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Analysing the University-Industry-Government Linkages in Punjab

Sehrish Khalid
Ph.D Scholar, Institute of Education & Research,
University of the Punjab, Lahore
Email:sehrish_rana88@yahoo.com

Abid Hussain Chaudhry
Professor, Institute of Education & Research,
University of the Punjab, Lahore

Abstract:

University-Industry-Government (UIG) linkages seem not as much strong in developing countries. This study is undertaken to fill the knowledge gap about university, industry and government linkages in Pakistan. The purpose of this study was to explore the existing linkage situation among university, industry and government regarding Research and Development (R&D), knowledge sharing and resource sharing. The researcher used quantitative approach. The researcher collected the data from randomly selected 924 university faculty members of social sciences, management sciences, and sciences faculties through a questionnaire to explore their perception about the current UIG linkages situation. Reliability of self-developed questionnaire was UIL scale Cronbach's Alpha 0.955 and UGL scale Cronbach's Alpha 0.931. Data were analysed by descriptive and inferential statistics (ANOVA). The results of the study reveal that universities, industry and government have medium to low research and development linkages. University-industry linkage level is different among the groups of faculties and University-Government linkage level is not different among the groups of faculties. It is suggested that the students might be appraised and categorized by their capability to participate in R&D of a practical nature and of direct significance to the industries. University faculty might encourage the students to select industry-relevant research topics and develop proposals so as to attract funds from external sponsorship.

Keywords: University-Industry linkages, Research & Development (R&D), Knowledge Sharing, Resource Sharing

I. Introduction

The University-Industry-Government (UIG) Triple Helix is used as an innovation model, taking into account institutional arrangements and policy models to reflect the development of the national innovation system. The interaction between these institutional partners creates a layer that rearranges these arrangements in the restraint mechanisms of the development system. In this national innovation system, "university research" is the source of the ability to realize it (Etzkowitz & Leydesdorff, 2000; Phani & Bhasker, 2018).

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According to Etzkowitz (2000), in some of the countries or regions, the main institutional area is the government. Industry and universities are the second part of the country. The government will play a coordinating role when establishing relationships between institutional areas. Under this model, the government is expected to lead the development of the project and provide resources for the new plan. Industry and academia are relatively considered weak institutional areas, and if they are not controlled, strong leadership is needed. The former Soviet Union, France, and many Latin American countries are examples of statistical models of social organization. Triple Helix I characterizes the historical environment of the state, including colleges and universities. This was a failure because the "state" exercised a high degree of control (Phani & Bhasker, 2018).

As Etzkowitz (2000) stated in this model, universities are providers of basic research and educated people. University plays its role related to the industry is to knowledge provider, generally in the form of graduates and publications, to bring implied and skilled knowledge to their novel jobs. It is the industry's responsibility; without any help they catch useful knowledge from universities. The industry is also expected to operate independently, and companies are interconnected through buying and selling relationships. Fierce competition between companies is expected and cooperation is forbidden. In the laissez-faire model, it is expected that the role of the government will be limited to clear cases of so-called "market failure", and economic motivation alone does not require activities.

The government is expected to have a limited role in regulations or product markets, but it is not essential in the closely linked military sector. For example, the military of the US economy functions according to a nationalist, top-down government-led model, and industry and academia play an important role in this coordination. Triple Helix II presents the state as the innovation partner and there are clearly defined institutional areas (Etzkowitz, 2008; Phani & Bhasker, 2018).Etzkowitz and Leydesdorff, (2000) believe that academia, government, and industry are jointly generating knowledge infrastructure through overlapping institutional areas, each of which plays a role for each other, and there is a hybrid organization at the interface.

Triple Helix III considered as a developing institutional structure with covering institutional boundaries and one participant participates in another participant (Etzkowitz & Leydesdorff, 2000), forming a hybrid organization, such as technology transfer offices, commercial and financial support institutions, such as research laboratories and companies. venture capital in laboratories (Etzkowitz, 2008; Phani & Bhasker, 2018). Universities plays vital role for the development of countries such as regional economic development because industry based countries have become more based on knowledge (Mongkhonvanit, 2008). Firms acquire knowledge from R&D organizations and laboratories, research institutes, universities and even sometimes they learn from their competitors. Universities are unavoidable because new knowledge is created in universities through basic research. Universities also provide the human capital to industries. Therefore, universities have a significant role to play for the socio-economic development of a country (Feldman & Kelly, 2002). Several studies proved the growth of those companies which have strong linkages with academia in comparison to those which do not have such linkages (Malairaja & Zawdie, 2008).

According to Joseph and Abraham (2009), determine the ways over which knowledge streams from universities to industry. These networks include personal links of industry academics and researchers, spin-offs of newly established university companies, participation in conferences and speeches, new graduates entering the industry, publications and research reports, public meetings and conferences, generally exchanges of information and sign with universities research, carry out cooperative and joint R&D projects, participate in university-related networks, provisional staff interactions, incubators centers, joint parks of science and technology, and the company is kept by the university (AbebeAssefa, 2016). Patent licenses and derivative products are definitely essential ways for the commercialization of research, but other links, such as collaborative research, student and teacher mobility seem to show greater relevance (Carayannis, Rozakis & Grigoroudis, 2016).

According to OECD (2013) nowadays, globalization is more open in access to research data and new forms of funding and is changing the way institutions encourage the transfer of knowledge from universities to society. In recent years, the necessity to share knowledge between universities and industry has become more and more obvious (Carayannis, Grigoroudis, Stamati & Valvi, 2019; Ferreira & Carayannis, 2019). The university also spreads knowledge to the industry and the local community through its graduates, who have received education and training in the university, and then join the industry and the community as a knowledge worker. These universities and higher education institutions play a fundamental role in people's lifelong learning through various industries employees training, government organizations, community organizations and institutions that provide social services including educational institutions, hospitals etc. The established links between universities, industry and communities also help them obtain all important financial resources for knowledge creation activities (Bashir & Ali, 2016). Then, knowledge transfer practices are defined as activities required to promote the use of knowledge in the context of another organization, such as teaching, managing interaction, and sharing data and technology (Vries, Dolfsma, & Windt, 2018).

According to Schartinger, Rammer, Fischer and Frohlich (2002) the interaction and knowledge sharing between universities and industry are divided into four different categories. University and industry joint research work including joint research publications, contract based research such as financing and consultation for research conducted in universities, personnel movement between universities and industry considered as mobility, joint supervision of students for research studies and during industry internship, placement, and training for example the training of company employees is conducted in universities and taught by industry professionals on selected topics. Most university knowledge is exchanged through traditional channels, such as personnel exchanges, publishing, consulting, and conferences (Geuna & Muscio, 2009). The interaction between universities and industry involves a wide range of relationships, including seminars, workshops, training, contract research, consulting, spin-offs, and many other interactions. The conservative role of the universities has changed from teaching and research to a step towards entrepreneurship. Economic development, teaching and research have integrated entrepreneurs (Bhutto & Lohana, 2018; Etzkowitz 1998).

The university-industry commitment serves as cooperation that benefits both parties. Universities and industries depend on each other, as the role of the university is to produce human capital to work in industries, and industries, on the other hand, need human capital to run their businesses (binti Othman, 2011). The academic cooperation refers to a comprehensive activities including research collaboration, contract based research and academic consultations. Academic engagement represents instances of collaboration between organizations, which generally involve person-to-person interactions that link universities and other organizations, particularly companies (Filippetti & Savona, 2017; Perkmann et al, 2013; Vélez-Rolón, Méndez-Pinzón, & Acevedo, 2020).

In terms of teaching and training, the university's industrial activities include the provision of professional courses for a fee to respond to the industry's special skills and training needs and share their resources with each other's. Universities can hire representatives of industry and other production sectors to participate in the curriculum to ensure that degree programs can produce graduates with the knowledge and skills required by the workforce. Another common way of connecting universities with industry is to create opportunities for student attachment and cooperatives in the production sector (Homma & Attalage, 2008; Munyoki et al, 2011; Yelma & Alemu, 2018). Arrangements like informal include lectures as a guest and resource persons or stakeholder meetings to modify the curriculum (AbebeAssefa, 2016; Mpehongwa, 2013). Previous researches highlighted the importance of knowledge and knowledge economy and emphasized on what are the linkages among universities, industries and government. There is need to create interaction and consistency between knowledge and production platforms. Current study focused on empirically testing the theory of triple helix in the context of Pakistan.

The research might be helpful to fill knowledge gaps about the role of higher education, and particularly the role of universities within the Pakistani context in reference to the global context of knowledge economy. It also strives to provide new knowledge about the higher education in relation to the knowledge economy among all stakeholders (students, teachers, policy makers, industrialists and government). The research might offer insights on higher education in Pakistan along with its political, economic, and social aspects, thereby informing: (a) Academics and stakeholders, by giving them a better understanding of university and industry linkage in building a knowledge economy; (b) Policy makers at state level, by conceptualizing higher education issues and providing a suggestion to improve and sustain the collaboration of university, industry and government. The objective of the study is to find out the linkage among universities, government and industry in the perspective of triple helix theory of knowledge economy. There are following hypotheses of the study;

$H_{0:}$ There is no significance difference between perception of university teachers regarding university-industry linkage in term of faculty (social sciences, management sciences and sciences).

H_0: There is no significance difference between perception of university teachers regarding university-government linkage in term of faculty (social sciences, management sciences and sciences).

II. Methodology

A. Research Design

The quantitative research was conducted in order to find out the linkage level among university, industry and government. The researcher used survey research in order to analyse the university teachers' perception about university, industry and government linkage. Researcher collected the data by personally visit the universities and through mail.

B. Population and Sampling

The population of the study comprised on university teachers of public sector universities of Punjab. The sample of the study was selected through multistage sampling technique. At first stage, researcher selected 12 general category public sector universities of Punjab province on the basis of Higher Education Commission (HEC) ranking of Pakistani higher education institutions. At the second stage, all departments were selected from the common faculties of the selected universities; social sciences, management sciences and sciences. At the third stage, teaching faculty from each department, two lecturers, one assistant professor, one associate professor and one professor was selected. Total required sample size from 225 departments was 225 x 5 = 1125. Due to COVID 19 situation, Fatima Jinnah Women University, Rawalpindi was excluded from the sample because the researcher did not obtain the acceptable level of response. So, sample of the study consisted of 1070 faculty members. Overall, response rate of 86.3% on questionnaire was achieved.

C. Instrumentation

Questionnaire for the faculty members of the university was developed. University-Industry-Government Linkage (U-I-G Linkage) questionnaire included two scales named as:

- University-Industry Linkage (UIL)
- University-Government Linkage (UGL)

Scale of University-Industry Linkage (UIL) included constructs; research and development, knowledge sharing, resource sharing and academic cooperation. UIL scale has 24 items. Scale of University Government Linkage (UGL) included constructs; research and development, knowledge sharing and resource sharing. UGL scale has total 15 items. Five-point Likert scale was used for UIL and UGL: to large extent=5, to some extent=4, a little=3, not at all=2 and I don't know=1.

Validity of the questionnaires were ensured by review of some educational experts. After finalizing the research instruments, these instruments were pilot-tested by administering to 125 university teachers. Scale wise Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) was run on collected data to confirm the factors. No item was excluded, all over measured items included on relevant construct. To check the reliability of the instrument Cronbach Alpha was applied. Cronbach Alpha found for scale UIL was .955 for all 24 items and UGL was .931 for all 15 items, which were suitable for utilization of questionnaire.

D. Data Analysis

Data were analysed through descriptive (mean and standard deviation) and inferential statistics (One way ANOV). Researcher divided linkages into three levels: mean score 4.5-5=high, mean score 4-3.5=moderate and mean score 3-1=weak.

III. Results

A. Level of linkages amongst university, industry and government in Punjab

Table 1: Scale Wise Mean and SD of Faculty Member Responses

Sr. No.	Scale	X	SD
1	**University Industry Linkage (UIL)**	3.37	0.73
2	**University Government Linkage (UGL)**	3.57	0.71

Table 1 shows that overall mean score of university industry linkage is 3.37 and university government linkage is 3.57. It is concluded that mean scores of university and industry linkage level shows weak and university and government linkage level moderate to weak.

Table 2: University-Industry Linkage of Sub Scales Wise

Sr. No.	Constructs	Mean
1	Research and development	3.40
2	Knowledge Sharing	3.54
3	Resource Sharing	3.25
4	Academic cooperation	3.32

This table shows the overall responses mean score of sub scales of university-industry linkage to determine the level of linkage. University industry linkage regarding research and development (UIRD), knowledge sharing (UIKS), resource sharing (UIRS) and academic cooperation (UIAC) mean scores are 3.40, 3.54, 3.25 and 3.32 respectively. It is found that linkage regarding research & development and knowledge sharing has medium level. A low level of university-industry linkage has been found regarding resource sharing and academic cooperation.

Table 3: University-Government Linkage of Sub Scales Wise

Sr. No.	Constructs	Mean
1	Research and development	3.58
2	Knowledge Sharing	3.49
3	Resource Sharing	3.66

This table shows the overall responses mean score of sub scales of university-government linkage to determine the level of linkage. University-Government linkage regarding research and development, knowledge sharing and resource sharing mean scores are 3.58, 3.49 and 3.66 respectively. It is found that linkage regarding research & development and knowledge sharing has low level. A medium level university-government linkage has been found regarding resource sharing.

Hypothesis: ***There is no significant difference between mean scores of faculties on university-industry linkage.***

Table 4: Faculty Wise Difference of University-Industry Linkages

U-I Linkage	Sum of Squares	*Df*	*Mean Square*	*F*	*Sig.*
Between Groups	6.506	2	3.253	6.084	0.002
Within Groups	491.921	921	.535		
Total	498.427	923			

Table 4 reveals that there is significant difference in groups. University-industry linkage level is different among the groups of faculties F (2,921) =6.084, p<0.05. Significance value is less than alpha $p < .05$ so, further move towards the *Post hoc* Tukey HSD test.

Table 5: Faculty wise Comparison of University-Industry Linkage

(I) Faculty	(J) Faculty	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Social Sciences	Management Sciences	0.16107	0.07713	0.093	-.0200	.3421
	Sciences	0.16997*	0.05174	0.003	.0485	.2914
Management Sciences	Social Sciences	-0.16107	0.07713	0.093	-.3421	.0200
	Sciences	0.00890	0.07922	0.993	-.1771	.1949
Sciences	Social Sciences	-0.16997*	0.05174	0.003	-.2914	-.0485
	Management Sciences	-0.00890	0.07922	0.993	-.1949	.1771

*. The mean difference is significant at the 0.05 level

Tukey Post-Hoc was applied on the social sciences, management sciences and sciences faculties as ANOVA was significant. It is found that no significant mean difference of social sciences faculty with management sciences p=.093, while significant mean score difference with faculty of science p=.003. However, faculty of management sciences found no significant mean difference with faculty of sciences p=.993.

Hypothesis: ***There is no significant difference between mean scores of faculties on university-government linkage.***

Table 6: Faculty wise Difference of University-Government Linkage

U-G Linkage	Sum of Squares	*Df*	Mean Square	*F*	*Sig.*
Between Groups	0.466	2	0.233	0.457	0.633
Within Groups	469.069	921	0.510		
Total	469.535	923			

Table 6 reveals that there is no significant difference in groups. University-Government linkage level is not different among the groups of faculties F (2,921) =.457 p=.633. Significance value is greater than alpha $p < .05$ so, there is no need to further move towards the *Post hoc* Tukey HSD test.

IV. Discussion

The study focused on achieving the following research objectives: to find out the linkage among university, industry and government in perspective of triple helix of knowledge economy. Universities considered as the main players in the economic development of countries all around the world. In current years, their direct relationship with the industry has improved, and they have formulated policies aimed at promoting universities and industry networks. Many studies explored the industry role is much important to interaction with research laboratories and universities. University is an important source of corporate knowledge and information and seeks to improve its innovation capabilities, and is considered to be a key role in the process of innovation interaction (Abebe Assefa, 2016). Results of this study reveal that university and industry linkage level in Pakistan, specifically in Punjab province is moderate to weak. Universities and industry interact with each other in some aspects like internship and

participation in workshops and seminars. The study of Yilma and Alemu (2018) support these findings of our study by stating that Dir Dawa University (DDU) has linkage with industries mainly in two areas which are training programs and students' internship. One of the most important part departments send their students to different industries for internship purpose. Almost 70% of the universities are offering their students internship to industry (Ashraf, Hou, Kirmani, Ilyas, Zaidi & Ashraf, 2018). Study results show that linkage regarding research and development was not very strong. Most of the industries do not use the research output of universities, this shows that there is a big gap between the two parties to work together (Yilma & Alemu, 2018). Difference of linkage was explored as term of faculty (Social Science, Science and Management Science), It is found that there is no significant mean difference of social sciences faculty with management sciences while significant mean score difference with faculty of science. However, faculty of management sciences found no significant mean difference with faculty of sciences. There is no significant difference found between university and government in term of faculties. There are less studies which explore the linkage among three stakeholders (university, industry and government).

V. Conclusion

This research study explores the linkage among university, industry, and government in Pakistan and specifically in Punjab. The study explores various types of linkage among university, industry, and government, including research and development, knowledge sharing, resource sharing and academic cooperation. It is concluded that university and industry linkage level regarding research and development and knowledge sharing were moderate and academic cooperation and resource sharing were weak. It is also found that university and government linkage regarding R&D and knowledge sharing were moderate to weak, but resource sharing was weaker. It is also concluded that university-industry linkage level is different among the groups of faculties. It is found that no significant mean difference of social sciences faculty with management sciences, while significant mean score difference with faculty of science. However, faculty of management sciences found no significant mean difference with faculty of sciences. It is found that there is no significant difference in groups, university-government linkage level is not different among the groups of faculties.

VI. Recommendations

There is a need for active involvement of the private sector and industry in curriculum development. Especially in the technical field, relevant technology might be considered and confirmed. As the private organizations can facilitate education and training programs by hiring and expanding funding for graduates, and allow apprenticeship and graduate program assistance.

The universities initially need to ensure that the graduates are skilful, talented and adapt to meet the developing needs of the business world. The students might be appraised and categorized by their capability to participate in R&D of practical nature and of direct significance to the industries.

A very effective role of industry is mandatory in the entire system of the things by being more accessible to the students for training, internship and placement. University faculty can encourage the students to select industry relevant research topics and develop proposals so as to attract funds from external sponsorship. This study was

delimited to public sector universities of the Punjab province. It is suggested that study might be replicated by including the private sector universities and make comparison. It might show a clearer picture of existing university, industry and government linkage situation in Pakistan, specifically in Punjab.

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