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The Effect of Academia-Industry Linkages for Sustainable Employment. The Mediating Role of Funding

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Abstract

The study's main goal was to ascertain how funding influences university-industry linkages and how it influences sustainable employment. The research design was triangulation (mixed method). The targeted population consisted of CCTU lecturers (N=175) with a sample of n=120 and 5 managers selected from organisations which has collaborated with CCTU. The Cochran sample size formula was used to determine the appropriate sample size. Stratification was the sampling technique used, and the respondents were chosen using a simple random method. The SEM-PLS (v. 4) and IBM SPSS software (v. 27) were used to analysed the data. The main findings were that university-industry linkages have a statistically significant positive direct effect on sustainable employability (UIL->SE, β=0.898, (95% CI:0.862, 0.927), t=55.03, p>0.05; $R^{2=}$0.806). It was estimated that university-industry linkages accounted for an 80.6% effect on sustainable employment. Nevertheless, university-industry linkages still have a significant positive effect on sustainable employability when mediated through funding. (UIL->FUN->SE, β=0.872 and 0.278 (95% CI:0.862, 0.927), t=3.696, p<0.05; R^2 = 0.825. The model accounted for an 82.5% indirect effect when funding mediated between the studied variables. Again, the level of linkages is low; hence, there is a gap between the requisite manpower needs and technology transfer. At CCTU, student internships, workshop seminars, publications and reports, training courses, and consulting services were the main collaborations. The main sustainable skills for employability were personal qualities, core skills, and subject knowledge. It was recommended that the government should fund university-industry partnerships and that universities should intensify linkage programs and budget for linkage programs. Universities should collaborate with industry and NGOs to secure funding through joint research. Since linkages are low, the supervising authorities of the tertiary institutions should enforce the

implementation of linkages policies in all universities.

Keywords: academic, industry, linkages, sustainability employment, funding, Triple Helix Model

1. Introduction

The traditional functions of teaching and fundamental research are being replaced globally by knowledge transfer, technology transfer, and the monetisation of knowledge through partnerships with industry. Amry, et. al. (2021). A nation's system of innovation in science and technology can flourish when university-industry ties are strong and productive. (Alexandre, et., 2022). This opens the door for industry to take in research output and university graduates. Rapid availability of early education has made graduate employability a significant challenge in the twenty-first century on a global scale. Technology breakthroughs and the fourth industrial revolution necessitate the need for workers with technical skills and capabilities. Due to the gap between academics and industry, many graduates are now unemployed and stranded (Teneng, 2016). In 2020, the worldwide unemployment rate was 5.42%, down from 5.39% in 2018 (Aaron, 2021). In their study, Arranz et al. (2022) discovered that a successful partnership between industry and higher education institutions greatly improves graduates' employability. Additionally, a study by Jackson et al. (2021) found that co-working and small and medium-sized businesses complement each other well, making it an effective way to develop students' entrepreneurial skills, especially their ability to communicate and think critically, behave creatively, and build confidence. According to a different study, university-business partnership improves students' employability and preparation for the workforce (Lubbe et al., 2021). According to Mgaiwa (2021), creating successful university-industry collaborations, coordinating university instruction with the nation's growth goal, and conducting frequent curriculum reviews.

1.1 Problem Statement

According to published research, connections between industry and academia improve cooperation, knowledge sharing, and strategy alignment—all of which increase innovation and promote socioeconomic growth and competitiveness. Despite these admirable results, research on university-business links is comparatively lacking in less developed economies due to the inefficiency of platforms for collaboration, the difficulties of matching corporate demands with educational outputs, and the short-term nature of relationships. Comprehensive frameworks that assess the efficacy of ties between academia and industry are lacking. Furthermore, regional policies may have an impact on how effective these connections are, as demonstrated by the example of free economic zones and how they affect collaboration amongst institutions of higher learning (Bebko, 2023). The "Entrepreneurial University" approach has gained popularity in the West and places a strong emphasis on turning academic findings into commercially viable goods.

Once more, institutionally constrained capacities result in limited linkages. Because the skills provided in higher education institutions do not fulfill industry demands, there is a barrier to employment, which has resulted in a delink or disconnect between universities and industry

(Amini et al., 2023; Uddin, 2021). Policies to improve cooperation and financial assistance are required to address this issue (Mihyo, 2013). According to ILO (2018) stated that Ghana experienced the highest unemployment rate of 10.36% in 2000. This declined to 5.8% in 2013 and peaked again in 2023 at 12% of the youth above 15 years were unemployed (Dumevi, 2023). Some of the determinants have been the delink between industry and higher education curriculum, and new courses are offered by universities without first establishing industry needs. The Hasabnis (2020) study ignored the non-commercial facets of translational science and concluded that links promote innovation and business development in a commercial translation of academic discoveries. The question of whether academic research can satisfy business needs and vice versa is still up for dispute. Hasabnis (2020). According to Beugré (2016) and Braeden & Goodman (2020), a crucial component of successful partnerships is private sector investment and resilience assistance for institutions. A.E. & U.U. (2023) claimed that business sector funding in university programs connected to skills is lacking. According to the literature, closing these gaps calls for a determined effort to improve partnerships and make sure that educational initiatives meet the demands and expectations of the sector. Finally, nothing is known about how long university-industry collaborations last.

1.2 Purpose of the Study

The main aim of the study is to establish the relationship between university-industry linkages on sustainable employment, and the mediating role of funding.

1.3 Hypotheses

H_1: University-industry linkages have a positive relationship with sustainable employment.

H_2: University-industry linkages have a positive relationship with funding.

H_3: Funding has a positive relationship with sustainable employment.

2. Review of Relevant Literature

2.1 Theoretical Underpinning and Hypotheses Development

2.2 Triple Helix Model

The theoretical foundation for industry-university partnerships strongly emphasizes cooperation, information sharing, and reciprocal advantages. Links aim to improve competitiveness, promote innovation, and tackle socioeconomic issues. This study adopts the Triple Helix Model (Etzkowitz & Leydesdorff, 1995), which holds that in a knowledge-based economy, the relationship between government, business, and academia is focused on entrepreneurship, innovation, and economic growth and development (Cai & Lattu, 2021). According to Hattangadi (2022), the Triple Helix Model of innovation refers to ongoing exchanges between governments, businesses, and academia to promote social and economic advancement. According to this concept, colleges can serve as hubs for transferring technology and information to businesses, resulting in increased competitiveness, productivity, efficiency, and support for economic expansion (Gharai et al., 2018).

The approach highlights the necessity of a synergistic relationship in which academic institutions actively collaborate with businesses to meet their demands while simultaneously producing research results. Universities are thought of as knowledge-creation hubs where new concepts and technology are produced through research and development. In the meantime, the industries use the knowledge to generate money and support economic expansion. The government offers the financial resources, policy assistance, and regulatory framework required to promote these exchanges and guarantee sustainability (Okonofua et al., 2021). Based on collaboration and information sharing, the model helps stakeholders overcome obstacles and guarantee social and economic advancement (Hattangadi, 2022). Nonetheless, the Triple Helix Model promotes a more coordinated strategy in which each of the three actors participates in an ongoing

The model emphasizes the need for a synergistic relationship where universities not only provide research outputs but also engage in active partnerships that align with industry needs (Hu, 2009). Universities are seen as centres of knowledge creation, where research and development activities generate new ideas and technologies. While the industries apply the knowledge to create wealth for economic growth. The government provides the regulatory framework, funding, and policy support necessary to facilitate these interactions and ensure sustainability. (Okonofua et al., 2020). The model is based on partnership and knowledge exchange, it enables stakeholders to overcome the challenges and to ensure economic and social development (Hattangadi, 2022). However, the Triple Helix Model advocates for a more integrated approach, where all three actors engage in a continuous feedback loop, leading to a more collaborative and dynamic innovation ecosystem (Kunwar & Ulak, 2023; Cai & Etzkowitz, 2020). Nonetheless, the Triple Helix Model promotes a more cohesive strategy in which all three participants participate in an ongoing feedback loop, resulting in a more dynamic and cooperative innovation ecosystem (Kunwar & Ulak, 2023; Cai & Etzkowitz, 2020).

2.3 Knowledge Spillover Theory

Knowledge spillover is when information produced by one organization—like a business or university—becomes available to others, fostering economic growth and innovation without requiring payment. According to Audretsch et al. (2012), collaborations make it easier for businesses to absorb knowledge from academic institutions, win creative endeavours, and enhance business performance. This is corroborated by data demonstrating that involved companies in university partnerships frequently benefit from increased technical breakthroughs and research productivity. Its foundation is the idea that knowledge ought to be applied for the benefit of the public, which makes it non-competitive and frequently non-excludable. Thus, R&D results could result in technical advancement and innovation (Belderbos et al., 2021). Nonetheless, firms within the same industry can transfer information intra-industry, and industry borders can be crossed when knowledge is transferred inter-industry (Todo et al., 2011). Geographical closeness, absorptive capacity, and the type of knowledge are all factors that affect how well knowledge spreading occurs. Once more, connection efficacy is predicated on governance structures, institutional support, and the alignment of industry and university goals with national or governmental policies (Morales et al., 2022; Nguyen et al., 2022).

2.4 Concept of Industry and Universities Linkages

The cooperative relationships that develop between academic institutions and business organisations are referred to as university-industry links. Its goals are to promote economic growth, technology transfer, and innovation. Through industrial backing, our alliance aims to close the gap between academic knowledge and real-world application to harness innovation. Igbongidi (2023). It provides the chance to start cutting-edge academic research and technological advancements. Gorlach (2017). According to Freitas et al. (2013), the university-industry partnership offers the potential for financial benefit and the chance to support economic development, turn universities into entrepreneurial organisations, and match educational programs with industry demands (Alaali (2023). According to Odibo & Ismail (2019), it trains students to develop employable skills and competency and improves their employability skills. University-industry links can be formed through various methods, such as technology transfer programs, internships, consulting agreements, and cooperative research projects (Obanor & Kwasi-Effah, 2013). Cultural differences, bureaucratic obstacles, institutional incompatibility, and conflicting goals are some primary obstacles Bruneel et al., 2010).

Ultimately, university-industry ties are an essential part of the innovation ecosystem, encouraging cooperation that propels technical development and economic expansion. These collaborations can result in major advantages by utilising the characteristics of both industries, such as better workforce preparedness, competitiveness in the global market, and greater research capacity. The obstacles that university-industry links encounter is numerous and include structural, financial, and operational issues such as a lack of investment and infrastructure (Attiany et al., 2023; Li, 2024; Mbatha, 2024; Salles-Filho et al., 2021). The absence of knowledge management strategies and weak industry-academia links and policy direction (Ramjeawon & Rowley, 2017; Igbongidi, 2023). the lack of funding, insufficient entrepreneurial support systems, and infrequent collaboration (Li & Niyomsilp, 2020). A thorough grasp of the unique difficulties present in each situation is necessary to address these obstacles, as is the creation of specialised tactics to do so (Agrawal & Pandey, 2021; Igbongidi, 2023; Khachatryan et al., 2024). University-industry ties have a big impact on sustainable employment because they make graduates more employable, encourage innovation, and boost economic growth (Heilu, 2024; Soam et al. 2023)

2.5 Concept of Sustainability Employability

Forrier & Sels (2003) define employability as "the individual ability to fulfill a variety of functions in a given labour market." The concept of sustainable employment holds that employability includes the abilities, know-how, experience, and character traits that allow people to find and keep a job, which calls for a proactive approach to lifelong learning and skill development. It is made easier by socioeconomic factors, organisational support, intrinsic job worth, and a friendly work environment (Mo et al., 2024). Thus, the capacity to sustain employment over time while protecting workers' physical and mental health, encouraging work-life balance, preventing burnout, fostering a culture of diversity, encouraging open communication, fostering environmental sustainability, productivity, and flexibility in response to shifting work environments

According to Murphy & Turner (2023), it entails work-life balance, job security and stability, well-being, and the matching of personal skills with workplace requirements, all of which are influenced by institutional and ideological variables. According to studies, businesses view students who participate in UIL activities as having greater employment prospects and entrepreneurial abilities, which increases their appeal. (Kumar Soam et. al., 2023; Heilu, 2024). According to Mo et al. (2024) and Moore (2019), sustainable employability necessitates strategic methods that include supportive work environments, policies that cater to the demands of various labour force demographic groupings, and intrinsic job value. Beyond individual employees, sustainable employment has ramifications for measures that boost job satisfaction and support under-represented groups (Hailu, 2024).

To be competitive in the job market, employees must be competent to adapt their expertise and skills under the ongoing changes brought about by economic conditions and technological breakthroughs (Gavriluță et al., 2022). To be employable, one must possess a comprehensive set of personal traits, professional competencies, and interpersonal skills. Both technical and soft skills—such as problem-solving, emotional intelligence, and critical thinking—are essential for employability, according to Soundararajan et al. (2021). Seven essential employable skills are listed by Nugraha et al. (2020): basic skills, information and communication technology (ICT) abilities, resource management skills, interpersonal skills, thinking skills, and personal attributes. This implies that employability is improved by both hard and soft abilities. The ability to traverse career paths and make well-informed judgements on professional development is known as career management abilities (Tomlinson, 2017). By matching educational programs with market demands, partnerships between industry and higher education institutions can improve graduates' employability (Leadbeatter et al., 2023). But according to Tejan & Sabil (2019), employability is influenced by a variety of factors, including industry demands, economic situations, and the capacity to think critically, be creative, collaborate with others, and communicate effectively. As a result, sustained work is not just a personal objective but also a social necessity that calls for cooperation from companies, legislators, and academic institutions.

2.6 Impact of Industrial-Universities Linkages on Sustainable Employment

Links between academia and business help to create long-term jobs by bridging the knowledge gap between academia and real-world business demands. It takes the shape of skill development innovation and technology transfer, which improves long-term employability and economic growth (Guo, 2024). Once more, internships give students a competitive edge when applying for jobs and help them develop new abilities (Odigbo & Ismail, 2019; Agbo & Nnajiofor, 2023). Students' entrepreneurial abilities are improved by UILs, while the industry gains from cutting-edge innovations (Soam, 2023). Although there are differences between nations because of economic development, research indicates that UIL fosters sustainable employment by boosting innovation, economic growth, and employability. However, UIC is unable to have a favourable effect on employment sustainability. Occasionally, it has been demonstrated that industry-academia collaboration lowers innovation efficiency, particularly in regions with less developed innovation abilities (Hou et al., 2018). Additionally, even though UIC typically boosts company performance and creativity, there are often obstacles that hinder academia and industry from collaborating successfully, such as differences in organisational culture and relationship styles (Lauvås & Rasmussen, 2022). However, the overall trend indicates that businesses and academic institutions can collaborate to create strategic partnerships that support job creation and long-term economic expansion (Guo, 2024; Soam et al., 2023).

A review of the literature indicates that links between academia and business greatly increase employability. These collaborations improve students' employability and skills, according to research (Ngesi et al., 2024; Soam et al., 2023; Igbongidi, 2023; Matsouka & Mihail, 2016); they also assist in aligning academic curricula with industry expectations (Igbongidi, 2023; Nguyen et al., 2022). However, there are disparities in employability (Singh, 2023). An institution's location, autonomy, embeddedness, and size all affect how effective it is. (Borah et al., 2020).

H_1: University-industry linkages have a positive relationship with sustainable employment

2.7 Funding as a Mediator between University-Industry and Sustainable Employment

The connection between university-industry ties and long-term job results is significantly mediated by funding. Facilitating collaborative research, improving graduates' employability skills, and encouraging innovation that meets industry demands are all requirements for funding as a mediation mechanism. Both the government and business can provide financial resources (Rybnicek & Königsgruber, 2018). The funds are typically utilised to support joint research initiatives, infrastructure investments, and research activities, all of which have an impact on the number and calibre of university-industry partnerships as well as the development of employability. Collaboration in school and internship opportunities, which are frequently supported by industry partners, can help students become more employable by giving them real-world experience and abilities that employers greatly value (Wang et al., 2021).

According to research, students who take part in these programs have a higher chance of finding work after graduation since they have the practical experience and professional networks that employers look for. Participation in the industry improves graduates' skill acquisition and increases their marketability (Kitagawa, 2017). Universities can promote innovation that results in the production of new goods and services, which in turn creates job possibilities, by obtaining funding for research and development initiatives (Assbring & Nuur, 2017). University-industry partnership frequently leads to the commercialisation of research findings, generating employment and stimulating regional economic growth (Al-Kfairy et al., 2022).

H_3: Sustainable funding has a positive relationship with sustainable employment

2.8 Determinant of University-industry Linkages

According to Trunina et al. (2020), the primary factors influencing the university sector are the research, financial, and organisational capabilities of universities as well as a common goal. Furthermore, universities and businesses can work together more effectively if faculty members engaged in research projects—especially those supported by the corporate sector—have fewer teaching responsibilities and are encouraged to publish in high-impact journals (Alrajhi & Aydin, 2019). Financial capacity, organisational capacity, research capacity, institutional processes, geographic proximity, researcher competency, and experience were among the ones used in the study.

2.8 Financial Capacity

According to Trunina et al. (2020), the university industry's main determinants include research, financial, and organizational capacity. Financial capacity refers to the resources universities and industries must invest in collaborative projects. Universities with robust financial resources can invest in research facilities, hire skilled personnel, and develop programs that align with industry needs, thereby enhancing their attractiveness as partners for industry (Sierra & Villazul, 2018). For instance, research parks and innovation centers funded by universities can serve as platforms for collaboration, providing the necessary infrastructure for joint projects (Sjöö & Hellström, 2019). Furthermore, financial incentives for researchers, such as grants and funding for joint projects, can stimulate collaboration by lowering the barriers to entry for both parties (Puerta-Sierra & Villazul, 2020). In regions where universities are seen as key players in the innovation ecosystem, their financial investments can significantly influence the extent and quality of UILs (Pavlova & Burenina, 2016).

2.8.1 Organizational Capacity

It pertains to the structures, processes, and expertise that facilitate collaboration. Organizational capacity encompasses the institutional frameworks, management expertise, and support systems that facilitate effective collaboration. A well-structured liaison office within a university can enhance networking capabilities and provide essential support for industry partnerships (Sjöö & Hellström, 2019). Additionally, the presence of dedicated personnel who understand both academic and industrial contexts can bridge the gap between the two sectors, fostering trust and communication (Plewa et al., 2013). Effective governance structures that promote strategic planning and collaboration among management boards of universities and industries are also crucial (Odigbo & Ismail, 2019). For example, the establishment of policies that encourage joint research initiatives and the sharing of resources can significantly enhance organizational capacity and, subsequently, the success of UILs (Agbo & Nnajiofor, 2023).

2.8.2 Research Capacity

Influences the effectiveness of university-industry linkages, this capacity encompasses various dimensions, including the quality of research output, the expertise of researchers, and the institutional frameworks that support collaborative efforts. High-quality research not only enhances the reputation of academic institutions but also attracts industry partners seeking innovative solutions to complex problems. Furthermore, the ability of universities to produce applicable research that meets industry needs is a strong predictor of successful partnerships (Muscio, 2013). Researchers who possess strong technical skills and a deep understanding of industry requirements are more likely to initiate and sustain collaborations with industry partners (Ting et al., 2019). This competence allows them to effectively communicate their research findings and align their work with the strategic goals of industry stakeholders. Moreover, the establishment of research centres with explicit missions to promote collaboration can enhance the overall research capacity of universities, providing structured environments for joint projects and innovation (Lind et al., 2013). Additionally, the institutional frameworks that govern university-industry collaborations are essential since an effective governance structure that promotes strategic planning and resource allocation can facilitate smoother interactions between academia and industry (Rossi, 2010; Villani et al., 2017). These frameworks can also include policies that encourage joint research initiatives and provide funding for collaborative projects, thereby enhancing the research capacity of both universities and industries (Kurdve et al., 2020).

2.8.3 Geographical Proximity

Is a significant determinant of UILs, as it facilitates knowledge spillovers and enhances the likelihood of collaboration. According to D'Este & Iammarino (2010) geographical closeness has an impact on collaboration Muscio (2013) reinforces this notion geographical proximity enhances collaboration frequency

2.8.4 Institutional Mechanisms

Furthermore, Agbo & Nnajiofor (2023) emphasize that skills and knowledge transfer can occur through multiple channels, including joint research, industry-sponsored projects, and temporary exchanges of researchers, which are essential for creating robust UILs.

2.8.5 Researcher Competence and Experience

Ting et al. (2019) assert that the competence, experience, and domain knowledge of researchers significantly influence the success of collaborations. This is echoed by (Bellini et al., 2018), who suggest that the previous experience of researchers in knowledge transfer channels can affect the outcomes of university-industry collaborations. Research indicates that universities with professors who have prior industry experience are better positioned to facilitate effective partnerships, as they can bridge the gap between academic and industrial expectations (Shenkoya, Hwang, & Sung, 2023).

2.8.6 The Strategic Orientation

of both universities and industries is crucial in shaping UILs. According to (Fallah et al., 2020), the relationship between universities and industries is often underdeveloped, particularly in certain regions, which can hinder collaborative efforts. This is further supported by (Wang et al., 2020), who discuss how the motivations for collaboration can be strategically aligned with funding opportunities. The alignment of goals and expectations between universities and industries is essential for fostering a collaborative environment conducive to innovation and technology transfer

2.8.7 Intellectual Property Policy

Additionally, institutional policies regarding intellectual property (IP) play a critical role; transparent and flexible IP policies are essential for building trust between universities and industry partners, particularly in sectors like biotechnology where IP disputes are common (Bstieler et al., 2014).

2.8.8 Competence of Researchers

Moreover, the competencies of researchers are pivotal in determining the success of university-industry collaborations. Researchers with strong technical skills and prior experience in collaborative projects are likelier to engage successfully with industry (Ting et al., 2019). The so-called "Matthew effect" suggests that well-connected and competent researchers tend to attract more industry projects, thereby reinforcing existing disparities in collaboration opportunities among researchers (Ting et al., 2019). This highlights the need for universities to invest in developing researcher competencies and providing incentives for collaboration to level the playing field. Trust is another critical factor influencing university-industry linkages. The formation of trust is often contingent upon previous collaborative experiences and the perceived reliability of partners (Bellini et al., 2018). Trust can mitigate potential conflicts and enhance the willingness of both parties to engage in joint projects.

2.8.9 Interpersonal Relationship

Furthermore, fostering interpersonal relationships through networking can significantly impact collaboration success, as personal connections often facilitate smoother communication and understanding between university and industry stakeholders (Rybnicek & Königsgruber, 2018). The socio-economic context also plays a significant role in shaping university-industry interactions. In regions where industries are less inclined to collaborate with universities, such as in some developing countries, the relationship is often characterized by skepticism from both sides (Fallah et al., 2020). Conversely, in regions with a robust innovation ecosystem, such as in advanced economies, collaboration is often seen as mutually beneficial, leading to enhanced funding opportunities and access to resources for both parties (Rybnicek & Königsgruber, 2018).

2.9 Conceptual Framework

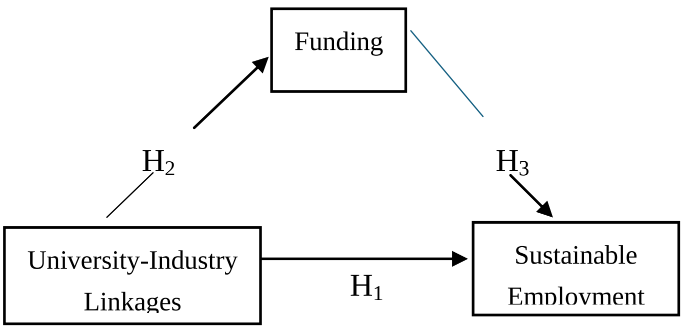

Figure 1. Conceptual Framework (Field Data, 2024)

3. Methodology

3.1 Research Design

This research is explanatory, quantitative, and cross-sectional. The survey method was used for data collection. Data were gathered from CCTU lecturers and selected industries linked to CCTU. The research design adopted for the study was triangulation (mixed method). Triangulation, or mixed methods is the integration of qualitative and quantitative approaches to capitalise on each strength and weakness. (Munhurrun & Durbarry, 2017). It involves the use of multiple data sources or methods to enhance the credibility and reliability of research findings (Aramo-Immonen, 2013). It provides a more comprehensive understanding of complex phenomena, and leads to more robust and credible results, as it addresses the limitations of individual methods (Turner et al., 2017).

3.2 Population of the Study

The targeted population consisted of CCTU lecturers (N=175) with a sample of n=120 and 5 managers selected from organisations that have collaborated with CCTU.

3.3 Sample Size Determination

The sample size was determined using Cochran's Sample Size Formula

p =Proportion of the population which has the attribute in questions (0.5 – 95% Confidence level)

Z = 1.96

q =1 – p (0.5)

e= Margin of error (5%)

$$n_o = \frac{Z^2\ pq}{e^2} = \frac{(1.96)^2\ (0.5)\ (0.5)}{0.05^2} = 384.16$$

$$n = \frac{n_0}{1 + \frac{(n_0\ -\ 1)}{N}} = \frac{384.16}{1 + \frac{383.16}{175}} = 120$$

3.4 Sampling Technique

Stratified sampling is a widely used technique in survey designs to improve convergence and increase precision in estimations (Jain et al., 2022). Stratified sampling has been applied in diverse fields, including economic surveys, and social sciences studies (Rashid et al., 2024). This approach involves dividing the population into homogeneous subgroups or strata before sampling, which can lead to more accurate and efficient results compared to simple random sampling (Khan et al., 2015). The adaptability of stratified sampling is meant to address complex sampling challenges and aid representativeness and data reliability (Saunders, Lewis & Thornhill, 2023).

Table 1. Stratification

	Schools in CCTU	No. of Lecturers	Proportional Sample
1.	School of Business	43	29
2.	School of Engineering	53	37
3.	School of Applied Arts	28	19
4.	School of Built & Natural Environment	23	16
5.	School of Applied Sciences & Technology	28	19
	Total	**175**	**120**

(Source: HR Section, 2024)

The simple random technique was used to select the respondents (lecturers) from the stratum. The five (5) managers of the companies that have collaborated with CCTU were selected using the purposive sampling technique since they possess the knowledge required for the study. (Saunders, Lewis & Thornhill, 2023). The 120 lecturers represent 68.57% which is a representation of the population of 175.

3.5 Instrumentation & Measurement Scale

The study used a Likert-scale-style measurement scale that was standardised and validated. It was divided into three sections: Section A dealt with demography; Section B addressed determinants of university-industry collaboration; and Section C addressed skills for sustained employability. areas of linkages, levels, and determinants of academic-industry linkages (Yilma1 &Alemu, 2018).

3.6 Data Collection Procedure

A standardised, verified questionnaire was used to gather data. Because self-administered questionnaires have the advantages of building rapport with respondents, having a high return rate, and providing participants with clarification on highly unclear items, they were used (Saunders, Lewis, and Thornhill, 2023; Bell, Bryman, & Harley, 2022).

3.7 Data Analysis

IBM SPSS (version 27) software and partial least squares structural equation modeling were used to analyse the data using descriptive and inferential statistics. According to Richter et al. (2022) and Wang et al. (2023), PLS-SEM is appropriate for research using intricate structural models with several constructs and indicators. According to Nitzel (2018), it is particularly helpful when working with archival data or formative measurements, when the theoretical foundation is poor, or during exploratory research stages. When the study's focus is on prediction, PLS-SEM is also suitable, especially for out-of-sample prediction to confirm external validity (Hair & Alamer, 2022). In management accounting, its use has increased recently (Nitzl, 2018). For complex models, non-normal distributions, or limited sample sizes, it is helpful (Wang et al., 2023; Hair & Alamer, 2022). Measurement models, structural models, and advanced analytical approaches are evaluated using a standardised process in SEM-PLS (Magno et al., 2022).

3.8 Ethical Consideration

To safeguard the rights and welfare of the respondents, ethical considerations serve as a means of improving the reliability, quality, and integrity of scientific research. Its purpose is to protect study participants' rights, confidentiality, and privacy. (Ahsan Ullah, 2022; Harnett, 2021). The participants were therefore asked for their agreement and were free to decline participation and remain anonymous (Ahsan Ullah, 2022). To sum up, ethical issues in research are a constant duty throughout the entire study process, not just a legal necessity. They include the values of fairness for all, respect for individuals, and care for the welfare of each person (Wang & Bickenbach, 2020). Researchers can safeguard participants' rights and welfare while maintaining their work's caliber and integrity by abiding by these ethical guidelines.

4. Results and Discussion

The results were analysed using descriptive statistics and the PLS-SEM technique to assess the measurement and structural models.

4.1 Demographics Characteristics

The targeted workers were lectures of CCTU and five managers of companies that had renewed standing collaboration with the university as of 2024. from three multinational firms in Ghana. The sample size was 175 and the sample size was 120. The questionnaires were retrieved from all 120 which constitutes a 100% return rate. In addition to the five (5) managers; the total number of questionnaires retrieved was 125. According to Table 2, men made up 64% of the total respondents, while women made up 36%. This sample had a high level of education since 205 (56%) had first degrees, master's, and professional certificates. The population ages were 30 – 40; (83) 66.4%, 41 – 50 (35) 28%, and 51 – 60 (7) 5.6% (see Table 2).

Table 2. Demographics Characteristics

Characteristics	**Freq.**	**%**	**Cum. %**
Gender:			
Male	80	64.0%	64.0
Female	45	36.0%	100.0
Total	**125**	**100.0**	
Education Qualification:			
Instructors	8	44.0	44.0
Masters	79	34.0	78.0
Ph. D	28	8.0	86,0
Professors	10	14.0	100.0
Total	**125**	**100.0**	
Age:			23.0
30 – 40	83	66.4	66.4
41 – 50	35	28,0	94.4
51 – 60	7	5.6	100.0

Total	**125**	**100.0**	
Schools/Companies			
School of Business	29	23.2	23.2
School of Engineering	37	29.6	52.8
School of Applied Arts	19	15.2	68.0
School of Built & Natural Environment	16	12.8	80.8
School of Applied Sciences & Technology	19	15.2	96.0
Companies	5	4	100.0
Total	**125**	**100.0**	

Source: Field Data, 2024

4.2 Levels of Linkages

Figure 2. Levels of Academic-Industry Collaborations

Out of the respondents, 105 representing 84% agreed that there are low academic-industry linkages.

4.3 Main Linkages

Figure 3. Main collaborations

Among the many types of academic-industry collaborations, the study results indicated that workshop seminars, publication reports, training courses, consulting services, and student internships were paramount in CCTU.

4.4 PLS-SEM Analysis

The PLS-SEM was adopted for data analysis, because of the intention to establish the relationship between the studied variables. Hair, et al., 2019). Chin, et al. (2020) proposed a two-step approach for the evaluation of PLS-SEM models: (i) the measurement evaluation and (ii) structural model evaluation. The reflective model was adopted in this study.

4.5 Measurement Model

In PLS-SEM, the measurement model evaluates the relationships between latent variables and their indicators. The validity and quality of study findings are assessed by the measurement model. It entails assessing the validity and dependability of construct measurements (Haji-Othman & Yusuff, 2022). As part of the measurement model evaluation, composite reliability and average variance extracted (AVE) are assessed to ascertain validity and reliability, respectively (Haji-Othman & Yusuff, 2022). The reflecting model was used in the study, which postulates that the construct produces the indicators (Hanafiah, 2020; Xu et al., 2019). Indicator reliability, internal consistency reliability, convergence validity, and discriminant validity are the reflective measures that researchers usually look at. Building a solid basis for structural model analysis and theory development requires a proper evaluation of the measurement model (Wang et al., 2023; Xu et al., 2019).

4.6 Validity & Reliability

Measurement model quality is evaluated using validity and reliability. Convergent, discriminant, and construct validity are used to assess validity. According to Azlis-Sani et al. (2013), construct validity looks at how well the measured items reflect the desired constructs. Average Variance Extracted (AVE) is used to assess convergent validity; values greater than

0.5 are indicative of strong convergent validity (Haji-Othman & Yusuff, 2022; Nabilla & Afifi, 2023). The Fornell-Larcker criterion or the Heterotrait-Monotrait (HTMT) ratio is frequently used to evaluate discriminant validity, which guarantees that constructs are unique and do not overlap (Azlis-Sani et al., 2013; Nabilla & Afifi, 2023). Using Cronbach's alpha and composite reliability, reliability is quantified. It is deemed satisfactory when composite reliability values are greater than 0.7 (Haji-Othman & Yusuff, 2022; Nabilla & Afifi, 2023). Additionally, for good reliability, Cronbach's alpha, an internal consistency measure, should be greater than 0.7 (Azlis-Sani et al., 2013; Henseler et al., 2016; & Nabilla & Afifi, 2023).

Table 3. Construct Reliability and Validity

Constructs	**Variables**	**Code**	**Cross Loadings**	**Cronb. alpha**	**rho_A**	**CR**	**AVE**
Access of Funding	**Funds**	FUN1	0.906	0.955	0.955	0.966	0.849
		FUN2	0.923				
		FUN3	0.923				
		FUN4	0.919				
		FUN5	0.935				
Determinants of UILs	**Interest of Academicians**	IOA1	0.908	0.950	0.951	0.962	0.833
		IOA2	0.916				
		IOA3	0.885				
		IOA4	0.925				
		IOA5	0.930				
	Previous experience	PE1	0.908	0.953	0.953	0.964	0.842
		PE2	0.913				
		PE3	0.926				
		PE4	0.918				
		PE5	0.923				
	Bureaucratic related factors	BRF1	0.911	0.957	0.957	0.967	0.853
		BRF2	0.922				
		BRF3	0.910				
		BRF4	0.935				
		BRF5	0.935				
	Availability of Collaborative Center	ACC1	0.924	0.957	0.957	0.967	0.853
		ACC2	0.911				
		ACC3	0.926				

		ACC4	0.923				
		ACC5	0.934				
	Communication with Industry	CI1	0.907	0.946	0.947	0.959	0.824
		CI2	0.899				
		CI3	0.913				
		CI4	0.913				
		CI5	0.905				
Sustainable Employment Skills	**Personal Qualities**	PQ1	0.923	0.958	0.958	0.967	0.855
		PQ2	0.901				
		PQ3	0.931				
		PQ4	0.931				
		PQ5	0.937				
	Core Skill	CS1	0.910	0.953	0.953	0.963	0.841
		CS2	0.916				
		CS3	0.935				
		CS4	0.910				
		CS5	0.913				
	Subject Knowledge	SK1	0.891	0.960	0.960	0.969	0.863
		SK2	0.900				
		SK3	0.904				
		SK4	0.912				
		SK5	0.903				

The average variance extracted (AVE) was used to test for convergent validity, and the threshold needed to be greater than 0.50. The percentage of variance that indicators of a specific construct match is known as convergent validity (Hair et al., 2019; Sarstedt et al., 2021). Each construct had convergent validity since the average variance extracted (AVE) values for all three variables were higher than the threshold value of 0.50 (see Table 1). The Cronbach's alpha values for all nine variables funds 0.955, academicians' interest 0.950, prior experience 0.953, bureaucratic related factors 0.957, collaborative centre availability 0.957, industry communication 0.946, personal qualities 0.958, core skill 0.953, and subject knowledge 0.960) showed that they were all considered reliable. Similarly, every variable's composite reliability was above 0.90, which is greater than the 0.70 threshold (see Table 3).

4.7 Discriminant Validity

Discriminant validity is the degree to which a collection of objects can differentiate one variable from another. Accordingly, discriminant validity characterises how a construct is different from other constructs in terms of how it correlates with other constructs and how its measured variables exclusively reflect this specific construct (Hair et al., 2021). There are several ways to quantify it, including Heterotrait-Monotrait (HTMT) (Henseler, Ringle, & Sinkovics, 2009), cross-loading, and the Fornell and Larcker criterion (Ab Hamid, Sami & Sidek, 2017). Using cross-loadings, the loading of the construct should be larger than their cross-loadings (Chin et al. (2020)

4.7.1 Fornell-Larcker Criterion

Henseler, Ringle, and Sinkovics (2009) state that the Fornell-Larcker criterion states that a model's indicators' variance is superior to its other constructs (Ab Hamid, Sami, & Sidek, 2017). According to Fornell and Larcker (1981), the Average Variance Extracted (AVE) of each latent construct needs to be greater than the highest squared correlations among all other constructs. Because the correlations of each construct are stronger than those of the others, this study demonstrates good discriminant validity. (Table. 2).

Table 4. Fornell-Larcker Criterion

	ACC	BRF	CI	CS	FUN	IOA	PE	PQ	SE	SK
ACC	**0.924**									
BRF	0.829	**0.923**								
CI	0.825	0.816	**0.907**							
CS	0.749	0.827	0.790	**0.917**						
FUN	0.790	0.836	0.829	0.812	**0.921**					
IOA	0.935	0.814	0.801	0.742	0.770	**0.913**				
PE	0.844	0.920	0.824	0.819	0.851	0.824	**0.918**			
PQ	0.809	0.815	0.939	0.808	0.814	0.784	0.818	**0.925**		
SE	0.807	0.860	0.886	0.962	0.850	0.791	0.855	0.924	**0.971**	
SK	0.748	0.816	0.803	0.938	0.801	0.734	0.807	0.833	0.971	**0.929**
UIL	0.948	0.938	0.911	0.840	0.872	0.935	0.944	0.890	0.898	0.836

Source: (Field Data, 2024)

4.7.2 Heterotrait–Monotrait (HTMT)

The HTMT was used to test discriminant validity, with a threshold of less than 0.85 (Hair et al., 2021) As noted by Heseler et al. (2015) suggested that an HTMT value below 0.90 signifies the establishment of discriminant validity and the reliability of the model. Since each of these thresholds has been reached, it can be said that the measurement model is dependable (see Table 3).

Table 5. Discriminant Validity HTMT

	ACC	BRF	CI	CS	FUN	IOA	PE	PQ	SE	SK
ACC										
BRF	0.866									
CI	0.867	0.858								
CS	0.784	0.867	0.832							
FUN	0.826	0.875	0.872	0.852						

IOA	0.980	0.853	0.843	0.779	0.807					
PE	0.883	0.963	0.868	0.860	0.891	0.865				
PQ	0.845	0.851	0.986	0.846	0.851	0.821	0.856			
SE	0.834	0.889	0.921	0.995	0.879	0.820	0.886	0.955		
SK	0.781	0.851	0.841	0.980	0.836	0.768	0.843	0.868	0.991	
UIL	0.976	0.965	0.944	0.867	0.898	0.966	0.974	0.917	0.915	0.859

Source: (Field Data, 2024)

4.8 Structural Model Assessment

The evaluation of the structural model comes when the measurement model has satisfied all the requirements. The proposed connections between latent variables in a study are represented by the structural model in PLS-SEM. It emphasises how constructions can be predicted from one another (Putra, 2022). It enables researchers to evaluate the direction and strength of correlations between constructs and test theoretical models (Kono & Sato, 2022). It is appropriate for exploratory research and studies that are focused on predictions since it provides flexibility about data requirements and model complexity (Hair & Alamer, 2022). The predictive usefulness of the model and the importance of path coefficients are two aspects of the structural model's evaluation (Cheah et al., 2020; Putra, 2022). It is employed to test the model fit, R square, f square, collinearity, and hypotheses.

4.8.1 Hypothesis Testing

Using SmartPLS, direct and mediating analyses were conducted to test the hypotheses. First, there is a direct correlation between sustainable employment (SE) and university-industry links (UILs). SE is directly impacted by UILs: β = 0.898, R^2 = 0.806, and p = <0.05. They were meaningful and constructive relationships. Additionally, following mediation, the findings showed that UIL and funds (FUN) have a positive relationship (R^2 = 0.760); funds and sustainable employment also have a positive relationship (β = 0.924; R^2 = 0.825) (see Table 4).

Table 6. Testing Hypotheses

Paths	**Original sample (O)**	**Sample mean (M)**	**Standard deviation (STDEV)**	**T statistics (|O/STDEV|)**	**P values**	**2.5%**	**97.5%**	**Decision**
UIL -> CS	0.863	0.863	0.018	48.543	0.000	0.949	0.971	Accepted
UIL -> PQ	0.829	0.829	0.022	37.048	0.000	0.783	0.871	Accepted
UIL -> SK	0.871	0.871	0.017	50.503	0.000	0.834	0.903	Accepted
UIL -> SE	0.898	0.898	0.016	55.039	0.000	0.862	0.927	Accepted

4.8.2 Collinearity

To evaluate multicollinearity in SEM-PLS, one additional method is to use variance inflation factors (VIF). The purpose of the test is to detect common method bias (Kock, 2017). It is employed in conjunction with average variance extracted (AVE) and composite reliability to assess the validity and reliability of their constructs (Haji-Othman & Yusuff, 2022).

Table 7. Collinearity (VIF)

Variable	VIF	Variable	VIF
ACC1	4.476	PE1	3.831
ACC2	3.997	PE2	3.930
ACC3	4.615	PE3	4.619
ACC4	4.486	PE4	4.218
ACC5	5.167	PE5	4.391
BRF1	3.910	PQ1	4.469
BRF2	4.394	PQ2	3.655
BRF3	3.915	PQ3	5.068
BRF5	5.240	PQ4	4.944
CI1	3.676	PQ5	5.554
CI2	3.889	SK1	4.428
CI3	3.848	SK2	4.369
CI4	3.878	SK3	5.008
CI5	3.641	SK4	5.280
CS1	3.997	SK5	5.645
CS2	4.179	IOA1	3.763
CS3	5.278	IOA2	4.100
CS4	3.979	IOA3	3.174
CS5	4.202	IOA4	4.495
FUN1	3.697	IOA5	4.695
FUN2	4.483		
FUN3	4.459		
FUN4	4.265		
FUN5	5.275		

Source: (Field Data, 2024)

Multiple collinearities are not a problem in the estimate model, as indicated by the variance inflation factors (VIF) values, which are less than 5 (Gefen et al. 2000).

5. Path Coefficient

Bootstrapping was used to assess the relevance of path coefficients and factor loading. In PLS-SEM, path coefficients show how strongly and in which direction latent variables in the structural model are related. These coefficients show the direct impacts of one construct on another and are comparable to standardized beta coefficients in regression analysis (Cho & Choi, 2020; Yuan et al., 2022). The inner and outer models are analysed using the path coefficient.

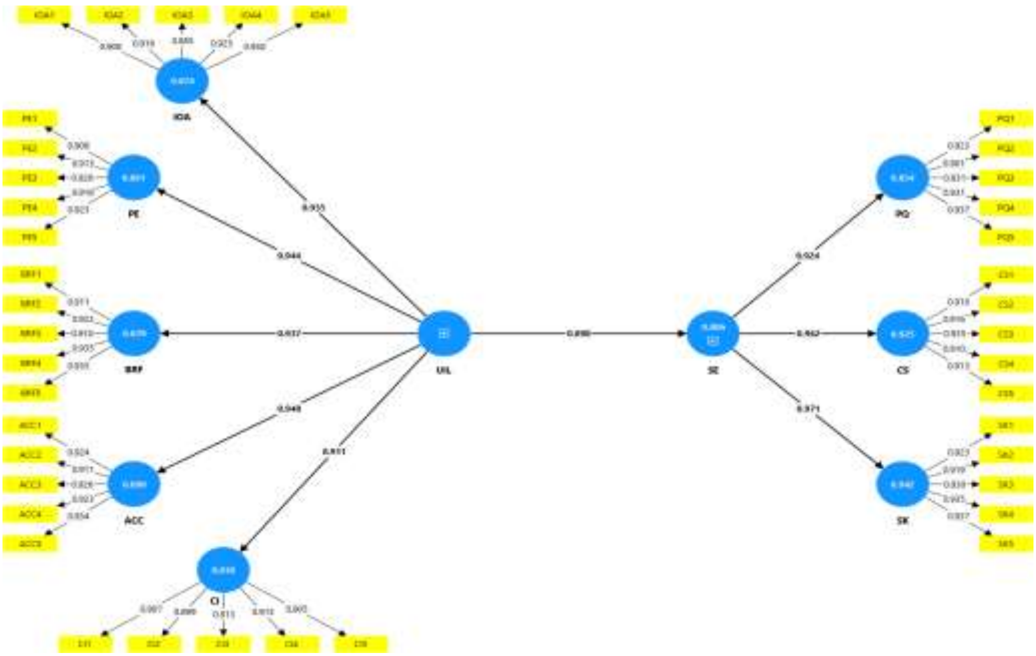

Figure 4. Path Coefficient without Mediation

Figure 2 depicts a positive strong correlation between the studied variables.

5.1 Mediating Analysis

According to Nitl et al. (2016) and Carrión et al. (2017), mediation is more advanced and enables more precise and nuanced interpretations of complicated interactions. One way to think of funding for sustainable employment and academia-industry links is as a sequential mediator. The study of Zhang et al. (2022), which found that government financial support positively influences political entrepreneurial risk-taking, is supported by this. Once the direct and indirect effects linkages between variables were examined, mediation was established (Magno et al., 2022).

5.2 Testing Mediation Effects

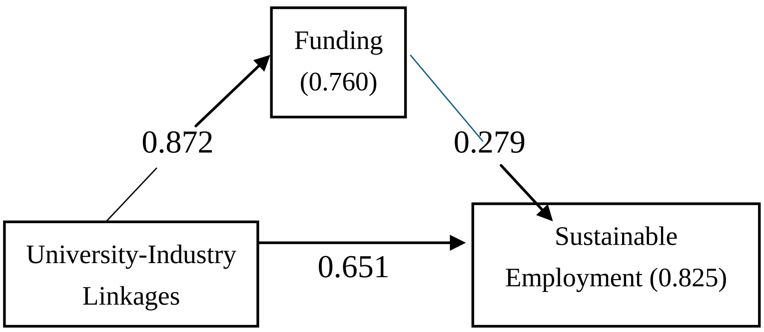

Figure 5. Hypotheses Testing

Table 8. Mediation Effect of Funding

	Path	Estimate
Total Effect	URLs -> FUN	0.872
	FUN -> SE	0.279
	URLs-> SE	0.651
Indirect Effect	UILs -> FUN -> SE	0.278

According to Hair et al (2019), the magnitude of mediation of a construct can be verified by using the Variance Accounted For (VAF). The VAF is computed as follows:

$$VAF = \frac{Indirect\ Effect}{(Direct\ Effect + Indirect\ Effect)}$$

$$Indirect\ Effect\ = Estimate\ of\ (UILs \dashrightarrow FUN) X\ (FUN$$

$$= 0.872\ X\ 0.279 = 0.243288$$

$$VAF = \frac{0.243288}{0.651 + 0.243288}$$

$$VAF = \frac{0.243288}{0.894288} = 0.272$$

Hair et al (2019) proposed that there is mediating effect is significant when the VAF is greater than 0.2; 0.2 – 0.8 partial effect and above 0.8 is full mediation. The mediation of funding between university-industry linkages and sustainable employment is significant since the VAF is greater than 0.2. The availability of funding for academic-industry linkages can boost sustainable employment since it will enhance innovation, transfer of knowledge, and entrepreneurial agenda.

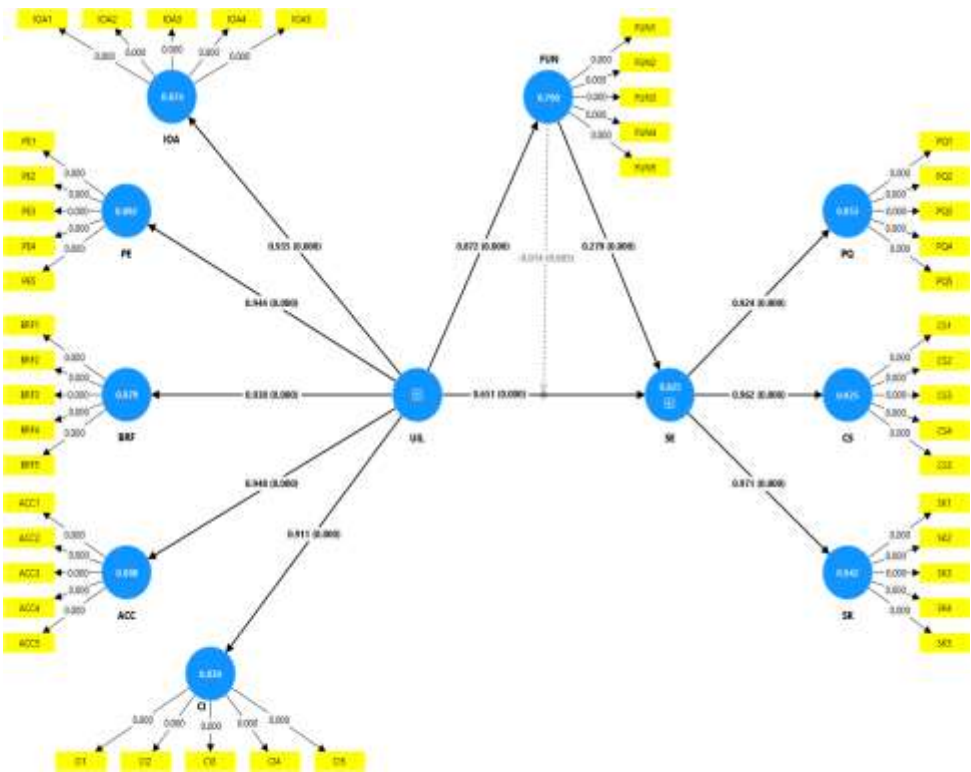

Figure 6. Path Coefficient with Mediation

The study is to investigate whether good effects mediate the association between UIL and sustainable employment. Bootstrapping was utilized to evaluate the mediation model using SEM-PLS. UIL is a positive predictor of sustained employability (UIL->SE, β=0.898 (95% CI:0.862, 0.927), t=55.03, p>0.05; R^2=0.806 (80.6%), according to results in Table 6. Additionally, the relationship between UIL->FUN->SE is strongly mediated by positive affect (β=0.898, 95% CI:0.862, 0.927), t=55.03, p>0.05.

Table 9. Hypotheses Testing

Paths	*β*	R^2	T statistics	P values	f^2	VIF	Remarks
UIL -> FUN	0.872	0.760	51.774	0.000	3.163	1.000	Accepted
UIL -> SE	0.655	0.825	55.058	0.000	0.588	4.163	Accepted
FUN -> SE	0.278	0.825	3.725	0.000	0.106	4.163	Accepted
UIL -> FUN -> SE (Mediation)	0.872 (0.278)	0.825	3.696	0.000	3.163 (0.106)	4.163	Accepted

Source: (Field Data, 2024)

UIL->SE, β=0.898, (95% CI:0.862, 0.927), t=55.03, p>0.05; $R^{2=}$0.806 (80.6%).

UIL->FUN ->SE, β=0.872 and 0.278, (95% CI:0.862, 0.927), t=3.696, p<0.05; R^2 = 0.825 (82.5%)

5.8 R square(R^2)

An essential metric for assessing the predictive performance of the structural model in PLS-SEM is R-square (R ²). It shows the amount of variation in the endogenous constructions that can be accounted for by all the associated exogenous constructs (Hair & Alamer, 2022). Cepeda-Carrion et al., (2018) suggested that an R2 value of more than 0.1 is indicative of the model's fitness. Higher R^2 values in PLS-SEM indicate higher prediction accuracy. Magno et al. (2022) state that R^2 values of 0.75, 0.50, and 0.25 are typically regarded as substantial, moderate, and weak, respectively. Other quality indices and assessment tools (f ²) include effect sizes (f ²) and predictive relevance (Q ²) (Kono & Sato, 2022). According to the R^2 before mediation, 80.6% of sustainable employment may be predicted by UIL. The R^2 was 82.5% when funds acted as a mediator between UIL and sustainable employment. Furthermore, Henseler, Ringle, & Sarstedt (2015) pointed out that the model's predictive usefulness was validated by a Q-Square value better than zero. (Refer to Table 7.)

Table 10. R square

	R-square	R-square adjusted
ACC	0.898	0.898
BRF	0.879	0.879
CI	0.830	0.830
CS	0.925	0.925
FUN	0.760	0.759

IOWA	0.872	0.873
PE	0.892	0.892
PQ	0.853	0.853
SE	0.825	0.824
SK	0.942	0.942

5.9 F-square (f^2)

PLS-SEM evaluates the influence of exogenous constructs on endogenous constructs in the structural model using the f-square effect size. When a particular exogenous construct is removed from the model, the f-square value shows how R-squared changes (Hair & Alamer, 2022; Magno et al., 2022). The following general rules apply when interpreting f-square values in PLS-SEM: 0.02: Minimal impact 0.15: Moderate impact 0.35: Significant impact. Beyond only statistical significance, these thresholds assist researchers in assessing the linkages in the model's practical significance (Kono & Sato, 2022; Ringle et al., 2020). To provide a thorough understanding of the relationships within the structural model, the f-square should be interpreted in conjunction with the R-squared and Q-squared (Magno et al., 2022; Rasoolimanesh et al., 2021; Hair & Alamer, 2022).

Table 11. F Square (f^2)

	f-square
	SE
FUN	0.107
UIL	0.563
FUN x UIL	0.001

From Table 8, the f^2 for funding was 0.107, 0.563 for university-industry linkages, and 0.001 for mediation of funding between linkages. This implies financial support or funding university-industry linkages is very substantial since it far exceeds the 0.35 large effect threshold.

5.10 Model Fit

PLS-SEM model fit assessment is an important aspect of evaluating the overall quality of the structural equation model. The model fit assessment aims to understand the underlying population mechanisms and draw statistical inferences (Schuberth et al., 2023).

Table 12. Model Fit

	Saturated model	**Estimated model**
SRMR	0.051	0.057
d_ULS	9.382	12.055
d_G	n/a	n/a
Chi-square	infinite	infinite
NFI	n/a	n/a

The model fit is assessed using the Standardised Root Mean Square Residual (SRMR) and a value less than 0.1 indicates the significance of the model fit (Hair et al., 2021).

5.11 Conclusion

The study aims to ascertain how university-industry collaboration affects sustainable employment, while also examining the role of finance or financial support as a mediator. Before mediation, the R^2 was 0.825 and the β was 0.651 for university-industry links. The use of finance as a mediator between UIL produced an R^2 of 0.279 and a score of 0.872. Funding's mediation effect on sustainable employment is $\beta=0.279$, and $R^2=0.825$. This assumes that subsidising university-industry connections is essential to long-term employment. University and industry managers need to strive for multi-level funding sources from various stakeholders. The goal of management and government policies is to encourage entrepreneurship to lower the high unemployment rate.

5.12 Managerial Implication

Universities face management issues because of the shift from traditional academic responsibilities to more entrepreneurial ones, particularly in developing nations (Sekerbayeva & Tamenova, 2021). There are important management ramifications to university-industry links (UILs), especially when financing is considered as a mediator. By combining expert knowledge and resources from both sectors, these partnerships can produce both concrete and intangible benefits. However, careful consideration of several elements is necessary for the proper management of these relationships. A key factor in enabling UILs is funding. When considering outliers in cooperation-intensive sectors, government funding is a strong predictor of university-industry collaboration. This means that to improve UILs, managers should actively look for and take advantage of government financing opportunities. Furthermore, by establishing suitable incentives and funding guidelines at the right levels, the "optimal" form of UIL portfolios should consider characteristics unique to each nation, area, and institution. This emphasises how crucial it is to put strong institutional structures in place to foster these links. Finally, managers who are active in UILs should concentrate on building strong relationships by considering how dynamic these connections are (Plewa et al., 2012). This involves investing in people and building trust, understanding, and communication as universal drivers of effective UILs. Accordingly, managers should also endeavour to clarify stakeholder responsibilities by building multi-level governance structures amongst ministries, universities, and municipal and regional governments. Through the proper utilisation of financing opportunities and the resolution of these managerial implications, companies can improve the impact and effectiveness of their university-industry partnerships.

5.13 Theoretical Implication

The theoretical implications of university-industry linkages incorporating Knowledge Spillover Theory, and the Triple Helix Model are significant for understanding innovation ecosystems and knowledge transfer processes. The Triple Helix Model emphasizes the importance of interactions between universities, industry, and government in fostering innovation and economic development. This model suggests that universities play a crucial role as primary sources of new knowledge, ideas, and innovation (Sekerbayeva & Tamenova, 2021). The Knowledge Spillover Theory complements this by explaining how knowledge generated in universities can "spill over" to industry, leading to technological advancements and economic growth. To comprehend innovation environments and information exchange workflows, university-industry links that incorporate information Spillover Theory and the Triple Helix Model have important theoretical ramifications. According to Sardana and Krishna (2006) and Sekerbayeva and Tamenova (2021), the Triple Helix Model highlights the significance of linkages among government, industry, and universities in promoting socioeconomic growth and technological breakthroughs. According to this approach, colleges are essential as origins of fresh insights, concepts, and inventions (Sekerbayeva & Tamenova, 2021). This is enhanced by the Knowledge Spillover Theory, which explains how knowledge produced in academic institutions can "spill over" to industry, resulting in economic expansion and developments in technology. The triple helix model in conjunction with knowledge spillover theory offers an extensive structure for comprehending linkages between academia and industry. Technology transfer offices, collaborative research institutes, and science parks are examples of procedures that emphasise the significance of knowledge transfer (Hailu, 2024). To improve innovation and knowledge transfer, future studies should concentrate on removing the obstacles to fruitful university-industry partnerships and investigating cutting-edge approaches such as the suggested Academia-Industry Collaboration Plan (AICP) design model (Ahmed et al., 2022).

5.14 Suggestion for Further Studies

The study of university-industry linkages covers many universities and industries in a longitudinal approach. The Academic-Industry Collaboration Plan should be the pivot for comprehensive study.

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