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**University entrepreneurial orientation,  
technology transfer offices and academic spin-  
offs: an empirical analysis of their relations**

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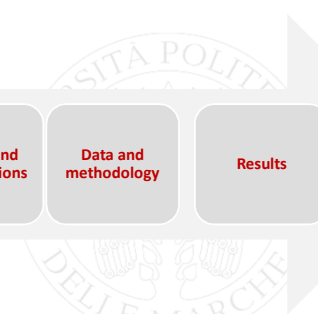
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**THE THIRD MISSION OF UNIVERSITY**

In Italy this is a quite recent phenomenon: up to 2000, researchers and professors (being civil servants) were not allowed to start and manage companies.

A law passed in 1999 allowed universities to authorize their staff to start-up their own companies (academic spin-offs) to commercially exploit the results of their research. From 2001 to 2010 Italian universities authorized about 1,000 spin-offs.

During the same period universities also set-up technology transfer offices (TTOs) to foster and support the valorisation of research outcomes (spin-offs, patents, university-industry collaborations)

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Background Data and methodology Results Conclusions

### Background of the paper

- After ten years of experience of spin-off promotion by universities and local institutions, there is a growing concern about the evaluation of the impact of spin-offs on universities' technology transfer and local economies
- Up to now empirical research focused on analyzing the characteristics of spin-offs, their growth patterns and their impact on technology transfer and on the local context
- Few studies analysed the interconnections between the creation of spin-offs and the establishment and the role of TTOs (Algieri et al. 2013)

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### OBJECTIVES

- The focus of this paper is on the role of TTOs in promoting and sustaining academic spin-offs.
- The literature usually hypothesizes that the presence and resources of TTOs play a positive role in fostering academic entrepreneurship. However, spin-off creation depends on many other factors and the causal relationship could be ambiguous.
- Italy is an interesting case given that both spin-offs and TTOs developed for the first time in the same period (2000-2010)
- The aim of the paper is to analyse the **causal relations** between spin-offs and TTOs and to determine whether researchers reacted more quickly to the new opportunities offered by the law than their parent universities.

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Background Data and methodology Results Conclusions

### DATA

The paper uses two large datasets about TTOs and academic spin-offs in Italian universities for the period 2000-2012

1. The first is the database of Italian spin-offs developed within the Centre for Innovation and Entrepreneurship of UNIVPM (<http://spinoff.dii.univpm.it>)
2. The second dataset originates from the annual survey of technology transfer activity in Italian universities carried out by NetVal (the Italian association of TTOs)

The availability of longitudinal data for a ten year period allows us to analyse the relation between the **investment in financial and human resources in TTOs** and the **set-up of spin-offs**. In the empirical analysis we also take into account of other factors that may affect the start up of spin-offs, such as the characteristics of the university and of the local context.

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**VARIABLES**

**Dependent variable:**

- the number of academic spin-offs set-up in Italian universities during the period 2000-2012:  $SPIN_{it}$  identifies the spin-offs set-up in the university  $i$  ( $i=1...67$ ) at time  $t$ . ( $t=2000...2012$ )

**Independent variables:**

- the presence of a TTO and of the resources allocated to it (2002-2011):  $EMP_{it}$  and  $BUD_{it}$  refer respectively to the number of employees and the budget (in thousands of Euros) in university  $i$  at year  $t$ .
- size of the university in terms of number of academicians: the number of researchers in the fields of science and technology
- amount of public funds supporting university research
- the presence of incubators (dummy)
- the number of patents by universities (total 2004-2010)
- the amount of industry-funded research by university (total 2004-2010)

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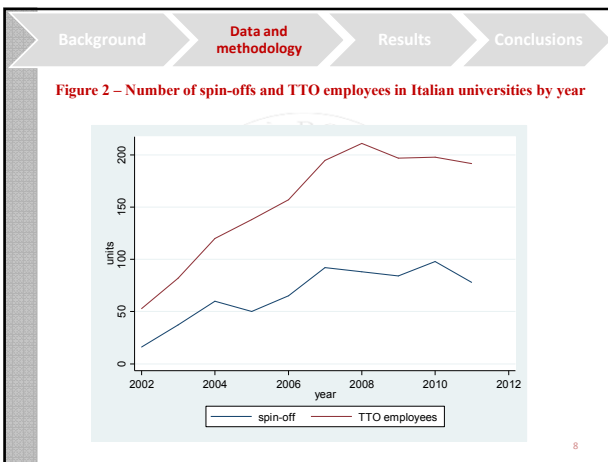
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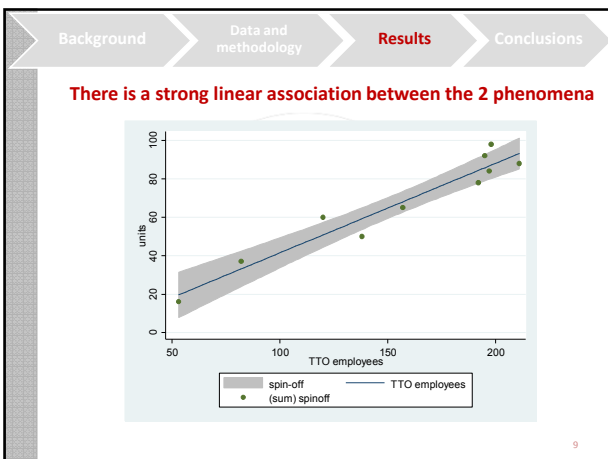
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Background Data and methodology **Results** Conclusions

### Correlations between employees in TTO per year

		L.1	L.2.	L3.	L4.	L5.
<b>2012</b>	1					
<b>L1. 2011</b>	0.844	1				
<b>L2. 2010</b>	0.7706	0.8637	1			
<b>L3. 2009</b>	0.7436	0.7781	0.8954	1		
<b>L4. 2008</b>	0.7079	0.7633	0.8194	0.9117	1	
<b>L5. 2007</b>	0.6143	0.679	0.7382	0.7841	0.8742	1

The employees in TTO show a greater persistence over time than the number of spin-off  
 THE FIRST ORDER AUTOCORRELATION OF TTO EMPLOYEES IS WELL ABOVE 0.8  
 AND REMAINS OVER 0.6 AFTER 5 YEARS

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Background Data and methodology **Results** Conclusions

### Correlations between spin-off start-ups per year

Spin-off		L.1	L.2.	L3.	L4.	L5.
<b>2012</b>	1					
<b>L1. 2011</b>	0.5274	1				
<b>L2. 2010</b>	0.3817	0.5036	1			
<b>L3. 2009</b>	0.3683	0.3769	0.4941	1		
<b>L4. 2008</b>	0.3269	0.3740	0.3966	0.4729	1	
<b>L5. 2007</b>	0.2633	0.2973	0.3729	0.4188	0.4990	1

THE FIRST ORDER AUTOCORRELATION FOR SPIN-OFFS IS ABOUT 0.5 AND DROPS BELOW 0.3

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Background Data and methodology **Results** Conclusions

### Correlation matrix of the main independent variables

	TTO employees	Research funds	Science faculty	Incubators	High-tech firms	Patents	Funds from firms
<b>1 TTO employees</b>	1						
<b>2 Research funds</b>	0.3099	1					
<b>3 Science faculty</b>	0.4429	0.8855	1				
<b>4 Incubators</b>	0.3793	0.332	0.3414	1			
<b>5 High-tech firms</b>	0.2499	0.2582	0.2787	0.0626	1		
<b>6 Patents</b>	0.5553	0.6564	0.6587	0.4643	0.4357	1	
<b>7 Funds from firms</b>	0.4305	0.724	0.7585	0.3296	0.4065	0.7477	1

HIGH CORRELATION BETWEEN 3, 2, 7, 6

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**Pooled OLS, independent variable: number of spinoffs**

	Coef.	t	P>t
TTO employees	0.1774***	5.5900	0.0000
Research funds	0.0001**	2.1800	0.0300
Incubators	0.3708**	2.4300	0.0160
High-tech firms	0.0000***	-4.1800	0.0000
Area	0.2694**	2.1200	0.0340
Sponsord research	0.0000***	2.9800	0.0030
Patents	-0.8708***	-2.7700	0.0060
Number of obs	558		
F( 7, 550)	14.09		
R-squared	0.2094		

Legend: \*\*\* significant at 1%; \*\* significant at 5%; \*significant at 10%.  
Robust standard errors

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**POSSIBLE EXPLANATIONS**

THE MOST ACTIVE UNIVERSITIES IN TERMS OF SPIN-OFFS ARE MEDIUM SIZED LOCATED IN AREAS WITH A LOW DENSITY OF HIGH-TECH FIRMS



UP TO NOW THE PHENOMENON OF SPIN-OFFS IN ITALY IS THE RESULT OF THE AUTONOMOUS PUSH BY ENTREPRENEURIAL UNIVERSITIES AND IS NOT MUCH INFLUENCED BY THE SURROUNDING ENVIRONMENT

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**MODEL**

- THE DEPENDENT VARIABLE IS A DUMMY VARIABLE THAT TAKES 1 IN CASE OF AN INCREASE IN THE NUMBER OF SPIN-OFFS
- WE PERFORM A LOGIT ESTIMATION TO ESTIMATE THE VARIABLES THAT INFLUENCE THE PROBABILITY OF AN YEARLY INCREASE OF NUMBER OF SPIN-OFFS OVER THE PERIOD CONSIDERED



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**Logistic regression. Dependent variable: yearly increase in spin-offs**

	$\beta$ (p value) Odds ratio	$\beta$ (p value) Odds ratio	$\beta$ (p value) Odds ratio	$\beta$ (p value) Odds ratio	$\beta$ (p value) Odds ratio	$\beta$ (p value) Odds ratio	$\beta$ (p value) Odds ratio
EMP <sub>t</sub>	1.87*** (0.000)	1.83*** (0.000)	1.65*** (0.000)	1.752*** (0.000)	1.587*** (0.000)	2.014*** (0.000)	2.150*** (0.000)
AREA	1.16 1.994 (0.325)	1.20 2.288 (0.268)	1.16 0.875 (0.823)	1.19 -1.245 (0.567)	1.22 -0.864 (0.715)	1.22 -0.884 (0.884)	1.24 -0.708 (0.936)
BUD <sub>t</sub>		1.26 -0.009 (0.142)	1.05 -0.020*** (0.007)	1.13 -0.022*** (0.003)	1.09 -0.026*** (0.002)	.96 -0.030*** (0.001)	1.02 -0.030*** (0.001)
TOTSPIN <sub>t</sub>			.0751*** (0.000)	.0630*** (0.000)	.0862*** (0.002)	.0876*** (0.000)	.0946*** (0.000)
FAC <sub>t</sub>			1.08	1.07 0.001*** (0.005)	1.09 -0.009** (0.016)	1.09 -0.001** (0.019)	1.10 -0.009** (0.018)
FAC <sub>t</sub> <sup>2</sup>				1.00 -0.0001*** (0.008)	1.00 -0.001*** (0.005)	1.00 -0.001** (0.010)	1.00 -0.001*** (0.009)
RESFUN <sub>t</sub>				.99	-0.000 (0.713)	-0.001 (0.628)	-0.001 (0.569)
PAT <sub>t</sub>					.99	-1.4635 (0.178)	-1.5548 (0.156)
EXTFUN <sub>t</sub>						.23 0.001* (0.099)	.21 0.0002 (0.107)
AGE <sub>t</sub>						1.00	1.00
N	620	620	620	620	558	558	558
LR chi <sup>2</sup>	23.3	26.21	53.59	61.79	70.53	73.44	75.02
Prob>chi <sup>2</sup>	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R <sup>2</sup>	0.03	0.04	0.07	0.08	0.11	0.11	0.11

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- ## RESULTS
- Positive influence of the number of employees (remains even after controlling for the stock of spin-offs already set-up: there is a cumulative effect in the set-up of new spin-offs)
  - The budget allocated to TTO has a negative sign
  - The size of universities shows a non-linear inverted U-shaped relation (the most active universities in promoting spin-offs are medium sized universities)
  - Public research funds doesn't have a direct impact
  - Research funds obtained from external sources has a positive impact
  - In the case of patent this mechanism could have a substitution effect
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## Dynamic model

When using dynamic models that take into account the cumulative nature of the two phenomena, the relations between the two appears much more complex. If we use the variation of employees in TTO to predict the probability of an increase in the number of spin-off the former variable remains positive but not statistically significant.

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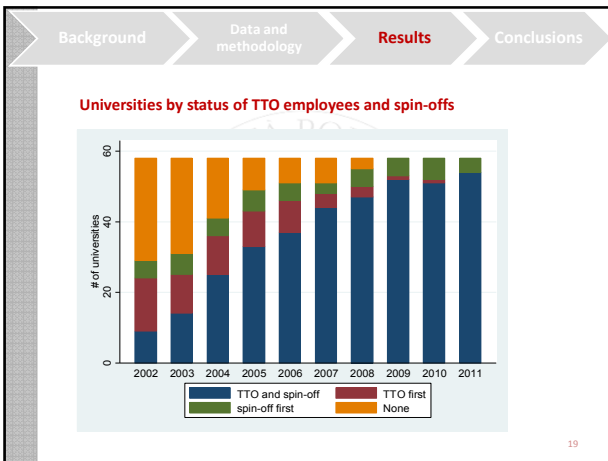
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Background Data and methodology Results **Conclusions**

- This paper is a first attempt at analyzing the relations between the investment of resources in technology transfer offices and the formation of spin-offs
- The size of the TTO has a positive influence on the probability on increasing the number of spin-offs set-up by the university.
  - This positive influence is associated with the employees in the TTO rather than the financial resources allocated to it

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Background Data and methodology Results **Conclusions**

- However, the casual relation between the two phenomena is not straightforward.
- The empirical analysis show that in a significant number of cases academicians started developing spin-offs even if the university had not set-up a TTO. This situation has maintained its relevance up to recent years.

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