Economic Success of Employment and Revenue Generated from Research Commercialization Activities

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Abstract: The concept of entrepreneurial universities has gained more attention from policy makers and academics due to its perceived prospect of contributing to innovation and economic growth. Spin offs companies helps universities to commercialize their knowledge and technological developments. The commercialization of academic research results through academic spin-offs is becoming an important and increasingly reliable source of revenue for universities. Universities also contribute to employment creation when they establish new spin off firms or help to revamp existing ones. Universities and industries usually cooperate and engagement themselves through joint research projects and this helps universities to commercialize and exploit research results by way of patents licensing and spin-offs. The main focus of this paper is to establish the relationship that exits between the economic successes of spin offs in terms of employment and revenue generation and their spillover effects of contributing to regional growth and development. Using the linear regression method, this paper has demonstrated that, spin offs firms contribute better to employment creation than revenue generation. Spin offs that are partially owned by higher educational institutions and those termed social enterprises contribute better to employment creation than those without the full control of university's management. Spin offs do contribute insignificantly to revenue generation.

1 INTRODUCTION

The idea of academic entrepreneurship has gained increased scholarly attention in recent years. Academic entrepreneurship basically involves universities taken measures to promote research commercialization and contributing to the development of their neighboring regions (Siegel and Wright, 2015). The creation of firms from universities and other research organizations constitutes an excellent way of commercializing public research results, as well as allowing universities to contribute to socioeconomic and regional development (Bellini et al., 2000). University spin-offs are deliberately established to commercialize new technologies that usually emanates from academic research (Zahra,Van de Velde and Larraneta, 2007). The firms that are established and affiliation to universities are referred to as academic spin-off firms. Spin off companies transfer technology from their attached universities to themselves, and also from themselves (spin offs) companies to customers. Spin-off firms born from university researchers initiatives are the dominant mode of commercialization of university research (Landry, Amara and Rherrad, 2006). The creation of spin-off companies is considered as the basis for the commercialization of university research and also a noticeable way of fulfilling the entrepreneurial dream of universities (Clarysse and Moray, 2004). University innovations policies encourage their contribution to the development of local economies by establishing new industries, promoting product development and directly contributing to employment and wealth generation (O'Shea, Chugh and Allen, 2008).

The choice of universities to venture into research commercialization represents a shift from the traditional mission of universities that have longed remained teaching and research. The commercialize-tion of academic research results or the fulfillment of third mission (entrepreneurial duties) has positioned universities in different role in society (Rasmussen, Moen, and Gulbrandsen, 2006). Universities have in recent times become key players in the economy because of their direct role in establishing innovative spin-off companies and cooperating with existing firms to create new products. The collaboration between universities and industry is of significant importance in the stimulation of technological

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change, economic development and competitiveness in industries (Mansfield and Lee, 1996; Stejskal and Hajek, 2016). The combination of the traditional as well as this new mission has resulted in the emergence of what has become the 'entrepreneurial university' which is now multi tasked universities combining research, teaching, as well as direct contributing to the local economy (Clark, 1998).

Spin offs firms emanating from "academic entrepreneurship," are established to exploit the results of academic research or intellectual property created at the university (Shane, 2004; Klofsten and Jones-Evans, 2000). A spin off is "a company that is founded (1) by a faculty member, staff member, or student who left the university to start a company or who started the company while still affiliated with the university; and/or (2) around a technology or technology-based idea developed within the university" (Smilor, Gibson and Dietrich, 1990, p. 63). These spin off firms are important and beneficial to the national and local economies due to the fact that they provide jobs and other economic opportunities. Besides their economic contribution, these firms tend to have a high turnover in terms of profits and offering high-wages to their employees. Spin offs helps university teachers to diversify their sources of income because these spin offs mostly rely on the expertise of academic inventors who are highly qualified staff with long experience from their research, this helps to reduce the likely of lecturers quitting the teaching job (Toole et al, 2015).

Universities the world over are deeply engaging in commercialization activities as a way of contributing to economic development of their regions and this is also necessitated by the fact that there is growing decline in public investment for funding traditional teaching and research of universities, so universities have to look elsewhere for reliable funding alternatives and spin offs seems to be the solution (Chiesa and Piccaluga, 2000).

The main objective of this paper therefore is to establish the relationship that exits between the economic successes of spin offs in terms of employment and revenue which have the spillover effects of contributing to regional growth and development. It will also identify which spin off type contributes better in terms of employment and revenue generation. With the above mentioned objective, I therefore want to assess whether spin offs are successful in generating employment or turnover. The following research question will accordingly be answered by this paper. Do spin off firms contribute better to job creation or revenue generation?

The paper is organized in the following order: section 2 constitutes the theoretical background providing reviews of literature, section 3 is devoted to the data and methodological aspect and section 4 presents the empirical analysis and its findings. Section 5 concludes the paper and draw attention to some policy implications.

2 THEORETICAL BACKGROUND

Research commercialization is the process whereby academic findings and inventions are transformed into profit-making products and services for social benefits. The commercialization of research plays an important role in economic growth, job creation and society's structural change. Spin-off companies are important means of commercializing technology and academic research (Roberts and Malone, 1996). Spin offs are new firms established by an academic to transform newly generated knowledge from universities and other public research organizations into market products that can generate revenue and offer employment opportunities. These spin-off firms transform scientific knowledge into commercial use to benefit individuals and other economic agents. The accumulation of knowledge has become a vital factor of production that increasingly contributes to firm's productivity and growth (Prokop, 2015). Spin-off establishment is an essential component in the knowledge transfer process, and this positions university better to solving economic and societal problems (Prokop and Stejskal, 2015). Establishing new spin off firms is increasingly seen by universities as evidence of their entrepreneurial quality and training.

One of the possible ways through which spin offs can contribute to the economic development of their respective regions and national economies is through job creation (Shane, 2004). Spin-offs serve as the means to transfer technology from research organizations and can contribute significantly to jobs and wealth creation (Steffensen, Rogers and Speakman, 2000). Spin offs entrepreneurship is arguably one of the best ways to create employment in recent times (Buenstorf, 2009). As evidenced by (Niosi, 2006) spin off companies are capable of generating employment and raising revenues. According to a research by Smith and Ho (2006), spin offs established by the Oxford university created and employed about 9000 people constituting approximately 3.5% of total local employment in the

Oxford region of the United Kingdom. In addition to the above mentioned, the Catholic University of Leuven in Belgium has been very successful in establishing about 61 spin-off companies and these companies combined employed over 2000 people annually (Macho-Stadler et al., 2008). In a similar dimension, the Chalmers University of Technology located in the Swedish city of Gothenburg has also been successful in establishing spin offs that contributes to the economic development of the city. Spin off firms from Chalmers University of Technology successfully offered about 2800 people employment in the year 1993 alone (Dahlstrand, 1997), they also directly contributed to creating about 10% of employment or created 70 new jobs annually (Wallmark, 1997). The Massachusetts Institute of Technology (MIT) is among the leading entrepreneurial universities in the world. A study conducted by the Bank Boston acknowledged that about 4,000 spin-offs companies associated to the MIT employed 1.1 million people (Boston, 1997).

These employments and revenues can contribute directly to individuals and national economic development. Academics and their student can diversify their incomes sources when they directly engage in spin off creation. Some students may stand the chance to benefit from temporal employment offered by spin offs due to the fact that most spin offs are in close proximity to the parent institution (Egeln, Gottschalk and Rammer, 2004). Spin-offs firms are capable of generating almost 40% of local jobs as compared to non-spin off firms, this makes spin off firms a significant contributor of jobs (Wallin and Dahlstrand, 2006; Perez and Sánchez, 2003).

Spin offs created by universities and their academic staff can be a reliable way to raise additional revenues to supplement the dwindling university sources of income (Van Geenhuizen and Soetanto, 2009). Universities can raise additional revenue by renting out their laboratories for experiments and also allow their staff to engage with industries and get some revenue. The commercialization of academic research outcomes by spin-offs in the form of license fees constitutes an essential source of income for universities.

Academic patent is also an alternative means of revenue for universities and academics (Etzkowitz et al, 1998). The products and services of spin offs can be sold to raise money for the company, staff and the parent university.

Academic capitalism (Slaughter and Leslie, 2001) has become core component of universities policies, they permit their academic staff to engage in market-like or profit oriented behaviours. Academics stand the chance to benefit from market behaviours through patenting activities, royalties, licensing agreements among others. A study by Smith and Ho (2006) has shown that spin off firms are greater revenue generators. Their study found out that the spin-offs companies established by Stanford University in the USA were able to generate about 42% or about US$ 106.3 billion of all revenue that accrued to 150 firms in The Silicon Valley in 2001. The MIT spin offs were also able to generate $232 billion from its annual sales (Steffensen, Rogers and Speakman, 2000).

It is not surprising that one of the criteria used to measure the success of spin off firms is their revenue generation ability. Spin offs firms are very fruitful at generating revenue, they accounted for about 99.4% of overall revenues generated by startups (Franco and Filson, 2006). In some instances, spin offs can generate a turnover of about 350 million Euros in a year (Macho-Stadler et al., 2008). In the United States, the Colombia University made a turnover of about $143 million through licensing income and this accounted for roughly 15% of all U.S. university income earned from patents (AUTM, 2001).

3 METHODOLOGY AND SOURCES OF DATA

Data for this paper was collected from the Higher Education Statistics Agency (HESA) 2014/2015-2015/2016 survey. HESA provides consistent information on higher education by conducting data collection and analysis on UK higher education. HESA conducts an annual Higher Education - Business and Community Interaction (HE-BCI) survey on all knowledge transfer activities of all higher education providers (Jörg et al, 2014). HE-BCI record is collected annually from all UK publicly funded higher education institutions (HEIs) and a number of alternative providers (APs), collectively referred to as higher education providers (HEPs) by HESA. This paper used the HESA-HEBCI data to analyze the economic success of UK universities commercialization activities in relation to their contribution to economic development by way of employment and income generation. This paper focused on the employment and revenue generation potential of these entrepreneurial universities. The data consist of about 161 higher education providers engaging with industries in various ways.

To measure the relationship between the economic success of employment and revenue generation from universities commercialization

activities, this paper used the linear regression analysis. The linear regression model helps to describe the relationships that exist between the dependent variables and the independent variables in a simplified and straightforward mathematical form (Schneider, Hommel and Blettner, 2010). The Linear regression analysis is the most commonly used statistical technique for measuring relationship that exists between two or more variables (Matthews et al, 1990). Additionally, the linear regression was used to ascertain the prospect of how universities through their spin offs contributes to job creation and revenue generation. First of all, the paper compared the employment and revenue turnover that spin offs created. These two variables we compared to each other to find out which spin offs were good at generating or creating.

The general formula for the linear regression equation is usually in the form

$$Y = a + bX \quad (1)$$

Where

X is the explanatory variable

Y is the dependent variable

b slope of the line

a is the intercept

4 RESULTS

The main aim of this paper is to measure the relationship that exist between spin offs (universities commercialize-tion activities), job creation and revenue turnover that these spin off firms generate by way of their contribution to economic development (fulfilling their third mission of contributing to society).

The results of the linear regression analysis are shown in the table below.

Table 1: Variables Entered/Removed[b].

Model	Variables Entered	Variables Removed	Method
1	Rev_SE, Emp_GSU, Rev_SNHEPO, Rev_SHEPO, Emp_SE, Emp_SSU, Rev_GSU, Emp_SNHEPO, Emp_SHEPO, Rev_SSU		Enter

a. All requested variables entered.
b. Dependent Variable: HESO

Legend: HESO- Higher Education Spin Offs, Emp_SHEPO- employment from spin-offs partially owned by HEP, Emp_SNHEPO- employment from spin-offs not HEP owned, Emp_SSU- employment from Staff start-ups, Emp_GSU-employment from graduate start-ups, Emp_SE-employment from Social enterprises, Rev_SHEPO-revenue from HEP owned spin-offs, Rev_SNHEPO-revenue from spin-offs not HEP owned, Rev_SSU-revenue from staff start-ups, Rev_GSU-revenue from graduate start-ups, Rev_SE-revenue from social enterprises.

Table 2: Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.745[a]	.554	.525	1.5978

a. Predictors: (Constant), Rev_SE, Emp_GSU, Rev_SNHEPO, Rev_SHEPO, Emp_SE, Emp_SSU, Rev_GSU, Emp_SNHEPO, Emp_SHEPO, Rev_SS

Table 2 above elaborates on the summary of the model used for this analysis. The results in Table 2 have shown that the R= 0.745, R^2 =0.554, Adjusted R^2 = 0.525 (rounded to 3 decimal places), which can be interpreted that the independent variables are 53% of the variability of the dependent variable i.e. Higher Education Spin offs. The Adjusted R^2 is also an estimation of the effect size, which at 0.525 (53%) is indicative of a medium effect size, according to Cohen's (1988) classification. Accordingly this model has demonstrated that it is statistically significant at F = 18.75, significance level = .000. This indicates that in the nutshell, the model applied is statistically significant and it can predict the dependent variable, HE spin offs.

Table 3 below presents the results of the empirical analysis of the variables used in this model, it can be

Table 3: Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.336	.147		2.277	.024
	Emp_SHEPO	.007	.001	.684	6.322	.000
	Emp_SNHEPO	.000	.002	-.017	-.207	.836
	Emp_SSU	.019	.010	.657	1.868	.064
	Emp_GSU	.001	.001	.084	1.127	.262
	Emp_SE	.017	.005	.265	3.477	.001
	Rev_SHEPO	-1.684E-5	.000	-.170	-1.814	.072
	Rev_SNHEPO	-6.372E-6	.000	-.034	-.378	.706
	Rev_SSU	.000	.000	-.648	-1.824	.070
	Rev_GSU	-1.413E-5	.000	-.055	-.736	.463
	Rev_SE	.000	.000	-.093	-1.513	.132

a. Dependent Variable: HESO

Source: Authors own

seen that when it comes to employment and turnover from spin offs and their spillover effects on economic development, spin offs contribute significantly to employment creation than revenue generation. The results show that universities commercialization activities contribute more to employment significantly. In all spin offs that are partially owned by higher educational providers contributed to employment generation with statistical significance of (.000). Again spin offs that constitute social enterprises generate employment; they are statistically significant at (.001). The employment generated by graduate startups, staff startups and spin offs with no HE ownership did not contribute significantly to employment creation.

On the hand when we compare the revenue generation prospect of HE spin offs, we can see that, the contribution of spin offs to revenue generation was very insignificant. The significance level of revenue generation by spin offs is showed no significance. The results of this analysis supports the claim that spin offs are good at contributing to employment than revenue. The results also show that when it comes to measuring the success of spin offs, it can be seen that spin offs perform better in employment than revenue. The reason why they perform better in employment generation than revenue generation can be attribute to their small and not competitive nature. Spin offs face stiffer competition from well established firms that are financially well positioned in the market. This can explain why spin offs are better or successful at generating employment than revenue.

5 CONCLUSION

This paper sought to measure the relationship between economic successes of spin off firm's contribution to fulfilling their third mission of contribution to economic growth. The main aim of this paper was to assess spin off firms and their contribution to job creation and revenue generation as a means through which they fulfill their third mission. The measure of success used in this paper was limited to the job creation and the prospect of profitability of spin offs.

As seen above, the empirical results from the analysis have demonstrated that, spin off firms are very successful in contributing to socioeconomic development of their regions. They do this successfully by offering employment opportunities. Empirically, university spin offs are very successful with their contribution in the form of employment creation than generating revenue for staffs, students and others. The employment contribution of spin offs was significant for spin offs that have a HE ownership and those characterized as social enterprises. Conversely, when it comes to the prospect of revenue generation, the results proved that, spin offs did not generate more revenue as expected. Through employment, spin offs help to reduce the high rates of unemployment and also they can be a way for individuals to earn some income. Since spin off companies partially owned by HEP and those termed social enterprises contribute significantly to job creation, it therefore calls for policy measures to support universities in

their entrepreneurial quest because the commercialization and commodification of academic research can generate employment. This policy dimensions can be tailored in the directions of sustainable funding for universities to carry out more research that will be beneficial to industries and society as a whole. Again industries can also provide some financial support to universities to carry out business research. These financial schemes can strengthen university industry collaboration.

The results of this paper therefore call for further research on the other possible dimensions universities can help contribute to the economic development of their respective regions. Additional research is also needed to ascertain why the remaining types of spin off do not contribute significantly to employment.

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