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## **Exploring the involvement of academic researchers in research collaboration with knowledge users – a study of two Ghanaian universities**

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**Abstract:** In the face of limited national innovation and competitiveness, it was imperative to examine research collaboration between academic researchers and knowledge users for attainment of a knowledge-based economy in Ghana. The study followed an explanatory sequential mixed methods approach to analyse survey data from proportionate stratified samples of academics from the sciences, technology, engineering and mathematics, social sciences and arts and interview data from 11 key informants, from two public universities in Ghana. Through descriptive analysis and Kruskal-Wallis tests, it was established that involvement of academics in research collaboration was low. There was no statistically significant difference, at the  $p < .05$  level, in the number of research collaboration across the three academic disciplines. Although the condition points to the existence of a wider knowledge filter, it presents the nation with the opportunity to institute the necessary measures to step up the uptake and commercialisation of research findings.

**Keywords:** academic researchers; entrepreneurship; Ghana; innovation; knowledge-based economy; knowledge spillover; research collaboration; university.

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## **1 Introduction**

Research collaboration consists of networks and the use of social capital in purposive action (Katz and Martin, 1997; Lin, 1999). It involves interactions, sharing of information and other resources and co-ordination of activities by persons of diverse interests to undertake research and or disseminate or use the research findings for purposes such as innovation for economic growth and development (Bukvova, 2010; Mueller, 2006). On the basis of Schumpeterian growth models (Howitt, 1999; Zachariadis, 2003) and the knowledge spillover theory of entrepreneurship (Acs et al., 2009), the theoretical framework of this paper demonstrates the capacity of research collaboration to contribute to economic growth and development via the spillover of tacit knowledge from researchers to users who transform the knowledge into innovation through entrepreneurship (Johnson et al., 2002; Robin and Schubert, 2013). The facilitating nature of research collaboration constitutes an integral requirement in the knowledge-based economy.

In the knowledge-based economy, economic growth and development are driven by constructed advantages from investment in research and innovation, carried out on a systems basis as put forward, for example, in the triple helix concept by Etzkowitz and Leydesdorff (1995) and the N-tuple of helices by Leydesdorff (2012). In this economy, the university is expected, through recursive interactions, to produce knowledge that is useful for innovation by industry and other knowledge users, while the government performs an oversight and supporting role (Brundenius and Göransson, 2011; Etzkowitz, 2003).

Consequently, countries such as the USA and Sweden have instituted various measures in support of their knowledge-based economies. Some of the measures are improvements in government and university regulations in support of collaboration, the creation of national research councils and the formalisation of collaboration between universities and society (Henrekson and Rosenberg, 2001; Mansfield, 1995). There is also a growing emphasis on the importance of all academic disciplines for knowledge exchange between academia and external entities, particularly industry. Studies by Bakhshi et al. (2008) and Hughes and Kitson (2012) indicate that the academic discipline of the sciences, technology, engineering and mathematics (STEM) is, habitually, given primacy in the promotion of interactions between the university and external entities.

In Ghana, the entrepreneurial role of universities and for that matter academic researchers/academics, to conduct research and assist in the use of the findings in innovation is highly crucial due to weak industrial research and innovation [Bloom et al., 2006; Robson and Obeng, 2008; United Nations Conference on Trade and Development (UNCTAD), 2011]. This has led to mounting appeals on higher education institutions to align their research agenda with national development priorities and with much expectation of academics to collaborate with users of research findings (Afful, 2013; Vice Chancellors Ghana, Letter to University Teachers Association of Ghana, July 17, 2013). Several universities, including the University of Cape Coast (UCC) and the Kwame Nkrumah University of Science and Technology (KNUST) have, therefore, strategised to undertake research, disseminate knowledge and foster relationships with stakeholders (KNUST, 2005; UCC, 2012). Moreover, the institutions have similar structures and incentives, such as funding and research directorates, in support of research and extension.

In spite of the measures at the institutional level, there appears to be limited research collaboration between academic researchers and the private sector which is the principal source of innovation for economic growth and development in Ghana (Abor and Quartey, 2010; Mensah and Nyadu-Addo, 2012). For example, Afful (2013) decried the limited space given to technology in Ghana's development pursuits and challenged industry to link up with tertiary institutions to develop new technologies and new products for the market. Oduro-Marfo (2015) also criticises the 2010 Ghana National Science, Technology and Innovation Policy for treating innovation as an offshoot of only Science and Technology. The situation is exacerbated by weak innovation in the country. Available rankings on innovation indicated that Ghana ranked 115 out of 133 countries in 2009 and dropped from 96, out of 141 countries in 2014, to 108 out of 143 countries in 2015 (Bartels et al., 2016; UNCTAD, 2011).

From the perspective of the network theory of social capital (Lin 1999; 2008), this paper acknowledges the fact that research collaboration between academics and the carriers of innovation is essential to capitalisation in the form of using resources embedded in social relations to achieve specific purposes such as knowledge production and innovation (Granovetter, 2005). The study, therefore, sought to analyse the involvement of academic researchers in research collaboration with knowledge users/the carriers of innovation and to contribute to the debate on the involvement of academics from different academic disciplines in research collaboration (Bakhshi et al., 2008; Moore et al., 2010). The study was, therefore, guided by the following research questions and hypothesis:

- a To what extent do academic researchers participate in research collaboration?
  - b With which sector(s) do academic researchers collaborate?
  - c Why do academics engage in research collaboration?
  - d Which forms of research collaboration do academics engage in?
- H<sub>0</sub> There is no significant difference in the number of research collaboration by academics from the STEM, the social sciences and the arts.
- H<sub>1</sub> There is a significant difference in the number of research collaboration by academics from the STEM, the social sciences and the arts.

The rest of the paper comprises theoretical and conceptual discussions, the research methodology and results of the study. These are followed by discussion of the results, conclusions and policy implications as well as limitations and direction for future research.

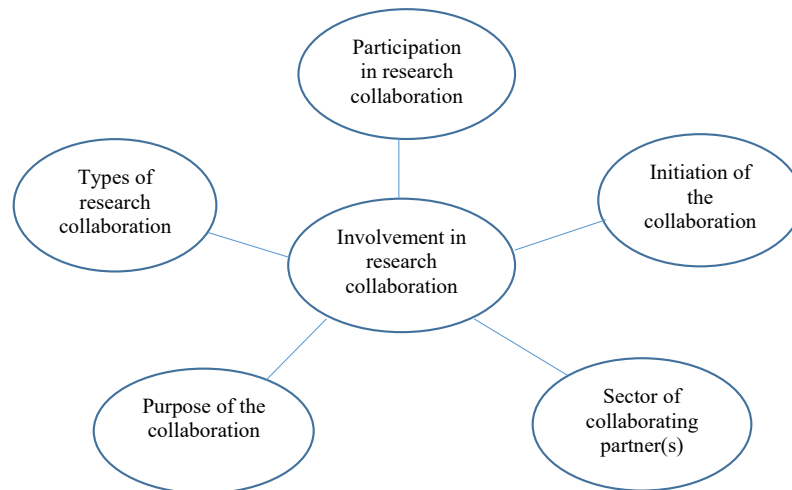
## **2 Theoretical and conceptual issues**

It is well acknowledged that investments in knowledge and human capital, as embodied in research and development, generate economic growth through the spillover of knowledge (Braunerhjelm et al., 2010). Amidst a myriad of models with claims and counter-claims on invalid scale effects (Jones, 1995; Zachariadis, 2003), Ang and Madsen (2011) argue that Schumpeterian growth models illustrate that economic growth can be maintained at a constant level if research and development "is kept to a fixed

proportion of the number of product lines, which is in turn proportional to the size of the population along the balanced growth path” [Ang and Madsen, (2011), p.1361]. Additionally, the knowledge spillover theory of entrepreneurship (Acs et al., 2009, 2013) demonstrates entrepreneurship as the missing link between research and innovation and economic growth.

The knowledge spillover theory of entrepreneurship (Acs et al., 2009) illustrates that the more efficiently knowledge flows over from entities such as universities and research institutes to other entities for exploitation, the bigger the effect of new knowledge, particularly tacit knowledge, on entrepreneurship for innovation, competitiveness, growth and development. Tacit knowledge is that dimension of knowledge that is embedded in its holder and is not easily transferrable without the participation of the holder in the process of knowledge transfer (Rinne and Koivula, 2005; Gibbons et al., 1994). It is a key source of competitive advantage for the pursuit of innovation and its nature makes interaction or collaboration, as opposed to publication, the ideal medium for its production and transfer from incumbents to users (Johnson et al., 2002; Robin and Schubert, 2013).

**Figure 1** Conceptual framework of the involvement of academic researchers in research collaboration with knowledge users (see online version for colours)



Source: Author's construct (2016)

As a result, participation in research collaboration (Figure 1), between the university represented by academic researchers and knowledge users particularly industry, is indispensable in ensuring that tacit knowledge is produced and actually used in innovation (Mueller, 2006; Robin and Schubert, 2013). In this way, research collaboration contributes to the reduction of the knowledge filter which Acs et al. (2013) describe as the gap that exists when investment in knowledge creation yields new knowledge that is yet to be exploited and put to commercial use. Furthermore, research collaboration promotes productive entrepreneurship which limits the tendency for a Swedish paradox. The Swedish paradox, according to Ejermeo and Kander (2006) and Braunerhjelm et al. (2010) consists of a situation whereby entrepreneurial opportunities,

generated through investments in knowledge production, remain under-exploited or are exploited outside the economic system.

The distinctive role of recursive interactions in the knowledge-based economy makes the initiation of research collaboration, as shown in Figure 1, an indispensable dimension of the involvement of academics in research collaboration. It also implies the relegation of the concept of ivory tower since evidence-based practice of entrepreneurship requires effective communication of research problems and research findings between the university and knowledge users (Steffens et al., 2014). An ivory tower is said to exist when academic researchers and knowledge users are disengaged from each other such that there is little or no interaction between them in the performance of their respective roles of knowledge production and innovation (Etzkowitz and Leydesdorff, 2000; Rinne and Koivula, 2005; Shapin, 2012). Studies by Perkmann and Walsh (2009) and Hughes et al. (2011) show that academics and firms can initiate the collaboration process based on their research interests.

Additionally, the interactive nature of research collaboration aligns with the network theory of social capital which relies on the principles of homophily and heterophily to propose a strong correspondence between intensity of interactions, shared sentiments and shared resources (Fu et al., 2012; Lin, 2008). Consequently, academics are expected to collaborate more with the predominant sector(s) that constitutes the industrial base of the economy to ensure that research findings are used in growth-oriented innovations (Hughes and Kitson, 2012; Mueller, 2006). Empirical work by Tödting et al. (2008) and Costa and Teixeira (2005) indicate that collaboration, between firms and research-based institutions, such as universities, produce valuable innovations some of which become technological breakthroughs.

The conceptual framework of the study (Figure 1) further illustrates the purpose of research collaboration as an important dimension to the involvement of academics in research collaboration. Lin (1999; 2008), in the network theory of social capital, identifies instrumental and expressive purposes of engaging in social interactions. Studies by Chang et al. (2011) and Hughes et al. (2011) show that academics pursue the instrumental purpose of acquiring resources as against the expressive purpose of sharing resources in their interactions with external parties. The resources could be financial or non-financial, for example infrastructure, research expertise, skills and contacts (Bozeman and Gaughan, 2007; Johari et al. 2012). A related study by Bozeman and Gaughan (2007) revealed that academics on industry grants were about three times more likely to initiate collaboration in the form of asking industrial researchers about their research as well as to engage in technology-related research.

Literature also shows that the purpose of acquiring resources is to use the resources to advance research work and to facilitate learning (Hughes et al., 2011; Perkmann and Walsh, 2009). For instance, D'Este and Perkmann (2011) and Moore et al. (2010) found, in related studies, that academics interacted with external parties mainly due to the benefits that knowledge exchange could deliver to their research work. Other purposes include the acquisition of knowledge to promote effective teaching, to assist society in solving problems and to raise or earn extra income (Hughes and Kitson, 2012; Moore et al., 2010).

Type of research collaboration is another key facet of the involvement of academics in research collaboration (Figure 1). There are various types of research collaboration, namely, contract research, joint research, consulting, business founding and technology transfer (D'Este and Perkmann, 2011; Perkmann and Walsh, 2009). D'Este and

Perkmann (2011) established, in a related study, that the highest proportion of researchers engaged, at least, once in the reference period of the immediate past year in contract research, joint research and consulting.

The preceding theoretical and conceptual review indicates a number of issues that relate to the involvement of academics in research collaboration with knowledge users. These include the extent to which academics engage in research collaboration, initiation of the collaboration, sectors with which academics collaborate, purpose of the collaboration and types of research collaboration. In the dire circumstance of limited national innovation and competitiveness, coupled with limited industrial research and innovation, analysis of these issues and the implications thereof is crucial to the development of appropriate policies and interventions for advancing the knowledge base of an economy.

### **3 Research methodology**

The study design was a descriptive survey (Sarantakos, 2005; Zikmund et al., 2013) that sought to describe and compare various dimensions of the involvement of academics in research collaboration. The explanatory sequential mixed methods approach (Cooper and Schindler, 2011; Feters et al., 2013) was used and, largely, comprised a quantitative survey of academics, followed by a qualitative study in the form of interview of key informants for insights into specific issues that emerged from the quantitative survey. The institutions of interest were the UCC and the KNUST in Ghana because, together, they constituted a representative population that allowed for the test of hypothesised differences, by academic discipline. All academic senior members of UCC and the KNUST, totaling 1531 academics, formed the population. UCC accounted for 41% of the total population while KNUST accounted for 59%.

Following recommendations in literature on stratified samples (Henson and Roberts 2006; Sola, 2014), the minimum sample size of 310 for the approximate population of 1,600 on the sample size determination table, by Krejcie and Morgan (1970 as cited in Sarantakos, 2005), was increased to 511. This was to ensure that the sample size was sufficiently large to permit reasonable estimation, maximise the validity and reliability of measures, fulfill parametric assumptions and reduce Type 1 and Type 2 errors (Leedy and Ormrod, 2010; Pallant, 2011).

All academics in the sciences, technology, engineering, mathematics and related departments formed the STEM group. Academics in departments that teach and research into various forms of expressions of human experience rooted in culture, constituted the arts. The social sciences comprised academics in departments that research into society, its structure, systems, functions and relationships (Hughes and Kitson, 2012; Bakhshi et al., 2008). Upon compilation of the discipline-related sub-samples (STEM = 297: UCC = 82, KNUST = 215; social sciences = 138: UCC = 92, KNUST = 46; arts = 76: UCC = 35, KNUST = 41), respondents from each stratum were selected using the computer method of choosing random samples (Leedy and Ormrod, 2010; Sarantakos, 2005).

The second phase of the sampling procedure involved selection of key informants for the qualitative aspect of the study. The key informants comprised three heads of research directorates and technology transfer office and eight academics with long-standing

experiences in research collaboration, making a total of 11. Two out of the three heads of research directorates were from KNUST while one was from UCC due to the fact that KNUST had two central offices, one in charge of research and the other responsible for technology transfer, while UCC had one office for research, innovation and consultancy. Out of the eight academics, one respondent was selected from the STEM, the social sciences and the arts in each institution, yielding a total of six respondents. The extra two key informants were selected from the STEM in KNUST and the social sciences, specifically education, in UCC to reflect the relatively larger number of academics in the disciplines, in the respective institutions. A questionnaire and two interview guides were designed for data collection.

The design of the questionnaire and the operationalisation of variables were guided by lessons from related studies such as those by Hughes and Kitson (2012) and Bakhshi et al. (2008) on the initiation of research collaboration and sector of collaborating partner(s) and from Hughes et al. (2011) and D'Este and Perkmann (2011) on the purpose and types of research collaboration. Nominal, interval and ratio scales were employed in the measurement of variables. Interval level data, such as the research-related purpose of research collaboration, were measured on unipolar semantic differential rating scales and according to the target, action, context and time (TACT) of research collaboration (Ajzen 1991; Zikmund et al., 2013). In accordance with the TACT principle (Ajzen and Klobas, 2013), the target for the study was the academic researcher, the action was to do research, the context was doing research with input from others who were likely to use the research findings in innovation and or problem solving and the time frame was the past ten years, which was determined based on the outcome of a pilot study that took place from September, 2014 to October, 2014.

Two interview guides (Jacob and Furgerson, 2012; Sarantakos, 2005) were also designed. The first interview guide solicited for information on the experiences of academics who had actively engaged in research collaboration within the time frame of the past ten years. The second interview guide was administered to heads/directors of the research units and or technology transfer office of the study institutions. The face validity and content validity of the instruments were assessed and confirmed by a team of five independent and experienced researchers. Upon receipt of ethical clearance from the Institutional Review Board of the UCC in August, 2014, the questionnaire was administered from November, 2014 to March, 2015 with a 53% response rate while interviews were conducted in May, 2015 and June, 2015 with a response rate of 100%.

The quantitative data were analysed with tools from the IBM Statistical Product and Service Solutions (SPSS) Version 19. Descriptive analysis of all data was conducted to provide a general overview of the research findings. Tests of difference(s) in the number of research collaboration by study organisation and across academic discipline were done with Mann-Whitney U test and the Kruskal-Wallis test, respectively, instead of T-test and ANOVA due to substantial departure of the distribution of the data from tolerable limits of below  $\pm 2$  skewness and below  $\pm 7$  kurtosis for parametric analysis (Kim, 2013; Lantz, 2013) and the presence of conditions with less than 25 participants for the conduct of ANOVA (Schmider et al., 2010; Lantz, 2013). Auditory and transcribed data were analysed through coding and interpretation of similar and contrasting themes, in relation to the quantitative data (Sarantakos, 2005; Zikmund et al., 2013).

## 4 Results

### 4.1 Demographic characteristics of respondents

Total number of respondents was 266 with 58% from the KNUST and 42% from UCC. The number of respondents from each study institution reflects the population of academics and samples drawn, in the methodology section of this paper, which showed that KNUST had more academic researchers than UCC.

Four background characteristics of respondents were assessed. They included sex, rank, academic discipline and years of service. Total valid responses were 266 for sex, 265 for rank, 256 for academic discipline and 261 for years of service. The majority (76%) of respondents were males. In terms of rank of respondents, senior lecturers were more (48%) while professors formed the minority (2%), although the majority of respondents from UCC were lecturers (40%).

In addition, more respondents (62%) belonged to the academic disciplines of the STEM, while the minority was from the arts (13%). The minimum and maximum tenure of respondents were one year and 39 years, respectively, while the mean tenure stood at ten years with a standard deviation of 6.699 and a skewness of .761. The standard deviation and the skewness (Leedy and Ormrod, 2010; Pallant, 2011) suggest that most respondents had served in their respective institutions as academic researchers for not more than ten years.

### 4.2 Descriptive results on the involvement of academics in research collaboration

The involvement of academics in research collaboration was examined in line with the conceptual framework of the study (Figure 1), which proposes research collaboration to constitute several facets that are important for delving into the apparent limited research collaboration and under-utilisation of research results, as advanced in the problem statement of the paper. The dimensions included engagement in research collaboration during one's professional career, initiator of the collaboration(s), sector of collaborating partner(s), purpose of the collaboration and types of collaboration.

Frequency distribution on the engagement of academics in research collaboration, based on 262 responses, showed a relatively higher percentage of 64.1% of the respondents indicating that, throughout their professional career, they had done research with or for another person or entity while the remaining 35.9% had not done so before. However, the figure reduced to 52.8% out of a total of 254 respondents, who consented that the collaborative research findings were used for purposes, such as problem solving and innovation, other than acquiring an academic degree or promotion. In other words, about half (47.2%) of the respondents did not engage in research collaboration, although some (11.3%) interacted with colleagues and other individuals for academic purposes.

As part of assessing the engagement of academics in research collaboration, the number of research collaboration within the past ten years was analysed. Results of the descriptive analysis of 133 responses showed skewness of 2.577 and kurtosis of 10.328, which are an indication of substantial departure of the distribution of the data from the tolerable limits of below  $\pm 2$  skewness and below  $\pm 7$  kurtosis (Kim, 2013; Lantz, 2013). As a result, the median (5) instead of the mean was reported. The average number of



research collaboration within the past ten years was a median score of 5 (interquartile range = 7) which is an indication that, on average, academics participated in research collaboration once in every two years.

Results on the initiation of research collaboration indicated an almost equal percentage of 49.4% of initiation by academics and 50.6% initiation by collaborating partners. Interview results revealed that seven out of the eight experienced academics, who acted as key informants to the study, initiated research collaboration through response to call for applications for funding, principally research grants. On the other hand, research collaboration that was initiated by collaborating partners was often informed by the research expertise of the academic researcher. For instance, one interviewee's response to a follow-up question on why the collaborating partner initiated the collaboration was "I was sought after due to my research expertise".

Examination of frequencies of multiple responses on sector of collaborating partner(s) revealed that a greater percentage of respondents (52%) collaborated with the third sector while relatively fewer respondents (22.6%) collaborated with the private sector. Collaboration with the public sector stood at 25.4%. From interview results, the highest number of collaboration in the third sector was with international funding organisations, which necessitated that the recipients of funds worked with public sector organisations such as relevant government ministries and public universities. Other third-sector collaborations were with the local community and non-governmental organisations (NGOs). Collaborations with the private sector were, mainly, with small and medium-sized enterprises (SMEs) especially those into artwork, farming, manufacture of energy-related products and food processing. There were few collaborations with large enterprises. A possible underlying reason is that the Ghanaian economy is predominantly made up of small enterprises which constitute over 92% of all businesses in Ghana (Ameyaw et al., 2016).

Closely associated with the sector of collaborating partner is the resource-related purpose of research collaboration, which the network theory of social capital categorises into instrumental purpose and expressive purpose (Lin, 1999; 2008). Frequency results showed that 53.4% of respondents had an instrumental purpose, that is, they sought to obtain additional resources as against the expressive purpose (46.6%) of sharing resources. The quantitative findings buttress the qualitative results, which revealed that the majority of interviewees engaged in research collaboration that came with funding. Purpose of research collaboration was further analysed with 367 multiple responses.

Frequency results indicated that more academics (33.5%) sought to advance their research work. The next higher purpose of research collaboration was the goal to help others (27.8%) and was closely followed by the goal to promote teaching (26.2%). Relatively fewer (12.5%) academics sought monetary gains. An interviewee communicated the dual purpose of advancing research work and helping others by stating that research collaboration "...helps to sharpen one's research skills... We don't know it all and need to complement each other". Other reasons provided by some interviewees for having the purpose to advance their research work were the need to get international perspectives on their research and to have access to state-of-the-art research equipment. On the quest to help others, some interviewees expressed the desire to find solutions to local problems, assist SMEs to add value to their operations and products, enhance learning in schools, improve upon the lot of farmers, tackle water pollution and enhance food supply in Ghana. Respondents, especially from the STEM, also mentioned the use

of students to offer consulting to SMES, as part of their practical training and for knowledge exchange.

Type of research collaboration also has implications on the knowledge-based economy and was analysed with responses from 10 to 90 respondents, per type of collaboration (Table 1). The descriptive statistics on number of engagement in various types of research collaboration showed standard deviations varying from .316 to 2.322 and skewness from  $-.256$  to  $3.162$ . The statistics are an indication that the scores were widely dispersed around the mean with most of the scores clustering at the lower end of the distribution (Lind et al., 2005; Pallant, 2011). Thus, the median was reported due to the high skewness (above  $\pm 2$ ) and high kurtosis (above  $\pm 7$ ) (Curran et al., 1996; Schmider et al., 2010).

**Table 1** Types of research collaboration

	<i>N</i>	<i>Min.</i>	<i>Max.</i>	<i>Mean</i>	<i>SD</i>
Contract research	90	1	10	2.92	2.089
Joint research	74	1	10	2.57	1.881
Consulting	64	1	10	2.56	2.322
Business founding	16	1	3	1.80	.676
Technology transfer	10	1	2	1.10	.316
	<i>Median</i>	<i>Interquartile range</i>	<i>Skewness</i>	<i>Kurtosis</i>	
Contract research	2.00	3.00	1.482	1.952	
Joint research	2.00	2.00	1.746	3.625	
Consulting	2.00	2.00	2.249	4.656	
Business founding	2.00	3.00	$-.256$	.126	
Technology transfer	1.00	0.00	3.162	10.00	

*Source:* Field survey (2015)

Assessment of the descriptive statistics, as shown in Table 1, revealed lower median scores of number of engagement in all types of research collaboration. Nonetheless, research collaboration that involved technology transfer had the least number of engagement (median = 1.00; interquartile range = 0). Interview results revealed that the collaborations led to the infusion into society products and processes such as improved teaching and farming methodologies, food processing tools and equipment and clothing accessories.

#### 4.3 *Involvement in research collaboration by study organisation and academic discipline*

Upon the premise that institutional and discipline-related factors, such as access to infrastructure and funding, could account for significant differences in the involvement of academics in research collaboration (Bozeman and Gaughan, 2007; Johari et al. 2012), two tests of differences were conducted. These were Mann-Whitney U test of difference by study organisation and Kruskal-Wallis test by academic discipline.

Analysis of descriptive results by study organisation yielded a total of 133 respondents indicating their involvement in research collaboration within the past ten

years. Out of this number, 59% were from UCC while 41% were from the KNUST. The analysis further revealed that, within the reference period, academics from UCC engaged in more research collaboration (*Median* = 6) than those from KNUST (*Median* = 5). Nevertheless, at an alpha level of .05, a Mann-Whitney U test did not show a statistically significant difference in the number of research collaboration by academics from UCC (*Median* = 6, *n* = 79) and the KNUST (*Median* = 5, *n* = 54),  $U = 2090.500$ ,  $z = -.196$ ,  $p = .845$ ,  $r = .02$ . It is essential to recall that both institutions renewed their commitment to research and extension in 2013 and put in place similar support services and incentives (KNUST 2005; UCC, 2012). A possible implication of the findings is that the support services and incentives are yielding similar motivations and impact across the two institutions.

In order to explore the impact of academic discipline on the participation of academics in research collaboration, a Kruskal-Wallis test was conducted. The test involved analysis of the number of research collaboration across discipline and was based on 130 responses. Descriptive results showed that the STEM had the highest number of collaboration ( $N = 79$ ) with a mean rank of 71.66, followed by the social sciences ( $N = 41$ ), while the arts had the least number of collaboration ( $N = 10$ ) with a mean rank of 44.55. The Kruskal-Wallis test yielded a statistically significant difference in the number of research collaboration, across the three academic disciplines at  $\alpha = .05$  level [(Group 1,  $n = 79$ : STEM, group 2,  $n = 41$ : social sciences, group 3,  $n = 10$ : arts),  $\chi^2(2, n = 130) = 6.596$ ,  $p = .037$ ]. The STEM had the highest median score (6), followed by the social sciences (5.00) while the arts recorded the lowest median score of 3.50.

In order to control for type 1 error, post-hoc analysis was done with the Mann-Whitney U test. According to Pallant (2011), in using the Mann-Whitney U test for post-hoc analysis, the Bonferroni adjustment should be applied. The Bonferroni adjustment involves dividing the alpha level of .05 by the number of tests and using the new alpha level as the criteria for determining significance. Three Mann-Whitney U tests were conducted, implying an alpha level of .017. The first Mann-Whitney U test showed a statistically insignificant difference, at  $\alpha = .017$ , in the number of research collaboration by the STEM ( $Md = 6$ ,  $n = 79$ ) and the social sciences ( $Md = 5$ ,  $n = 41$ ),  $U = 1285.000$ ,  $z = -1.861$ ,  $p = .063$ .

Similarly, there was no statistically significant difference, at  $\alpha = .017$ , in the number of research collaboration by the STEM ( $Md = 6$ ,  $n = 79$ ) and the arts ( $Md = 3.50$ ,  $n = 10$ ),  $U = 243.000$ ,  $z = -1.987$ ,  $p = .047$ . Again, there was no statistically significant difference, at  $\alpha = .017$ , in the number of research collaboration between the social sciences and the arts: social sciences ( $Md = 5$ ,  $n = 41$ ), arts ( $Md = 3.50$ ,  $n = 10$ ),  $U = 147.500$ ,  $z = -1.378$ ,  $p = .168$ . The outcome of the analysis led to acceptance of the null hypothesis ( $H_0$ ) that there is no statistically significant difference in the number of research collaboration by academics from the STEM, social sciences and the arts.

## 5 Discussions

A fundamental argument of this study is that research collaboration is indispensable in the knowledge-based economy due to its capacity to bridge the knowledge filter and militate against the occurrence of a Swedish paradox in an economy (Braunerhjelm et al., 2010; Ejermo and Kander, 2006). In the face of apparent limited research collaboration in the Ghanaian economy, the study sought to examine the involvement of academics in

research collaboration that is driven by the goals of research and innovation. The study provides evidence that a little over half of academics participated in research collaboration while the others did not. Thus, whereas collaborating partners may benefit from the tacit knowledge embedded in the collaborating academics, the knowledge-based economy in Ghana falls short of the tacit knowledge that may be entrenched in the non-collaborating academics (Gibbons et al., 1994; Rinne and Koivula, 2005).

Out of the number of collaborating academics, few were of professorial rank while the majority were of the rank of senior lecturer and below. In addition, the number of female respondents were very few as compared to males. The rank and gender disparities reflect the general statistics on academic staff of public universities in Ghana. Summary of basic statistics on public universities in Ghana, compiled by Ghana's National Council for Tertiary Education (NCTE), shows that professors and associate professors form the minority of academic staff in Ghana's public universities (NCTE, 2014). According to the NCTE's basic statistics, overall, professors and associate professors constitute less than a quarter (that is 14%) of academic staff in the public universities. The NCTE statistics further show that females make up 18% of the total number of academic staff in Ghana's public universities (NCTE, 2014). The low representation of females in Ghana's public universities had also been established in a previous study by Adika (2003) on internet use among faculty members of the University of Ghana, the KNUST and UCC.

The study also shows an almost equal number of research collaboration that was initiated by the academics and their collaborating partners. The finding supports Rinne and Koivula (2005) who reiterate that the fall of the ivory tower is evidenced by demands and expectations that pour in from students, the work environment and the state. Nonetheless, a further important dimension to the ivory tower is the sector of origin of collaborating partners. It was evident from the results of the study that more research collaboration took place with the third sector against few collaboration with the private sector, which is the industrial nucleus of the Ghanaian economy (Abor and Quartey, 2010; Mensah and Nyadu-Addo, 2012). The finding indicates possible existence of an ivory tower between academics and the private sector; that is, there was relatively less engagement between the two sides in knowledge production and usage (Etzkowitz and Leydesdorff, 2000; Rinne and Koivula, 2005; Shapin, 2012).

However, the ivory tower explanation may not, entirely, reflect reality since interview results showed that the closer collaboration with the third sector, including international development agencies and national and foreign NGOs, was as a result of the existence of relatively more funding opportunities in the sector. The importance of funding to the sector with which academics collaborate conforms to Bozeman and Gaughan's (2007) findings that funding, in the form of grants and contracts from industry, had significant effect on academics' propensity to work with industry and that academics on industry grants were about three times more likely to initiate various forms of collaboration.

Academics also engaged in all forms of research collaboration. However, comparison of the findings to those of previous studies showed that the mean number of collaborations, within the past ten years, was relatively low. For instance, in a related study in the UK, D'Este and Perkmann (2011) established that the highest proportion of researchers engaged, at least, once in the reference period of the immediate past year in contract research, joint research and consulting. In accordance with the network theory of social capital (Lin, 1999; 2008), the disparity between the findings of this study and that

by D'Este and Perkmann (2011) may be due to differences in collective assets and structural and positional variations, such as differences in support systems.

Thus, whereas this study was conducted in a developing country that is beset with several institutional, financial and infrastructural challenges (Ministry of Environment, Science and Technology, 2010; UNCTAD, 2011) the study by D'Este and Perkmann (2011) was done in a developed country with relatively advanced institutions and support systems. Hence, the relatively lower engagement in research collaboration by the academics surveyed in this study, may be attributable to limited support for research collaboration as also confirmed by interviewees who decried the limited opportunities, particularly infrastructure and funding, in Ghana.

Nevertheless, the relatively higher involvement of respondents in contract and consulting-based research is consistent with findings by Bozeman and Gaughan (2007) that grants and contracts have significant effect on academics' propensity to work with industry. However, the relatively least involvement of respondents in technology transfer is similar to Hughes and Kitson's (2012) findings, in a related study, which showed few direct commercialisation activities of various knowledge exchange mechanisms in the UK. The implication is that funding is important to the type of collaboration that academic researchers are likely to engage in, as shown in other findings of the study.

Specifically, the study provides evidence that academics engaged in research collaboration, mainly to obtain additional resources for their research work. This finding is consistent with those of Chang et al. (2011) and Hughes et al. (2011) who established that academics who engaged in collaboration sought instrumental gains in the form of resource acquisition. The academic-related purpose of research collaboration is also similar to D'Este and Perkmann's (2011) and Moore et al.'s (2010) findings that academic researchers participated in collaborations mainly to advance their research work.

It can, therefore, be implied from the academic-related purpose of research collaboration that the opportunity to access resources for the promotion of one's research work is imperative to the willingness of academics to engage in research collaboration. It is, therefore, not surprising that more academics engaged in contract research and joint research since these forms of research collaboration offer relatively better opportunities for publication as part of the deliverables of the collaboration. Research collaboration that involves technology transfer and/or business founding do not usually result in publication of research findings due to the need for secrecy and protection of intellectual property (Perkmann and Walsh, 2009).

Generally, promotion requirements of public universities in Ghana, including the KNUST and UCC, place more emphasis on publication of research findings as against teaching and engagement in extension services/outreach. For instance, in the Statutes of UCC (2012), assessment of application for promotion to the next higher rank involves the allocation of 50, 35 and 15 percentage points to publication, teaching and extension/community service, respectively. Underneath this reality is a recent emphasis on publication of research articles in top journals, as defined by impact factor. Cognisant of the fact that publication of research findings constitutes a key determinant of promotion of academics in public universities in Ghana (KNUST, 2005; UCC, 2012) and that research collaboration is highly time consuming (Hughes and Kitson, 2012) and may not result in publication, it can be deduced that academics would ordinarily not be very much attracted to research collaboration that does not offer opportunities for the fulfilment of their career aspirations on promotion/advancement.

Furthermore, it is evident from the results that there was no major statistical difference in the number of times academics from the STEM, social sciences and the arts engaged in research collaboration. The finding supports arguments by Hughes et al. (2011) and Bakhshi et al. (2008) that all academic disciplines are relevant to knowledge exchange, implying that the arts and the social sciences, or the humanities, are as important as the STEM in knowledge exchange.

## **6 Conclusions and policy implications**

On the whole, the study provides support for the argument that research collaboration is limited in the Ghanaian economy reflected in the high number of non-collaborating academics, the low and infrequent engagement of collaborating academics in all forms of research collaboration, as well as low engagement with the private sector, which is the industrial nucleus of the economy. The situation, in the face of continuous academic research, serves as a signal to the existence of a wider knowledge filter in the form of under-utilisation of research results in innovation and, possibly, a looming Swedish paradox. The condition, however, presents the opportunity to put in place the necessary measures to advance the knowledge-based economy in Ghana.

The aforementioned conclusions are presented in recognition of the fact that almost half of the respondents of the study were of the rank of senior lecturer while professors were relatively small in number. Considering the fact that academics of professorial status have reached full tenure and would ordinarily not be so much preoccupied with research for the purpose of promotion, a larger population of academics in the professorial rank is likely to be a good catalyst for stepping up research collaboration in the Ghanaian economy. Thus, from the perspective of academics of non-professorial status, making research collaboration count towards their promotion has a higher tendency of getting them to actively engage in research collaboration for attainment of a knowledge-based economy in Ghana.

It is, therefore, recommended that academics advocate for institutional and national policies for the promotion of research collaboration. This can be approached through public lectures and national discussions, for example, situated within the framework of the ongoing consultations for the preparation of a 40-year national development plan. Through this approach, it may also be necessary for academics to engage in national dialogue for the establishment of a research and innovation council and a corresponding fund in support of research collaboration. The discussions should also promote policy that supports all academic disciplines to actively engage in various types of research collaboration, especially commercialisation that will enable Ghana to pursue outward-oriented industrialisation, with a competitive edge on the international market.

## **7 Limitations and future research**

Although this study adds a developing country perspective to the existing literature on university interaction with external entities, a key limitation is that it misses out on the perspectives of other key actors, such as knowledge users. Therefore, the findings of this study should be interpreted within its scope. Moreover, assessment of the existence of an

ivory tower between academia and the private sector may be a promising and relevant research agenda to confirm or disprove the findings of the study, which point to possible existence of an ivory tower between the two sides.

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