# XXI. MEZINÁRODNÍ KOLOKVIUM O REGIONÁLNÍCH VĚDÁCH. SBORNÍK PŘÍSPĚVKŮ.

# 21ST INTERNATIONAL COLLOQUIUM ON REGIONAL SCIENCES. CONFERENCE PROCEEDINGS

Place: Kurdějov (Czech Republic)
June 13-15, 2018

Publisher: Masarykova univerzita, Brno

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**Vzor citace / Citation example:**

AUTOR, A. Název článku. In Klímová, V., Žítek, V. (eds.) *XXI. mezinárodní kolokvium o regionálních vědách. Sborník příspěvků.* Brno: Masarykova univerzita, 2018. s. 1–5. ISBN 978-80-210-8969-3.

AUTHOR, A. Title of paper. In Klímová, V., Žítek, V. (eds.) 21st *International Colloquium on Regional Sciences. Conference Proceedings.* Brno: Masarykova univerzita, 2018. pp. 1–5. ISBN 978-80-210-8969-3.

*Publikace neprošla jazykovou úpravou. / Publication is not a subject of language check.*
*Za správnost obsahu a originalitu výzkumu zodpovídají autoři. / Authors are fully responsible for the content and originality of the articles.*


ISBN 978-80-210-8969-3
ISBN 978-80-210-8970-9 (online : pdf)

DOI: 10.5817/CZ.MUNI.P210-8970-2018-14

# FACTORS INFLUENCING SPIN-OFF ACTIVITIES AT UNIVERSITIES: EMPIRICAL EVIDENCE FROM THE UNITED KINGDOM

## Faktory ovlivňující spin-off aktivity na univerzitách: Případová studie z Velké Británie

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***Annotation***
*This paper intends to develop the understanding of the various factors that contributes to university knowledge transfers and spinoff activities. Using data from the HESA-BCI survey and the Structural Equation Model (SEM) we analysed the various determinants that influence spin off activities of universities in the United Kingdom. The empirical results demonstrate that (1) incentive support provided to academics influences their spin off activities positively; (2) incubation support in the form of science parks, entrepreneurial support, venture capital has a positive influence on universities spin off activities; (3) the governance of universities' spin off activities doesn't necessary contribute to academic spin off activities. Practical implications are also offered to universities management, academics and industries on best strategies to support their spin off activities.*

***Keywords***
*spin offs, universities, knowledge transfer*

***Anotace***
*Tento příspěvek má za cíl analyzovat vybrané faktory, které přispívají k transferu znalostí z univerzit a ovlivňují spin-off aktivity. K analýze byla využita data z průzkumu HESA-BCI a vytvořeny modely strukturálních rovnic (SEM). Zkoumány byly různé determinanty, které ovlivňují spin-off aktivity univerzit ve Spojeném království. Empirické výsledky ukazují, že (1) stimulační podpora poskytovaná akademickým pracovníkům má pozitivní vliv na jejich spin-off aktivity; (2) inkubační podpora ve formě nabídky využití vědeckých parků, poskytnutí veřejné podpory v podobě např. rizikového kapitálu má pozitivní vliv na spin-off aktivity univerzit; (3) řízení spin-off aktivit univerzitami nezbytně nepřispívá ke zvýšení produkce vědeckých výsledků v rámci akademických spin-off aktivit. Příspěvek poskytuje praktické implikace, které mohou být v praxi aplikovány managementem univerzit, akademickými pracovníky a být případně využito v rámci strategického zacílení na spin-off aktivity v celých průmyslových odvětvích.*

***Klíčová slova***
*spin-off, univerzity, transfer znalostí*

***JEL classification:*** *O30, O31, O33*

## 1. Introduction

Universities contribute to regional development through demand sided knowledge and absorptive capacity development through new business formation (spin offs), graduate startups and graduate placements (Kempton et al., 2013). The academic setting has undergone several structural revolutions that have transformed the roles of universities in the economy. The first of this kind of revolution took place way back in the 1930s (Etzkowitz & Viale, 2010). The first academic revolution was the era where universities embraced research as a university

function simultaneously to their traditional mission of teaching (Etzkowitz, 2003) but this did not lead academics to collaborate with universities. It was the second and third academic revolutions that took place in the 1980s (Etzkowitz & Viale, 2010) that metamorphosed and paved way for the direct engagement of universities in the economy, and the emergence of entrepreneurial scientists and entrepreneurial universities (Etzkowitz, 2001). Entrepreneurial universities combine their academic goals of teaching and research and decipher knowledge produced within the university domain into economic and social usefulness (Clark, 1998). The surfacing of the entrepreneurial university concept has given universities dual responsibilities, first is to create new knowledge and secondly to take measures appropriate to facilitate the transfer of technology and knowledge spillovers (Audretsch, 2014). The entrepreneurial path taken by universities has emphasized new roles and expectations of university in socioeconomic development and cooperation between external stakeholders such as industries and governments (Sam & van der Sijde, 2014).

Many universities have buttressed their entrepreneur drive by setting up specialized supporting structures such as technology transfer offices (TTOs), incubators and science parks within or in close proximity to their campuses (Clarysse et al., 2005). Spinoffs generally emanate from institutions conducting noteworthy discovery research activities such as universities (Odei, 2017) or other public research institutions (Hájek & Stejskal, 2016).The main distinguishing feature of spin offs as a means of university-industry collaboration is the direct engagement of faculty who double as the academic inventors who are mostly affiliated with universities (Bigliardi et al., 2013). Academic spin offs are the bridges that connect industries with academia. Spin offs facilitates the transfer of knowledge and technology from the academic setting into new companies (Nicolaou & Birley, 2003).

Spinoffs are considered as a medium to expedite the transfer and dissemination of university research outcomes, and contributing mainly to the economy and also diffusing technologies to firms (Rasmussen & Wright, 2015). However, the overconcentration on patenting and spin-off activities may "obscure the presence of other types of university– industry interactions that have a much less visible economic pay-offs, but can be equally as (or even more) important both in terms of their frequency and economic impact" (D'Este & Patel, 2007; Geuna & Muscio, 2009). Spinoffs also have minimal impact on community and regional economic development because they are mostly small in nature and takes longer time to mature (Degroof & Roberts, 2004) and compete with other high-tech companies (Ensley & Hmieleski, 2005).

The rest of this paper is structured in the following manner. The next section describes the theoretical background. In the methodology section the research methods and sources of data are explained. The results and analysis section elaborates on the empirical results. The conclusions and implications section conclude this paper by summarizing the most important findings, discussing several implications for policy-makers, industries and universities as a whole.

## 2. Determinants of spinoff activities

The burgeoning literatures on university spinoff activities have demonstrated that spinoff firms are not established accidentally, but they require conceited efforts and initiatives. The establishment of academic spin offs is a multidimensional phenomenon, often determined by a numerous factors such as institutional factors and support mechanisms, individual, social and legal framework (Bruton, Ahlstrom, & Li, 2010; Stenholm, Acs, & Wuebker, 2013). The institutional factors clearly influences academic spin off creation, this is evidenced by the uneven distribution of spin offs among universities (O'Shea et al., 2005). Some universities are well known to be associated with spinoffs while others struggle to even establish one.

The propensities for universities to spin off firms to utilize their academic research depend on the availability of support infrastructure and strategies. These instruments include science parks, laboratories, incubation facilities, technology transfer offices (TTO), venture capital, and any other infrastructure which promotes the creation of firms (Lockett and Wright, 2005, Fini et al. 2009; Salvador, 2011). University science parks foster spin off establishment (Vinig & Van Rijsbergen, 2010). These innovation hubs encourage and manage knowledge and technology flow between universities and innovation-based firms. According to Wright et al. (2007), incubators have expansively become a pivotal instrument employed by universities since the 1990s to promote the establishment of spinoffs. Start-up incubators are public financed to links industries and academia regionally and locally (Hackett and Dilts, 2004). Technology transfer offices (TTO) and incubators represent the most important supportive instruments (Bergek & Norrman, 2008) in spin offs creation. TTO act as the mediating agency responsible to identify the prospects of spinning out companies thus relieving academics of the time and resources to carry out such a daunting task. TTOs carry out the due diligence and the viability to commercialize an IP (Lockett et al, 2005). These tasks carried out by TTOs leads to the unremitting interaction with industry

(Siegel et al., 2003). The incubation services provided by university science parks intensify the frequency of spinning out new firms as well as dampening start-up costs (Caldera and Debande, 2010).

Therefore we propose that
*$H_1$: Universities that have supporting infrastructure will generate more spin off firms.*

Research funding also plays a critical role in universities spinoff activities. Without ample access to finance, universities cannot carry out quality research that will have commercial value (Sørheim et al, 2011). Numerous studies have shown that the amount of research funding has a positive influence on university spin off activities (Lockett et al., 2004; Lockett & Wright, 2005; Van Looy et al, 2011; Rasmussen et al, 2014). Financial resources contribute crucially to the establishment or revamping of new spin off firms, funds are needed to come up with business plans or conduct market research (Vohora et al., 2004). Three types of funding are crucial to spin offs development; they are research funding which has the goal of financing the development of innovation and technologies (Geuna, 2001). Governments the world over are providing these funding schemes to universities and other research organizations because of the spillover effects of such knowledge and its contribution to economic growth (Audretsch & Keilbach, 2008).

Additionally after the quality research has been carried out and assessed to possess some commercial value, universities will require investment funding to kick start the idea of commercial production. This investment funding will be used to establish the premises of the prospective company, pay the scientist and academics involves in the idea and product development etc. (Smith & Ho, 2006). Finally, incubator funding will also be required to provide the needed infrastructure needed to sustain the newly established spinoff firm. Establishing science parks to accommodate spinoffs requires huge investment that universities may not be capable of financing (Chan & Lau, 2005). This therefore requires support from governments and business that might be potential beneficiaries. Many European countries such as the UK, Germany, and Spain where universities are known to collaborate with universities have this financial support (venture capital and business angels) critical for the establishment of new spin offs (Gras et al, 2008). A study by Lockett and Wright (2005) concluded that the number of spinoff firms established by UK universities was positively associated with R&D funding. We therefore propose that,
*$H_2$: The availability of research funding supports universities spin off support infrastructure*

Institutional support mechanisms such as incentives also play a central role in universities spinoff activities (Fini et al, 2009; D'este & Perkmann, 2011). Offering financial incentives to faculty members will motivate them to contribute to academic spin offs formation. Providing academic researchers with incentives to augment their research activities and technology transfer activities will make them committed to the university where students and the academic community can continue to enjoy their services. In the UK, government provides financial and political incentive arrangements to boost entrepreneurship (Smith & Ho, 2006). A study by Link and Siegel (2005) has demonstrated that universities that provide astronomical percentages of royalty disbursements to their staffs positively impact the effectiveness of university technology transfer undertakings. We therefore hypothesize that
*$H_3$: Incentives support provided to faculty supports their spin off activities*

To add to the above-mentioned factors, it is envisaged that the number of people that govern the spin off process from its initiation states to when it becomes fully operational matters a lot. Governance of Knowledge Transfer (KT) activities was mainly spearheaded faculty members without the involvement of their institutions (Geuna & Muscio, 2009). But this has been institutionalized in many parts of the world with universities taking charge of establishing TTOs to regulate this venture (O'Gorman et al, 2008). The governance structure must be constituted in such a manner that it must involve experts from the industrialist, academics, legal experts, financial experts among others. Effective governance arrangements in extremely uncertain environment encourage experiments and adaptation capable of unearthing the true value of the spinoff (Chesbrough, 2003). Therefore we hypothesis that
*$H_4$: Effective governance contributes to university knowledge transfer support activities*

The main aim of this paper therefore is to examine the various factors that contribute to universities knowledge transfer activities. The United Kingdom was selected for this study because it's been one of the countries in Europe where government has devoted lots of resources to promote spin off activities, industry-science collaboration (Mustar & Wright, 2010; Guerrero et al., 2015). Almost all public universities in the UK have established spin off companies to commercialize their research outcome (Soetanto & Jack, 2016). Outcomes of this paper can serve as a guide to universities elsewhere aiming to start research commercialization. This paper also intends to contribute to the burgeoning literature on university-industry collaboration.

## 3. Data and methodology

Data for the empirical analysis was from the Higher Education Business and Community Interaction Survey (HE-BCI) for the 2015/16 academic year. The HE-BCI Survey is compulsory for all higher education providers in Wales and England. The HE-BCI Survey is the vehicle for evaluating the volume and direction of collaborations between UK higher education providers and industries and the general community (Rae et al., 2012). The survey also collects information on capacity and strategies of HE providers, and their financial data with regard to their third stream activity concerned with the production, use, application and utilization of knowledge and other HE provider capabilities outside academic environments.

The study subsequently used the Structural Equation Model (SEM) to develop a model to analyze and test the hypothesis. The model was chosen because of its distribution-free assumption, the predictive focus and the explanatory model development approach for understanding the determinants of university spinoff activities (Kock & Hadaya, 2018). Path analysis in the SEM, allows for all coefficients of association in multiple regression models to be estimated at once (Kock, 2011).

## 4. Results

This study carried out number of measurements to determine the reliability and internal consistency of the model. These included composite reliability, convergent validity and discriminant validity. Construct reliability uses the Cronbach's alpha coefficient to estimate measurement errors and true composite weights. A Cronbach's alpha with the value of equal to or greater than 0.7 is acceptable (Hair et al., 2010). From table 1 and table 2 below all the constructs demonstrated this. The model demonstrated that all the constructs were above the 0.7 threshold with the only exception been the support variable. Again convergent validity is the extent to which the measurement items together explain the construct they represent in the structural model (Hair et al., 2010). It can be assessed by the Average Variance Extracted (AVEs) that should have minimum loading of 0.50, and through composite reliability (CR) with acceptable minimum of 0.70 (Hair et al., 2010; Kock, 2014). All the variables in this model have loadings higher than the 0.50 threshold.

***Tab. 1: Construct Reliability Tests***

| | PAT | FUN | SUP | INCEN | GOV |
|---|---|---|---|---|---|
| Composite reliability | 0.954 | 0.839 | 0.772 | 1.000 | 1.000 |
| Cronbach's alpha | 0.927 | 0.742 | 0.556 | 1.000 | 1.000 |
| AVE | 0.873 | 0.569 | 0.530 | 1.000 | 1.000 |
| Full collinearity VIFs | 1.852 | 1.906 | 1.295 | 1.266 | 1.040 |

*Source: Own processing*

*Note: PAT=patenting activities, FUN=research funding, SUP=knowledge support infrastructure, INCEN=incentives schemes, GOV=governance systems in place, AVE= Average Variance Extracted, VIF= Variance Inflation Factor.*

***Tab. 2: Combined loadings and cross-loadings***

| | PAT | FUN | SUP | INCEN | GOV |
|---|---|---|---|---|---|
| PAT1 | **0.929** | -0.260 | 0.014 | -0.005 | -0.051 |
| PAT2 | **0.913** | 0.158 | -0.045 | -0.027 | 0.056 |
| PAT3 | **0.962** | 0.101 | 0.030 | 0.030 | -0.005 |
| FUN1 | 0.432 | **0.759** | -0.107 | -0.082 | 0.133 |
| FUN2 | -0.153 | **0.766** | -0.004 | 0.041 | -0.176 |
| FUN3 | 0.006 | **0.847** | 0.066 | 0.068 | -0.061 |
| FUN4 | -0.343 | **0.628** | 0.045 | -0.042 | 0.136 |
| SUP1 | 0.055 | -0.096 | **0.709** | -0.240 | -0.105 |
| SUP2 | -0.219 | 0.330 | **0.698** | -0.016 | 0.191 |
| SUP3 | 0.147 | -0.209 | **0.775** | 0.234 | -0.075 |
| INCEN | -0.000 | 0.000 | -0.000 | **1.000** | -0.000 |
| GOV | -0.000 | 0.000 | 0.000 | 0.000 | **1.000** |

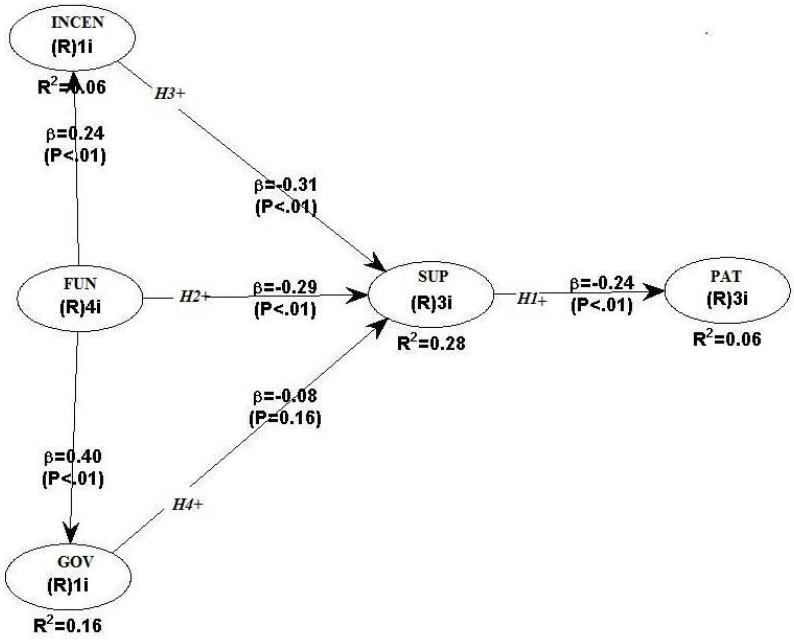
*Source: Own processing*

### 4.1 Structural model results

Figure 1 below represents the results for the hypothesis testing. It can be seen that the strongest factor that influences university knowledge transfer activities that is supporting activities and infrastructures was incentive support (β=0.31), this was closely followed by funding support schemes (β=0.29). The least determinant was the

governance structure (β=-0.08) implying that it influenced spin off activities in a negative way. Again it can be evidenced that all these support infrastructure and mechanisms positively influenced patents acquisition process (β=0.24). Cohen (1988) has suggested that path coefficients can be indicative of the effect sizes users can ascertain i.e. whether the effects are small, medium, or large. A value of 0.02 indicates a small effect, 0.15 indicates medium effect and 0.35 large effects. Values below 0.02 mean that the effects are too weak to be considered relevant from a practical point of view (Cohen, 1988). This means that this model' constructs have almost a medium predictive effects.

***Fig. 1: Results of hypothesis testing***




*Source: Own processing*

***Tab. 3: Path Estimates and Hypotheses Testing***

| Hypothesis | Regression weights | P values | Remarks |
|---|---|---|---|
| H1 SUP>PAT | 0.24 | 0.001*** | Supported |
| H2 FUN>SUP | 0.29 | 0.001*** | Supported |
| H3 INCEN>SUP | 0.31 | 0.001*** | Supported |
| H4 GOV>SUP | -0.08 | 0.16 | Rejected |

*Source: Own processing*

## Conclusion

The main objective of this paper is to examine the factors that influence university knowledge transfers activities (spinoffs). The results of the empirical analysis has demonstrated that the availability of support infrastructure such as science parks, incubators, incentives supports and research funding have more influence on university spin off activities (patent acquisition). An essential determinant that influences universities spinoff activities is the availability of support mechanism either on campus or the surroundings of the universities. This can be in the form of TTOs, incubators and science parks. This supports ***H1***. The study found out that support infrastructure contributes to patent acquisition which was used to measure spin offs activity. It had a coefficient of (β=0.24). This supports other research by Fini et al (2011) and Nosella & Grimaldi (2009) which all concluded that internal support mechanisms for academics motivate them to start commercializing their research results.

Again ***H2*** is also supported. This study found out that funding support from the public, EU, universities and other sources significantly contributes to the support mechanism and infrastructure (β=0.29). This buttress Sternberg (2014) and Soetanto & Van Geenhuizen (2015) claim that university' access to venture capital funds boosts spin off spawning. Universities that provide greater research funding have humongous propensity to generate spin off companies, this is because the cost of spawning such spin offs are very exorbitant for individual faculty members. So when universities provide this for them, it relieves them of the pain of meeting these financial demands.

The study also supported ***H3***. The study found a significant and a positive effect of incentive support has a mediating effect on spinoff activities (β=0.31). This means that certain enticing rewards whether in cash or material support can influence university faculty members to engage in spin off activities. The process of spin off can be increased when there are incentives to support academic entrepreneurship (Iacobucci & Micozzi, 2015; Rasmussen & Wright, 2015).

The ***H4*** is not supported. The study found that the number of people that manage or govern spin off activities does not necessary influence spin off activities. This is because there can be better governance mechanism but if they refuse to come up with sweetener policies to entice faculty to commercialize, then their efforts will be insignificant. Our results contradicts that of Lockett et al. (2004) and Lockett and Wright (2005), they rather found a significant and positive effect of spin off governance or membership on the ability of universities to spin out new academic firms.

From the forgoing discussion, this study strongly believe that universities can increase their knowledge transfer activities and spin off creation when they are provided with the necessary support infrastructure, financial support to carrying out commercial viable research, incentives to support and entice faculty members that intend to venture into research commercialization as evidenced in the literature will increase their spin off activities. These support mechanisms buttress and forms the basis of every universities' spin off activities. This study can further be replicated in other countries since it narrowly focused on the United Kingdom.

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***Acknowledgment***
***This work was supported by grant provided by the scientific research project of the Czech Sciences Foundation Grant No: 17-11795S.***