Introduction

Focusing on the process of creating, discovering, and exploiting technological opportunities created by university research has been a remarkable increasing interest in Academic entrepreneurship as a field of research. The commercialization of university research is today also at the core of many national and local economic policies, including Europe, North America and increasingly Asia (Kroll and Liefner, 2008; Rasmussen, 2008; Shane, 2004). The technology transfer process is an extended course of actions that start with opportunity identification that is clearly an intentional process (Krueger et al., 2000). Moreover technology transfer process involves different groups of interest. According to the Association of University Technology Managers (2004), federal government in the US now provides more than 27.7 dollars billion annually to university researchers to conduct scientific research. This continuing investment expands human knowledge supporting the building of relationships between the different actors involved in the creation of a new business and helps to educate the next generation of science and technology leaders.

There is large literature about entrepreneurship in University and technology transfer and the numerous theoretical works investigate the determinants and consequences of university spinoff activity but even though, the most important gap might concern robust empirical studies that investigate this important phenomenon at the individual level (Prodan, I., Drnovsek, M. 2010). We investigate the specific determinants that characterize of academics’ entrepreneurial intention within University context analysing this emergence at individual level.

We use empirical data from PhD students employed in the sciences departments of the faculties of one of the most important University in Italy. The paper is structured as follows. We first review prior literature on academic entrepreneurial intention (AEI) and their determinants which are key to the creation of spin-off companies and then present the model grounded in social cognitive theory and hypotheses.

*The author listing is alphabetical; the authors have contributed equally to the research reported in this paper.*
1. Entrepreneurial intention in Academia

Ventures get started and develop through initial stages largely based on the vision, goals, and motivations of individuals. New organizations are the direct outcome of these individuals' intention and consequent actions, moderated or influenced by environmental conditions. (Bird, 1988).

Much prior research about entrepreneurial intention analyzed different populations of potential entrepreneurs in order to understand their decision-making processes with respect to becoming entrepreneurs.

Intention in the psychological literature, have proven the best predictor of planned behavior (Ajzen, 1991), particularly when that behavior is rare, hard to observe, or involves unpredictable time lags (Krueger et al., 2000).

Recognizing that starting a business is an intentional act (Krueger et al., 2000) and entrepreneurship is a planned behaviour (Bird 1988; Katz and Gartner 1988) entrepreneurial intention’s model had substantial implications for intentionality research in entrepreneurship (Krueger et al., 2000) and entrepreneurial intention can be seen as an accurate predictor of planned behavior towards starting a new business (Fishbein and Ajzen, 1975).

Inside the University the PhD students are potential academic entrepreneurs, they have a critical role in the identification of the best way for commercialize the results of their research to improve the technology transfer process. This kind of process is a consequence of two broad categories of determinants: (1) individuals with certain characteristics, abilities, and perceptions who find themselves in (2) a context which is conducive to venturing (Bird,1988).

Intention is a state of mind directing a person's attention, experience, and behavior toward a specific object or method of behaving.

"Since much of human behavior appears to be under volitional control, . . . the best single predictor of an individual's behavior will be a measure of his intention to perform that behavior" (Fishbein & Ajzen,1975).

The individual behavior is also a direct consequence of different environmental characteristics. There are different determinants of this University context that could affect the potential entrepreneurs’ intention of starting a new firms for commercialize the invention.

This model acknowledges that entrepreneurial event is a result of a dynamic interaction between individual and environment (Shane and Venkataraman, 2000),which is in agreement to social cognitive perspective of entrepreneurship.

Using an existing framework of planned behavior in psychology and intentionality in entrepreneurship, we analyze the determinants of academic entrepreneurial intention (AEI) and testing the validity of a theoretical model (Prodan and Drnovsek, 2010).

Fig. 1 presents our proposed model of academic-entrepreneurial intention that come from entrepreneurial intention model originally proposed by Bird (1988) and Krueger (1993) and that we adapt in the Academic context from Prodan and Drnovsek, (2010).
The theory of Planned Behavior (Ajzen, 1991) identifies three attitudinal antecedents of intention.

The first is perceived behavioral control. It reflects the perceptions that the behavior is personally controllable. Perceived behavioral control is dependent on an individual’s perceived ability to execute the intended behavior of entering entrepreneurship. The PBC could be expressed through entrepreneurial self-efficacy, these are, therefore, concepts quite similar (SE) (Bandura, 1997).

The second concerns Personal Attitude toward outcomes of the behavior and in the economic context toward the desirability of an entrepreneurial career (that is expressed through perceived role models) (Chen et al, 1998). It includes not only affective (I like it, it is attractive), but also evaluative considerations (it has advantages) about being an entrepreneur. (Ajzen, 2001; Autio et al., 2001).

The third comprehends all those perceived social norms. They consider the individual perception of what connected and close people think about performing a particular behavior.

Empirically, we must identify the most important social influences (for example, parents, significant other, friends) including any “role model” or “mentor” (Krueger, 2000). Research into the personal networks of entrepreneurs often focuses on flows of resources and information. Some studies address also social norms and values provided by network members (Shapero, 1982).
2. Determinants of academic entrepreneurial intention

2.1 Entrepreneurial self-efficacy and academic-entrepreneurial intention

The self-efficacy (SE) is a concept regarding people’s beliefs in their abilities to mobilize the motivations, cognitive resources, and courses of action needed to exercise control over events in their lives. The self-efficacy perspective is one determinant of Planned Behavior for the study of entrepreneurship (Chen et al., 1998) that could explain.

The entrepreneurial self-efficacy concern about individuals’ beliefs regarding their capabilities for achieving goals and attaining success. The concept of self-efficacy reflects on the confidence that he or she has with their ability for successfully performing the roles and tasks of an entrepreneur (Boyd and Vozikis, 1994; Scherer et al., 1989).

There are several theoretical works that studied different populations of entrepreneurs, and entrepreneurial self-efficacy has been positively related to the intention to set up one’s own business. There are also several studies that considered the potential population of entrepreneurs (Chen et al. 1998; Zhao et al.’s 2005) with self-efficacy positively related to intention.

Usually, the PhD. Students, also if they work in the laboratories, they need business skills that are necessary when you have the idea to commercialize and exploit their inventions. The ability to connect specific knowledge and commercial opportunity requires a set of skills, aptitudes, insights, and circumstances that are distributed neither uniformly nor widely (Venkataraman, 1997).

The perceived conviction of performing specific roles and tasks in entrepreneurship is represented by the entrepreneurial self-efficacy construct. Thus, this leads us to propose the following:

Hypothesis H1: Entrepreneurial self-efficacy is positively related to academic-entrepreneurial intention.

2.2 The relationship between personal network and self-efficacy

Prior research addressed to the network literature highlighting the importance of personal ties to successful entrepreneurship (Birley, 1985). The venture creation from University is a process that involves different and numerous actors (venture capitalist, business angels, and colleagues) and resources both. The Academic and also PhD students with a strong business networks can benefit from opportunity identification, access to important information’s and
resources that cannot otherwise be obtained, timing, and receiving positive recommendations and evaluation. Landry et al.’s (2006) explored the social capital assets of researchers for predict the likelihood of them creating spin-offs. In addition, Personal Networks (PN) have been found to be an important predictor of entrepreneurial self- efficacy (Ozgen and Baron, 2007) reinforcing their beliefs or their abilities to mobilize the motivations, cognitive resources, and courses of action. Building on research findings on the importance of personal networks in the entrepreneurship process, we put forward the following:

**Hypothesis H2**: Academic’s personal networks are positively related to the entrepreneurial self-efficacy.

**Hypothesis H3**: Academic’s personal networks are positively related to the academic-entrepreneurial intention.

### 2.3 Personal attitudes as a predictor of Academic-entrepreneurial intention

According to theory of Planned behavior, Personal attitudes (PA) was demonstrated to be a valid antecedent for intention. PA refers to the degree to which the individual holds a positive or negative personal valuation about being an entrepreneur (Ajzen, 2001; Autio et al., 2001; Kolvereid, 1996b). It includes not only affective (I like it, it is attractive), but also evaluative considerations (it has advantages) (Liñán, F. and Chen, Y.W. 2009).

The exploitation of new ventures depends of the entrepreneurial culture and entrepreneurship experience in successful spin-off companies is crucial for potential academic entrepreneurs. In addition, faculty members can offer moral and material support to colleagues who are trying to establish a company (Etzkowitz, 1998).

The Academics that decided to their own firms are influenced from their perception about their potentiality to become entrepreneurs and this kind of perception depends also from how they feel confident in the context they are working.

On the basis of these findings, we argue that Personal attitudes are directly related to academic-entrepreneurial intention and also to entrepreneurial self-efficacy; therefore, we posit the following:

**Hypothesis H4**: The Personal attitudes are positively related to the entrepreneurial self-efficacy.

**Hypothesis H5**: The Personal Attitudes are positively related to the intensity of academic-entrepreneurial intention.
2.4 Number of years spent at the academic institution and academic-entrepreneurial intention

Prior researches about age distribution of entrepreneurs show as younger individuals are more active in new firm creation than are older people. It depends from some reasons, for example for the risk aversion that rise from the age increasing or for the major stability of the career for older people. Because entrepreneurship activity involves substantial inherent risk, an academic may expose his or her career path by creating spin-offs and reducing other research responsibilities (Lee and Gaertner, 1994). The younger academic (students, PhD. students and lecture) are often encouraged from their Professor to embark in a new experience creating spin-off. The development of Silicon Valley can itself be partly attributed to the actions of scientists who left their industrial or academic labs. It was Professor Frederick Terman who convinced and supported two of his students, Hewlett and Packard, to start an entrepreneurial initiative in Palo Alto (Saxenian, 1996; Zagnoli, 1991). Thus, the number of years spent at the academic institution (UY) (which highly correlates with age) is a proxy for an academic’s scientific seniority, which should negatively affect academic-entrepreneurial intention. Thus, we propose the following hypothesis:

Hypothesis H6: The number of years spent at the academic institution is negatively related to academic-entrepreneurial intention.

2.5 Type of research, cooperation with industry and academic-entrepreneurial intention

Knowledge is continuously been produced under different forms. Codified knowledge is produced mainly in research labs, published in journals and broadly diffused; tacit knowledge is produced in research labs too, but not only there: it is also generated at plant level through learning-by-doing processes, and in a number of other industrial contexts. Nonetheless, even if knowledge is produced in many different places by various organizations, (large) firms and public research labs are (at present) the most important producers (Chiesa, Piccaluga, 2000). Applied research promises a more immediate return from the development of marketable products, which is extremely important in the technology transfer process. Academics devoted to applied research generally pay much attention to industry requirements and to understanding the potential for market applications of academic research results (Grandi and Grimaldi, 2005), which could help them establish their own company or run their company more efficiently.
Rahm (1994a) investigate the relationship between Academics and industry and discovered that Academics that interact with industry are slightly more likely than other researchers to feel pressure to become involved in applied industry research efforts because they sense that grant agencies, as well as university departments or central administration look favorably on such activity.

In according of the existing evidence on the importance of research focus in the formation of entrepreneurial intention, we propose the following:

**Hypothesis Hp7:** Prevalence of applied research is positively related to AEI.

**Hypothesis Hp8:** Cooperation with industry is positively related to AEI.

**Hypothesis Hp9:** Cooperation with the industry is positively related to applied research (type of research).

3. Method

**Sample**

This research is based on a sampling frame of PhD. students, which are from sciences department and research area of University d’Annunzio in Italy. We sent a questionnaire of 729 PhD. students of which 85 responded at our survey, with a response rate of 12%. The data collected was used to measure all the variables of our model.

**Variables measurement**

Academic entrepreneurial intention was measured with six items with five point Likert scale, asking the respondents to indicate how they were interested to start their business, how they are determinate (Chen et all, 1998), how they consider to become an entrepreneur (Kassicieh et all, 1997), to indicate the possibility that they start their business in the next five years and in the next two years, and at the list to indicate which activities they had started to start their business (Gatewood et al., 1995).

Considering self-efficacy, respondent were asked to rate their capacity to perform firm’s start-up activities, we used six items on seven point Likert scale (Kolvereid, 1996b).

Personal attitude was measured though an aggregate scale. According with Ajzen (2001) we measure attitudes as an aggregate measure. The respondents were asked to choose on seven point Likert scale, how much they thought that
being an entrepreneur implies more advantages, that a career as entrepreneur is attractive, that they’ll like to start new firm, about satisfaction, and if they’ll choose to be entrepreneur. In order to measure how the scientists interact with their community we measured their personal network with three items. The first item it’s about the average number of hours per week that the respondents spent his time to maintaining contacts, the second item measure the number of hours per week to develop new contacts, and the third the total number of the people with respondents discuss business. The others variables referred more to university context, such as the type of research, the number of years spent at the academic institution, the cooperation with industry. Type of research was measured by a ratio between the numbers of applied research on the total number that scientists work per week (Greve, 1995). This measure it’s relevant to better understand if there are some differences about theoretical and applied research. We assume also that the number of years spent at the academic institution will be important to evaluate, then we measured the total years of employment in university. Cooperation with industries was measured by the number of hour for week that respondents spent to work at industry-ordered projects, and as the percentage of industry founding.

*Structural equation modeling*

To verify our hypothesis we used structural equation modeling testing simultaneity both the measurement model and the path model (Jöreskog and Long, 1993). LISREL was used to estimate the causal linkage between a set of variables, observed and latents variables, to test the model in Italian context.

4. Analysis and results

The correlation and descriptive statistics are displayed in table 2. To test the hypothesis in our model, we analyze the paths between academic entrepreneurial intention, self-efficacy, personal attitude, personal networks and other academic variables. For each hypothesized relationships, we calculated path coefficients and test statistical significance. Using LISREL, the model that we are testing produced a chi-square of 216.17 \((df=85; \ p<0.001)\), the resulting model’s goodness of fit indices indicated a fairly good fit (GFI=0.77, AGFI=0.75, NFI=0.70, CFI=0.74, RMSEA=0.08). The results of the structural equation model are displayed below (Fig.2), and it shows all the hypothesis and results of the model test, within the unstandardized coefficients.
Hypothesis 1 is statistically significant and supported, coefficient (p<0.10), then mean that entrepreneurial self-efficacy is positively related with academic entrepreneurial intention.

Hypothesis 2 is not statistically significant then we can’t support the positive relationship between personal networks and self-efficacy.

Personal network is statistically positively related to academic entrepreneurial intention (p<0.10), then we support hypothesis H3.

Personal attitude is statistically positively related to self-efficacy (p<0.001), then our hypothesis H4 can be supported.

Hypothesis H5 it’s also confirm in our model, in fact personal attitude is positively related to academic entrepreneurial intention (p<0.10).

There is support for hypothesis H6 which demonstrate that the relationship between number of year spent in academics is negatively related to academic entrepreneurial intention (p<0.001).

Hypothesis H7 is statistically significant and supported (p<0.01), therefore type of research is positively related to academic entrepreneurial intention.

H8 isn’t statistically significant then we can confirm that cooperation with industry is directly related to academic entrepreneurial intention. Hypothesis H9 is also confirmed, given that cooperation with industry is positively related with type of research (p<0.05).

Fig. 2 Results of the model

![Diagram showing the relationships between variables and coefficients.](image-url)
Table 1 – Standardized path estimates

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Entrepreneurial self-efficacy is positively related to academic-entrepreneurial intention</td>
</tr>
<tr>
<td>H2</td>
<td>Academic’s personal networks are positively related to the entrepreneurial self-efficacy</td>
</tr>
<tr>
<td>H3</td>
<td>Academic’s personal networks are positively related to the academic-entrepreneurial intention</td>
</tr>
<tr>
<td>H4</td>
<td>Personal attitude is positively related to self-efficacy</td>
</tr>
<tr>
<td>H5</td>
<td>The Personal Attitudes are positively related to the intensity of academic-entrepreneurial intention</td>
</tr>
<tr>
<td>H6</td>
<td>The number of years spent at the academic institution is negatively related to academic-entrepreneurial intention</td>
</tr>
<tr>
<td>H7</td>
<td>Prevalence of applied research is positively related to AEI</td>
</tr>
<tr>
<td>H8</td>
<td>Cooperation with industry is positively related to AEI</td>
</tr>
<tr>
<td>H9</td>
<td>Cooperation with the industry is positively related to applied research (type of research)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Path coefficients</th>
<th>p&lt;value</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>0.20</td>
<td>0.10</td>
<td>Supported</td>
</tr>
<tr>
<td>H2</td>
<td>0.02</td>
<td>-</td>
<td>Non Supported</td>
</tr>
<tr>
<td>H3</td>
<td>0.26</td>
<td>0.10</td>
<td>Supported</td>
</tr>
<tr>
<td>H4</td>
<td>0.48</td>
<td>0.001</td>
<td>Supported</td>
</tr>
<tr>
<td>H5</td>
<td>0.17</td>
<td>0.10</td>
<td>Supported</td>
</tr>
<tr>
<td>H6</td>
<td>-0.39</td>
<td>0.001</td>
<td>Supported</td>
</tr>
<tr>
<td>H7</td>
<td>0.29</td>
<td>0.01</td>
<td>Supported</td>
</tr>
<tr>
<td>H8</td>
<td>-0.06</td>
<td>-</td>
<td>Non Supported</td>
</tr>
<tr>
<td>H9</td>
<td>0.32</td>
<td>0.05</td>
<td>Supported</td>
</tr>
</tbody>
</table>

(n=85)

5. Conclusions, implications, limitations

Building on results of previous studies, this paper contributes to test the robustness of the model of academic entrepreneurial intention in sciences research area. In particular this paper analyzes the determinants of the academic entrepreneurial intention of PhD. students, investigating the best predictor of planned behavior.

We hypothesized that the different dimensions are related to academic entrepreneurial intention and we concentrate on the variables that can better explain the personal networks of “Academics”. We find that personal networks are straight related to academic entrepreneurial intention, and that “Academics” with these characteristics are more oriented in the commercialization of the results of their researches and in the new venture creation.

We can conclude that personal attitude has a very strong influence on the intention to act and the level of the intention. Davidsson (1995) also found that attitude strongly influenced the intention towards entrepreneurship.
For the managerial practice, our findings can suggest that the Italian policy makers should consider the academics’ intention to provide resources for stimulate the creation of new ventures. This research contributes also in entrepreneurship education field, to underline the orientation of PhD students about their beliefs in entrepreneurship as choice for their career.

Attitudes towards career alternatives are developed during ours study, so if a student is not fully aware of entrepreneurship as an alternative, he/she will never develop a positive attitude towards it. Therefore if he/she will instead develop a positive attitude towards alternatives, they could be opened to see the entrepreneurial career as a valid option for their life.

Our findings demonstrate and confirm that academic entrepreneurial intention is negatively related to the number of years that academics spent in the university, and it’s related to the type of research. The Italian scientists seem to don’t agree with the necessity to start-up spinoff, and this is true if considering the increase of the age of academics. The “tower” of academics is a weakness in university Italian system, given that the low level of academic entrepreneurial intention don’t bring forward the necessity to commercialize the results of their scientific researches. About the relationship with the cooperation with industry, our model can’t explain the existence of direct relationship with the academic entrepreneurial intention, but this cooperation seems affect the type of research. For further researches it could be interesting to investigate how these variables can’t affect directly the academic entrepreneurial intention.

Our paper is not without limits, the first one is that we can limit the analysis (in this first phase) just to one sample of PhD students from Italian university, and we would like to build a longitudinal database to check in different time, which characteristics the academic entrepreneurs should have, to allow a successful venture spinoff creation.

References


Table 2 – Descriptive statistic and correlations

| AEI | AEI | AEI | AEI | AEI | PA | PA | PA | PA | PA | SE | SE | SE | SE | SE | SE | PN | PN | PN | CI | CI | TR |
|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| AEI | 1   |     |     |     | AEI | .827** |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| AEI |     | .578** | .432** |    | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| AEI |     | .669** | .629** | .493** |    | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| AEI |     | .545** | .569** | .397** | .812** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| PA  | .200 | .161 | .075 | .223** | .117 | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| PA  | .283** | .266* | .143 | .181 | .138 | .590** |    | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| PA  | .208 | .169 | .154 | .117 | .169 | .542** | .733** | 1 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| PA  | .377** | .347** | .091 | .172 | .162 | .541** | .743** | .723** | 1 |     |     |     |     |     |     |     |     |     |     |     |     |
| PA  | .208 | .246* | .062 | .137 | .150 | .583** | .748** | .716** | .738** | 1 |     |     |     |     |     |     |     |     |     |     |     |
| SE  | .065 | .048 | -.012 | .144 | .067 | .244* | .175 | .027 | .100 | .130 | 1 |     |     |     |     |     |     |     |     |     |     |
| SE  | .148 | .095 | -.017 | .104 | .024 | .438** | .580** | .476** | .535** | .510* | .251* | 1 |     |     |     |     |     |     |     |     |     |
| SE  | .138 | .100 | .052 | .198 | .136 | .445** | .362** | .290** | .389** | .364** | .339** | .648** | 1 |     |     |     |     |     |     |     |     |
| SE  | .136 | .074 | -.062 | .231* | .166 | .290** | .095 | .104 | .243* | .140 | .232* | .310** | .538** | 1 |     |     |     |     |     |     |     |
| SE  | .268* | .256* | .028 | .215* | .066 | .290** | .269* | .148 | .338** | .231* | .097 | .478** | .580** | .642** | 1 |     |     |     |     |     |     |
| SE  | .178 | .114 | .076 | .052 | -.006 | .459** | .445** | .336** | .376** | .400** | .321** | .592** | .608** | .367** | .486** | 1 |     |     |     |     |     |
| PN  | .260* | .211 | .159 | .301** | .374** | -.011 | -.020 | .110 | .119 | .071 | -.012 | -.056 | .089 | .072 | .099 | .068 | 1 |     |     |     |     |     |
| PN  | .215* | .166 | .194 | .274* | .257* | .016 | .148 | .134 | .197 | .160 | -.011 | .018 | .116 | -.090 | .070 | .081 | .713** | 1 |     |     |     |     |
| PN  | .430** | .344** | .214* | .481** | .399** | .146 | .150 | .185 | .126 | -.033 | .104 | .181 | .254* | .122 | .135 | .176 | .251* | .202 | 1 |     |     |
| CI  | -.027 | -.155 | -.070 | -.011 | -.001 | .179 | .061 | .021 | .052 | -.051 | .110 | .006 | .098 | .126 | .014 | .017 | .048 | .066 | .060 | 1 |     |     |
| CI  | .090 | -.009 | .012 | .163 | .232* | .029 | .018 | .055 | .016 | -.043 | .052 | -.129 | -.050 | .022 | -.074 | .085 | .341** | .286** | .145 | .469** | 1 |     |     |
| TR  | .210 | .199 | .037 | .205 | .294** | -.024 | .110 | .001 | .149 | .007 | -.158 | -.133 | -.155 | -.077 | -.135 | -.220* | .261* | .244* | .085 | .247* | .206 | 1 |     |
| UY  | -.338** | -.361** | -.391** | -.262* | -.097 | .052 | .110 | .032 | -.051 | -.039 | .051 | .097 | .042 | .110 | -.045 | .096 | -.048 | -.130 | -.084 | .242* | .069 | .140 |     |

*** Correlation is significant at the 0.01 level (2-tailed). ** at p< 0.05 level, *at p<0.10