTSI researchers are awarded more grants than non-CTSI researchers even before the creation of the CTSI. However, their productivity, in terms of attracting more external funding, increased relative to what would have been otherwise expected following their association with CTSI. The results suggest that the association with CTSI directly enhances research productivity by providing valuable services and resources to researchers. These findings are robust to alternative empirical specifications.

Figures 2.1. UF HSC External Funding



The dashed lines and the corresponding green numbers represent the average for each period, pre-CTSA from 2002 to 2008, and post-CTSA from 2009 to 2015 for each CTSI and non-CTSI researchers.

3. Regional Economic Impact

In the process of providing services and resources to accelerate the translation of scientific discoveries into practical applications and practices, the UF CTSI contributes directly to the economy with jobs, earnings and the associated household spending. Moreover, the expenditures associated with their operations impact the local economy of Alachua County and the State of Florida by creating indirect jobs and earnings through the purchase of goods and services from the supporting industries, and through the value of goods and services purchased by all workers in such industries.

3.1 Methodology

To provide goods and services, firms purchase goods and services from other firms in the same or different industry, and in or out the region they belong. The economic contribution of a firm is defined as the gross changes in a region's existing economy that can be attributed to the firm by tracking the gross economic activity as the dollars cycle through the region's economy. One of the most common ways to perform this analysis within a geographical region is with the use of a multiplier analysis based on an Input-Output (I-O) model, such as the RIMS-II model of the Bureau of Economic Analysis (BEA).⁶

The RIMS II regional economic model is based on an accounting framework called an Input-Output table. For each industry, an Input-Output table shows the distribution of the inputs purchased and the outputs sold. In other words, the I-O table is a set of recipes for production in a given economy. The table provides data on industry demands and supplies to all industries. The economic model is built to represent the structure and degree of interconnectedness in the regional economy with the output of each industry broken down and attributed to expenditures on intermediate inputs or to value-added components such as labor, taxes, and returns to capital. This model enables the derivation of economic multipliers which capture the effects of input purchases, and household spending by employees for a new final demand to the region's economy. The model considers all the leakages that may occur, so the multiplier is genuinely a regional one. The leakages consist of any expenditure that does not take place within the region, such as imports from other regions. These multipliers are used to estimate economic impacts in terms of output, employment, value added, and earnings.⁷

To estimate the impact of a given expenditure on final demand, the UF CTSI total expenditure was allocated across industries according to how it was spent, then industry level expenditures were multiplied by industry specific multipliers. These multipliers come from the RIMS II model, and were obtained for both Alachua County and the State of Florida. Finally, the resulting products were added to obtain the total contribution for each region.

3.2 Results

Table 3.1 contains the expenditure pattern of the CTSI between 2012 and 2016. Between 2012 and 2016, the total expenditure of the institute was \$51.6 million. There are two main categories that account for

⁶ More detailed information about the RIMS II model is available at the user's guide:
http://www.bea.gov/regional/pdf/rims/RIMSII_User_Guide.pdf

⁷ Gross output refers to the total value of economic activity within the region. Value added is gross output less the cost of intermediate goods, or the increase in regional gross domestic product.

almost 90 percent of the expenses (Figure 1). Around 63 percent of the expenditure goes to salary and wages (Salary and OPS) and around 26 percent goes to contractual expenses, such as legal, accounting and consulting services. The rest of the expenditure is distributed among other categories such as the purchase of materials, repairs and maintenance, travel expenses, capital asset purchases, and utilities and communications.

Table 3.1. Expenditure Pattern of UF CTSI

(thousands of dollars)	2012	2013	2014	2015	2016	Total	%
Expenditure category							
Salary Expenses	\$5,224	\$5,208	\$6,145	\$6,720	\$6,554	\$29,850	57.8
OPS (Earnings)	\$410	\$445	\$602	\$503	\$570	\$2,530	4.9
Contractual Expenses	\$5,349	\$2,155	\$1,703	\$1,389	\$2,675	\$13,271	25.7
Repairs and Maintenance	\$65	\$45	\$67	\$61	\$77	\$315	0.6
Travel Expenses	\$159	\$105	\$118	\$123	\$119	\$624	1.2
Capital Asset Purchase	\$258	\$55	\$10	\$8	\$0	\$330	0.6
Material	\$311	\$469	\$335	\$265	\$222	\$1,602	3.1
Patient Care Expenses	\$0	\$56	\$406	\$654	-\$319	\$797	1.5
Utilities & Communications	\$22	\$30	\$31	\$41	\$37	\$161	0.3
Financial Aid	\$259	\$266	\$244	\$318	\$420	\$1,507	2.9
Other	\$124	\$109	\$98	\$194	\$130	\$655	1.3
Total	\$12,179	\$8,943	\$9,758	\$10,275	\$10,487	\$51,643	100.0

Figures are in June 2016 dollars.

Figure 3.1. Distribution of UF CTSI Expenditure

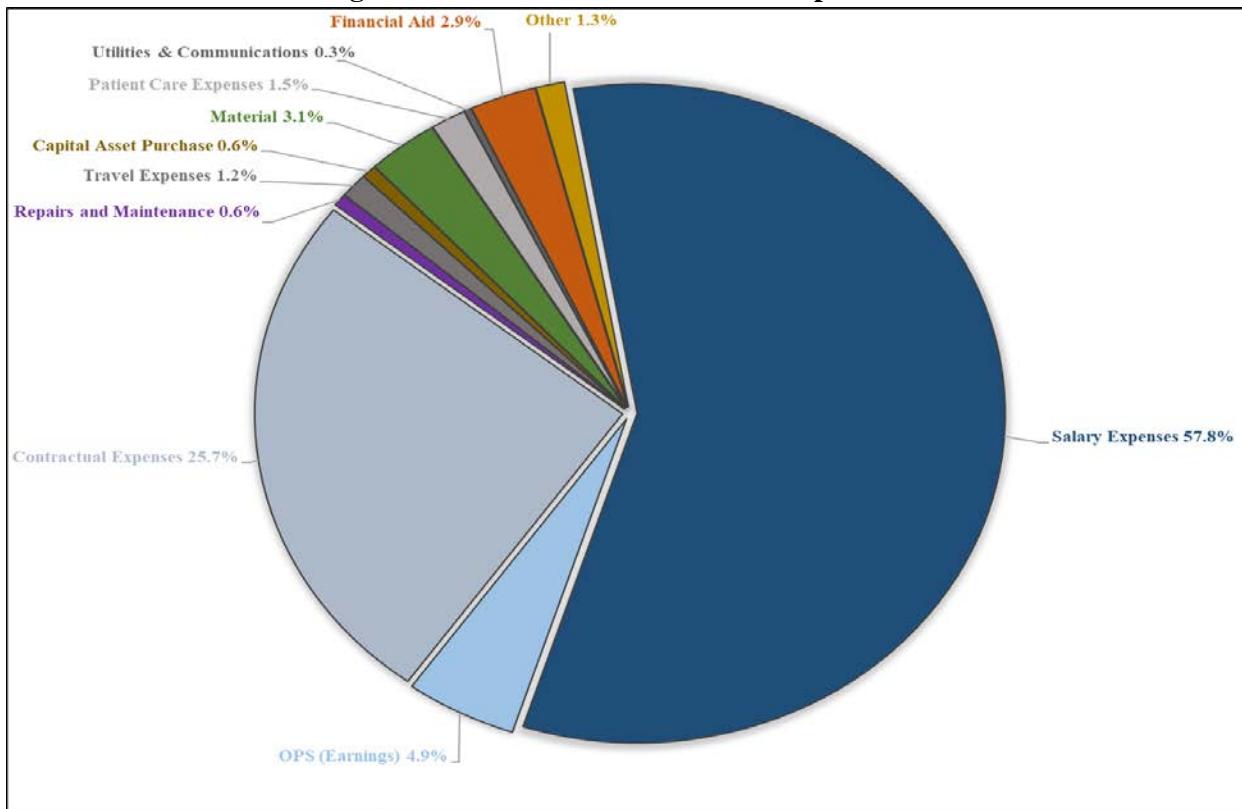


Table 3.2 contains the total economic contribution of the UF CTSI activities between 2008 and 2016 in Alachua County and the State of Florida in terms of output, value-added, employment, and earnings. The last column reports the yearly economic impacts, which are the following. Since the beginning of the UF CTSI operations in 2008 and up to 2016, the institute's total average annual economic contribution to Alachua County was \$214.2 million in output, creating 1,225 jobs with earnings of \$67.3 million, and \$115.6 million on value-added. The annual economic contribution to the State of Florida was \$293.4 million in output, 2,034 jobs created with earnings of \$100.4 million, and a valued-added of \$163.1 million.

Table 3.2. Regional Economic Impacts of UF CTSI

(millions of dollars)	2008 [†]	2009 [†]	2010 [†]	2011 [†]	2012	2013	2014	2015	2016	Total	Yearly	Total / CTSI
CTSI Expenditures	5.5	8.2	8.6	10.4	12.2	8.9	9.8	10.3	10.5	84.3	9.4	
Additional External Funding*	0.0	8.4	92.2	141.3	161.4	165.6	170.2	195.5	185.5	1,120.2	124.5	13.3
Total Spending	5.5	35.7	140.0	162.1	173.6	174.6	179.9	205.8	195.9	1,273.1	141.5	15.1
Economic Impacts												
Alachua County												
<i>Output (millions of dollars)</i>	9.4	27.3	162.8	244.4	277.4	279.0	286.7	328.4	312.3	1,927.8	214.2	22.9
<i>Earnings (millions of dollars)</i>	4.8	11.4	56.4	83.7	84.5	84.6	86.6	99.3	94.5	605.7	67.3	7.2
<i>Employment (number of jobs)</i>	47	145	948	1,448	1,594	1,587	1,623	1,861	1,774	11,027	1,225	130.8
<i>Value-added (millions of dollars)</i>	6.8	17.9	98.1	146.5	144.7	145.0	148.9	170.6	162.2	1,040.7	115.6	12.3
State of Florida												
<i>Output (millions of dollars)</i>	12.2	36.7	223.5	335.8	379.9	382.0	392.8	449.8	427.8	2,640.6	293.4	31.3
<i>Earnings (millions of dollars)</i>	6.0	15.5	82.7	123.4	126.8	127.1	130.3	149.3	142.1	903.2	100.4	10.7
<i>Employment (number of jobs)</i>	77	240	1,580	2,413	2,635	2,631	2,697	3,091	2,945	18,308	2,034	217.2
<i>Value-added (millions of dollars)</i>	8.6	23.8	135.2	202.5	205.6	206.3	211.9	242.7	230.9	1,467.5	163.1	17.4

All figures are in June 2016 dollars. Figures from 2008 to 2011 come from Dewey and Schaub (2013) "The Economic Impact of the University of Florida's CTSI", but were adjusted to June 2016 prices. * Considering the impacts on research productivity found by the current report, that is, \$168 thousand per year and CTSI investigator, the additional external funding was calculated as \$168 thousand times the number of investigators affiliated to the CTSI in each year. For example, in 2012 there were 961 CTSI researchers, thus 961 times \$168 thousand equals \$161.4 million. † To keep the time series consistent with the current findings, the additional external funding and corresponding impacts for the years between 2009 and 2011 were recalculated.

4. Conclusions

The University of Florida Clinical and Translational Science Institute is the academic hub for clinical and translational science throughout the University, and increasingly throughout the State of Florida. The institute provides a wide range of services and resources for research teams. By doing so, the institute increases their productivity and also generates an important economic contribution to the local economy.

The empirical evidence indicates that CTSI researchers' productivity increased relative to what would have been otherwise expected following their association with CTSI, at least in terms of attracting more external funding. This result implies that the association with CTSI directly enhances research productivity by providing valuable services and resources to researchers, and also shows that the CTSI has a high return on investment. Importantly, the impacts are higher for those researchers using the services for a longer period of time.

Finally, the expenditures of the CTSI and associated increases in external funding support a large volume of employment and economic activity in the region. The additional multiplier effect implies that one million dollars of CTSI operating funding supported 131 jobs in Alachua County and 217 in the State of Florida.