Essays on the Economics of Higher Education in Pakistan

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Dedication

This thesis is dedicated to

“My Loving Parents”

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Abbreviations

ATE	Average Treatment Effect
AJK	Azad Jammu and Kashmir
BIC	Business Incubation Center
BPS	Basic Pay Scale
CEE	Central and Eastern European
CPEC	China Pakistan Economic Corridor
ELTR	English Language Teaching Reforms
GCF	Grand Challenge Fund
HCI	Human Capital Index
HCT	Human Capital Theory
HDI	Human Development Index
HDI	Human Development Index
HEC	Higher Education Commission
HEIs	Higher Education Institutions
HRD	Human Resource Development
ICRG	Innovative & Collaborative Research Grant
ICT	Information and Communication Technology
IMR	Inverse Mills Ratio
IPFP	Interim Placement of Fresh PhDs
IPRs	Intellectual Property Rights
IRR	Incidence Rate Ratio

IRR	Incidence Rate Ratio
ISI	Institute for Scientific Information
ITM	Incentive Theory of Motivation
KE	Knowledge Economy
KI	Knowledge Index
KII	Key Informant Interview
KP	Khyber Pakhtunkhwa
KUST	Kohat University of Science and Technology
LCF	Local Challenge Fund
MDGs	Millennium Development Goals
MENA	Middle East and North Africa
MTDF	Medium-Term Development Framework
NAHE	National Academy of Higher Education
NIBAF	National Institute of Banking and Finance
NB	Negative Binomial
NUML	National University of Modern Languages
NUST	National University of Science and Technology
ORICs	Office of Research Innovation and Commercialization
PBAIRP	Problem Based Applied Interdisciplinary Research Program
PCA	Principal Component Analysis
POM	Potential Outcome Mean
QAU	Quaid e Azam University

QEC	Quality Enhancement Cell
SDGs	Sustainable Development Goals
SBP	State Bank of Pakistan
TF	Task Force
TFP	Total Factor Productivity
TTS	Tenure Track System
TTSF	Technology Transfer Support Fund
TTSR	Tenure Track System Ratio
UFE	University Fixed Effect
UNDP	United Nations Development Programme
UNESCO	United Nations Educational Scientific Cultural Organization
UOO	University of Orleans, France
WB	World Bank

Abstract

The Higher Education Commission (HEC) of Pakistan enacted important reforms offering scholarships for students and incentivizing teachers in public sector universities by adding the option of hiring through the Tenure Track System (TTS), which contains higher salary packages as compared to the Basic Pay Scale (BPS). Primarily, the aim of the incentive is to increase the quality of research productivity. This study consists of three research essays on the impact of TTS on higher education outcomes in Pakistan.

The first essay provides an overview of higher education in Pakistan. For that purpose, we utilize the data from the HEC and numerous other sources. The study uses trend analysis as its methodological framework and presents evidence suggesting that the HEC has played a significant role in promoting higher education (through these reforms?). HEC started its reforms in 2002 and set targets to improve access, relevancy, and quality. The number of universities, teaching faculty (both PhD and Non-PhD), academic research papers, citations, and PhD graduates increased, but efficiency did not rise to the desired level. Female enrollment also increased, from 36% in 2002 to 45% in 2020. Total enrollment increased from 0.27 million to 1.99 million in 2020. In addition to the trend analysis, we conducted Key Informant Interviews (KIIs) with **25** HEC officials who have been involved in policy implementation. The KIIs suggest that the deteriorating budgetary situation, lack of cooperation among public sector universities, and questions surrounding the HEC's autonomy are major challenges to the HEC in promoting an effective and inclusive higher education in Pakistan.

The second essay aims at estimating the consequences for their research productivity of university teachers' decisions to opt for the TTS mode of appointment as compared to BPS. For that purpose, we conducted an online survey of university teachers and obtained 359 responses. Six indicators of research productivity are used: a composite index for research productivity, an index for international research activities, an index for national level research activities, the number of PhDs produced, authorship of books, and the H-Index. The Heckman type treatment effect model is applied to try to obtain the counterfactual impact of TTS on research productivity as compared to BPS faculty at public sector universities. The results suggest that TTS hired teachers are more research productive than BPS-hired teachers.

The third and final essay focuses on estimating the impact of TTS mode of employment on research productivity at the university level. The treatment variable is the ratio of TTS faculty to the total faculty, while outcome variables include PhDs produced, H-Index, number of research papers published, and citations. The results indicate a linkage between universities with a higher ratio of TTS faculty with a higher level of research productivity. However, pertaining to the limitation of comprehensive data causality could not be established. While not definitive, the results of the study corroborate the literature that incentivizing university teachers, in our case through Tenure Track System, can lead to higher research productivity.

Key Words: *University, Research productivity, Citation, H-Index, faculty, Tenure Track.*

Chapter 01

Introduction

1.1 Background

After the completion of the Millennium Development Goals (MDGs) in 2015, the global leaders have pledged to achieve Sustainable Development Goals (SDGs). Out of total 17 SDGs, maintaining quality education for all has been set as SDG-4. Quality of education has been considered one of the key determinants of human capital. Human capital is one of the key drivers of economic growth as indicated in the theoretical framework of the first-generation endogenous growth models (Romer,1986; Lucas, 1988). Specifically, higher education boosts research and development which ultimately helps an economy to achieve high economic growth and development. As Sukhdev (2020) and Brinkley (2006) show that inventions and innovation turn the economy to a knowledge economy.

Keeping in view the global trend, as the growth strategy of global economies switch from resource base to knowledge base over the past few years, the theme of the knowledge economy has become a crucial and central point of discussion in Pakistan. Knowledge economy can be defined as this is an economic system where the production, distribution, and consumption of goods and services are highly dependent on knowledge, experience, and high level skills. It is considered as a source of economic growth and development, and competitiveness in all sectors. Technology revolutions, inventions, innovations, and globalization transform the contemporary economy into a "knowledge economy"[1]. In the knowledge economy, the business is governed by the new form of organizations and work of business, and it demands fast expansion of knowledge and skills. With the rise of the information-based economy, businesses have placed a greater emphasis on scarce resources and knowledge supply in order to improve corporate efficiency, competitive advantage, and efficacy in the economy (Podra *et al*, 2020; Hadad, 2017).

1 The knowledge economy is an economic indicator suggested by the World Bank Institute to measure a country's ability to generate, adapt, and diffuse knowledge.

Studies on the subject demonstrate that knowledge economy stands on four pillars– economic incentive and institutional regime, education and human resources, the innovation system, and information and communication technology (ICT (Debrulle & Maes, 2014; Bashir, 2013; Melnikas, 2010). The growth literature has reached on the consensus that knowledge is a main determinant to sustain long-run economic growth (Solow K Swan 1956; Romer, 1988; Lucas, 1988; Romer, 1989). Hence in order to sustain long run economic growth, countries have to improve the role of knowledge in their growth process.

Knowledge is deemed to be considered as an intangible instrument for sustainable organization. For that purpose, organizations keenly attempt to implement multiple policy interventions to update and improve the skills of the workforce through different trainings and harmonizing the workers with modern technological changes to maintain their capacity building. Such intervention programs have become an essential element for raising the organization's competitiveness and productivity (McConnell *et al.,* 2009). Therefore, enhancement of quality of human capital through formal and informal education, experience, and training is commonly exercised which does not only relate to acquiring existing knowledge, but also relates to creation of new knowledge that ultimately leads to economic growth and development. The stronger the literacy rate, the more the prosperity and economic growth and vice versa (Livingstone *et al.,* 2021; Matousek and Tzeremes, 2019; Vidotto *et al.,* 2017; Mankiw *et al.,* 1992; Lutz and Samir, 2011; Romer, 1986; Lucas, 1988; Mincer, 1981).

1.1.1 Higher Education and Incentives

In the early 2000s, the World Bank and UNESCO constituted a Task Force on higher education and society. A study by World Bank (2002) finds that, besides many other reasons behind having a low public access to education in developing countries, unqualified faculty and relevance issues are the key factors that explain lower quality of higher education. Moreover, the World Bank (2002) has suggested that developing countries need to formulate inclusive and effective policies to improve the quality of higher education by incentivizing the teaching faculty. To implement the World Bank report recommendations, HEC Pakistan has launched a number of higher education reforms. One of these reforms is to incentivize university faculty members to increase research productivity and improve quality of teaching and research.

Incentivizing the teachers and faculty is cursor to scale up the individual's productivity and prestige to organization (Derrick and Bryant, 2013). Evidence indicates that developing countries are offering multiple forms of incentives to higher education teaching faculty—research grants, trainings, attractive salary packages, promotions, and awards. Theoretically, the incentive theory tweaks the incentives to bring about an increase in concerned individuals (Kumar, P., *et al.,*1999).

Incentive theory began to emerge during the 1940s and 1950s building on the earlier drive theories produced by Psychologists such as Clark Hull. Although Adam Smith discussed the role of incentives two centuries before any formal incentive theory, however, it is in recent decades that incentive theory has emerged to place the problem at the center of economic thought (Laffont, and Martimort, 2002). Incentive theory explains that actions of individuals are motivated by a desire for external benefits. According to the incentive theory, people are drawn to activities that result in rewards and driven away from acts that may result in bad consequences (Ferster, C. B & Skinner B.F,1957).

The incentive theory of motivation states that a person's activity is usually motivated by what they will get as a result of their actions, such as recognition, promotion, or some other sort of reward (Ferster, C. B & Skinner B.F. 1957). Incentive theory relevance with this study justifies the incentives which are given to TTS faculty in form of salaries, promotions and supporting environment in universities as compared to BPS faculty. The TTS was introduced in 2003 to incentivize the faculty with higher pay, promotion, and viable environment as compared to BPS to boost up research productivity in Pakistani HEIs. Human capital theory (HCT) is more concerned with people, while ITM is more concerned with motivation for some incentives to get desired results.

Motivation broadly falls into two categories namely intrinsic motivation and extrinsic motivation. Intrinsic motivation is mainly defined as when someone is driven to do something because they want to get a reward or avoid punishment. Love, anger, and fear are examples of intrinsic motivation. Whereas extrinsic motivation explains that an activity is performed for its own sake and for personal reward. for instance, to study hard to get good grades (Killeen, 1981. Killeen, 1985). Most recently some studies have shown that incentivizing through different offers in higher education have increased the research productivity of the beneficiary teachers in

developing countries (Chen *et al.*, 2021; Zhao, 2021; Charness *et al.,* 2020; Fei, 2020; Wu *et al.,* 2020).

1.2 Higher Education in Pakistan

Human capital development in Pakistan has a historical perspective which dates back to the independence of the country. Pakistan and India adopted Indian Act 1935 at the time of independence, wherein special importance has been given to education. The Act stresses to achieve higher levels of literacy of both male and female population (Govt of India Act, 1935). Similarly, the subsequent constitutions (e.g., the constitutions promulgated in the years of 1956, 1962 and 1973) Pakistan has demonstrated, how legislation may ensure that all people have access to education. Between 1955 and 1998, incumbent governments in Pakistan developed five-year plans that prioritized maintaining adequate education, among other goals, in order to allow the economy to flourish. However, these five-year plans were only partially successful. The main reasons of failures consisted of political instability, economic volatility, demographic factors, and failure to implement institutional reforms (HEC, 2015-16).

On the whole, Pakistan has launched eight education policies. Although such policies might have brought some positive influences on literacy rate but failed to produce the desired results (HEC, 2015-16). In response to the request of academic community, Ministry of Education, Pakistan, had constituted a Task Force (TF) in April 2001, to review higher education and give recommendation for the improvement of the quality of higher education. The TF was given the task to prepare a comprehensive report on the status of higher education in Pakistan. One of the recommendations of the task force was to establish a Higher Education Commission (HEC) to overhaul higher education sector in Pakistan. Therefore, in the light of recommendation by the TF, government of Pakistan established the Higher Education Commission in 2002 to foster the level of higher education. The Commission is an autonomous body whose responsibility is to bring reforms and regulate higher education in Pakistan to obtain economic growth through tweaking of knowledge economy in the country. Pakistan's Medium-

Term Development Framework 2010-15[2] and HEC Vision 2025 both have acknowledged the importance of knowledge economy and its role in economic growth (HEC, 2015-16).

According to the HEC Vision 2025, the HEC has taken many initiatives to address the human capital shortfall in the country. Access to higher education has increased from 0.27 million in 2002 to 1.99 million in 2020. There is an enormous expansion in the number of higher education institutions (HEIs). In 1947, Pakistan had only one university, whereas by 2020, the number increased up to 230 Higher Education Institutes (HEIs) Out of which 142 belong to the public sector while 88 are from private sector (HEC, 2020).

Moreover, the HEC has launched reforms to meet the requirements of doctoral faculty members in universities. PhDs are produced through indigenous and foreign scholarships. It did not only increase the number of PhDs in the country but also increased the doctoral faculty in universities. Total full-time faculty in universities is 50249 (excluding part time faculty), out of which 32.3% hold PhD degrees whereas 67.7% are non-PhD faculty. Shortage of PhD faculty in Pakistani HEIs is an issue yet to be addressed (HEC, 2019). Furthermore, the HEC has initiated multiple incentive-based reforms to hire more competent and highly qualified faculty members against the existing mode of hiring in public universities which is commonly known as Basic Pay Scales (BPS). The most prominent incentive-based intervention is Tenure Track System (TTS) to flourish the overall quality of education and promote research in public universities.

1.2.1 Tenure Track System (TTS): The HEC's Reform

Since it came into being in 2002, the HEC has introduced monetary incentive-based mode of hiring against the prevailing system BPS. The TTS is purely a choice-based incentive which provides attractive monetary benefits to the newly or existing professoriates in public universities. The main objective of the TTS is to foster research activities and to promote quality education in public universities. According to estimated data released by HEC (2020), around 79% PhD faculty are working under BPS, while 21% are working under TTS policy.

Since professors were incentivized through TTS mode of employment, these incentives may have created positive impact in the higher education scenario. Teaching faculty has been

[2] https://www.researchgate.net/publication/236656045_Achievement_of_MDGs_under_MTDF_2005-10

increased both in public and private sectors at a fast pace. The main incentives which have been provided by the HEC to faculty members are increased research grants, funding for organizing workshops, seminars, foreign travel grants for presenting research papers, and other miscellaneous awards.

The TTS program was introduced by the HEC in 2003 to improve the quality of teaching, research and to attract capable and better qualified faculty so that they can contribute to Pakistan's higher education sector. It is expected that the TTS would replace BPS in public sector universities completely. The HEC and universities are striving hard for the successful implementation of TTS program at a large scale. In this regard, the system would be made financially more attractive and competitive for faculty recruitment, and the issues of promotion, retention and tenure would be resolved with consultation of stakeholders.

1.3 Objectives of the Study

The ongoing dissertation has maintained focus on conducting three research essays regarding higher education and research productivity in Pakistan. The specific objectives of these research essays are given as follows.

1.3.1 Research Essay 01

The paramount focus of first research essay is to explore the higher education reforms by Higher Education Commission (HEC) in Pakistan. The specific objectives of the underlying research essay are given as follows.

- To unfold and better understand the intricacies of the reforms implemented by Higher Education Commission (HEC).
- To explore the success and failure of HEC in achieving its targets since its inception in 2002.
- To investigate the key challenges which HEC has been facing in order to implement its policy agenda related to higher education.

1.3.2 Research Essay 02

The second research essay maintains focus on evaluating the impact of HEC's incentive-based mode of hiring, Tenure Track System (TTS), against conventional Basic Pay Scale (BPS) policy on research productivity of the university professoriate faculty members. The specific objectives of the ongoing research essay are given as follows.

- To construct a composite index to measure research productivity of university professoriate faculty members.
- To evaluate the impact of TTS policy on research productivity of university professoriates faculty members
- To examine the impact of TTS policy on research productivity by decomposing the composite research productivity index: research activities at international and national level, book-writing, H-index, and PhD produced.
- To compare the impact of TTS relative to BPS on research productivity index with respect to designation of faculty members and different disciplines (e.g., Social Sciences, Natural Sciences, and etc.).

1.3.3 Research Essay 03

Last research essay has focused to examine the performance of the university professors. This research assumes that the increasing research productivity of the TTS faculty members would enhance the research productivity of whole university, vice versa. Therefore, the ongoing research aims to investigate the influence of TTS policy on research productivity of the universities. The specific objectives of the third essay are given as follows.

- To evaluate the impact of TTS policy on research productivity at university level; and H-Index, Citation, Number of Papers published, and PhD produced.

1.4 Significance of Study

This study aims to contribute to the literature which empirically focusses on formation and evaluation of the policies on higher education in Pakistan. Specifically, the empirically obtained findings are envisaged to be helpful in the process of achieving the fourth goal of Sustainable Development Goal (SDG-4), which stresses ensuring education for all. In Pakistan the HEC is the leading authority which formulates the policies related to higher education. This study aims to prove helpful in the process of the Commission to review its policies regarding reforms in mode of hiring, as the first objective of the study would highlight the policy gaps and critical insights to let flourish the higher education and research quality in Pakistan which ultimately is expected to lead to the new avenues for knowledge economy.

Apart from policy perspectives, the empirical findings of this study contribute to the existing literature regarding human capital and knowledge economy by keeping in light the incentive theory. The literature, specifically linked to Pakistan, lacks rigorous empirical attention towards evaluating HEC's policies. Especially Tenure Track System (TTS) and BPS (Aman, 2011; Jawaid, 2016; Riaz *et al*., 2017; Ahmed *et al.,* 2021; Abbasi *et al*., 2021). This study aims to fill that gap and intends to encourage empirical focus towards evaluation of policies related to higher education in Pakistan.

The first essay maintains focus on estimating the historical role of the HEC in terms of producing PhDs, flourishing research activities amongst students and teachers, and allocation of research and recurring grants. In short, the first essay adds in the literature in outright policy conduits.

Likewise, to our knowledge, the second research essay is the first study of its kind which has conducted the impacts of TTS policy relative to BPS on university professoriates' research productivity. The supplementary contributions of the second research essays are as follows: 1) the study has constructed the composite index for measuring the research productivity of the university professoriates faculty members, 2) the study has measured the extended research activities and collaborations at national and international level which has invigorated the significance of the on-going research essay, and 3) the study has contributed to the available literature by empirical policy point of view, because the choice between BPS and TTS has

brought about the non-randomness in the model owing to the self-selection biasedness. Hence, the study has found the causal relationship between TTS policy relative to BPS and research productivity through implementing the counterfactual analysis.

The third and final research essay is the extended form of the second essay from individual level to the university level. The paramount concern of the research essay is to explore how impacts of TTS policy on teachers' productivity leads to the overall research productivity of the public sector university. Hence, to our knowledge, the third research essay is the first study of its kind which maintains impacts of the HEC's reforms in mode of hiring that influence the research environment and productivity at university level.

To sum up, the findings obtained from all these mentioned research objectives and their contribution to the literature are supposed to advise the HEC, other policy makers, and university-administration about policy agenda and initiatives to boost up the higher education and research productivity at both the national and international levels.

1.5 Scheme of Study

The subsequent parts of the dissertation include as follows: chapter 2 has weaved up detailed discussion on the structure of the mode of appointments in the public sector universities. The chapter 3 provides detailed and comprehensive discussion on research essay-1 wherein overall critical overview of the HEC reforms regarding higher education in Pakistan is provided. Likewise, chapter 4 is designed to contain detailed discussion on the research essay 02 which is about the impacts analysis of TTS reform on research productivity of teachers. Chapter 5 provides the third and final essay of the study while chapter 6 concludes the study.

Chapter 02

Mode of Appointment: An Overview

2.1 Introduction

Currently in Pakistan, in all public universities, two major modes of hiring are being followed by universities: permanent and contractual hiring. The permanent hiring i.e., comprises twofold: i) Basic Pay Scale (BPS) and Tenure Track System (TTS). The TTS mode was introduced by the HEC in 2003. So, this chapter aims at carrying out the comparison of the structure and modality of both the TTS and BPS. As second and third research essay of the underlying dissertation maintain the focus on evaluating the role of the TTS policy on research productivity of the teachers and university on the whole; therefore, the description of these two-hiring system is supposed to help evaluate their influences in effective way.

2.2 Tenure Track System (TTS):

The HEC has introduced TTS in universities, as part of a quality-improvement plan for higher education. The objective of this reform is to attract capable and better-qualified faculty, enhance the research productivity of the universities, and to recognize and reward better performance. It is expected that the TTS will replace BPS in public sector universities completely in the years to come. The HEC aims to make Tenure Track System (TTS) financially more attractive and competitive for faculty recruitment, the issues of promotion, retention and tenure would be resolved with consultation of stakeholders.

The first edition of the TTS statutes was developed in 2003, and a few universities adopted and implemented it in 2005. The TTS statues were amended later and in 2008 the final version named "Model Tenure Track Statutes, Version 2.0," was approved. This revised version is being followed by the public universities. The TTS has improved the number of PhDs produced by Pakistani higher education institutes (HEIs) over the last 16 years. It has shown some good results, most notably a change in academic attitudes toward research output and

competition. The mindset of both TTS faculty and BPS faculty has changed as well as that of the students who are thinking about their future careers. In 2005, only 95 faculty members were hired through TTS, but now 3410 faculty members are working under TTS. Similarly total faculty increased by tenfold since 2003. Similarly, the total number of PhDs awarded during the pre-TTS era (1947–2003) was surpassed in just 7 years (2003 to 2010). Finally, research productivity (i.e., the number of papers published) has risen from 949 in 2003 to 20,292 in 2020 (Banuri, T. 2020). The implementation of the TTS program is a big challenge for the HEC and universities. The status of the TTS program implementation in public sector universities is shown in table 2.1.

Table 2.1: Number of Public Sector HEIs that implemented TTS program during 2018-19

Province/Region	**Total Public Sector HEIs**	**HEIs with TTS**
Federal	15	11
Punjab	41	21
Khyber Pakhtunkhwa	29	19
Sindh	25	7
AJ&K	5	5
Balochistan	8	3
Gilgit-Baltistan	2	2
Total	125	68

Source: HEC, 2018-19

Table 2.2: Among Federal territory and provinces the Federal territory and Punjab province have the highest ratios of public sector universities that have adopted TTS program. 40.94%, 39.30% and 14.57% TTS faculty are placed in Federal, Punjab and Khyber Pakhtunkhwa regions respectively. AJK and Gilgit Baltistan, however, has implemented TTS program in all public sector universities. TTS has a good presence in universities of Khyber Pakhtunkhwa (KP). Sindh is the second-largest province in terms of population, but TTS is not familiar in universities. TTS has been introduced in three of the eight universities in Balochistan.

Table 2.2: Province/Region wise number of TTS faculty and Percentage during 2018-19

Province/Region	TTS Faculty	Percentage
Federal	1396	40.94
Punjab	1340	39.30
Khyber Pakhtunkhwa	497	14.57
AJ&K	58	1.70
Balochistan	56	1.64
Sindh	55	1.61
Gilgit Baltistan	8	0.23
Total	3410	100

Source: HEC, 2018-19

Over time, the number of TTS faculty has improved in public sector universities. There are 82 percent Assistant Professors of the total, 13 percent Associate Professors and 5 percent Professors. One of the reasons the number of Assistant Professors is the largest could be that TTS is offered to the rank of Assistant Professor and above. So, the starting point of recruitment under TTS is Assistant Professor. A PhD degree is needed for TTS faculty position. Similarly, Table 2.3 gives details of BPS faculty by designation who have not opted TTS.

Table 2.3: Number and Percentage of TTS and BPS faculty By Designation during 2018-19

Designation	BPS Faculty	TTS Faculty		
		Number	Share in Total TTS (%)	Share in Designation (%)
Assistant Professors	4468	2798	82	38.50
Associate Professors	1564	429	13	21.53
Professors	1520	183	5	10.75
Total	7552	3410	100	

Source: HEC, 2018-19

Initially TTS attracted many teachers but then the tendency declined. A strong determinant of the declined attraction of TTS is that perk and privilege remained static. As a result, researchers were therefore dissatisfied and are reluctant to choose TTS as a career. Other major concerns of the TTS faculty are the exclusion of non-salary benefits such as illegibility for administrative posts, pension, and health insurance and TTS faculty is also not satisfied with unjustified delay in acceptance of their promotion's proceedings. The success of TTS program is a challenge for HEC and universities. To make the TTS a success story, recently, the HEC has made changes in the TTS appointment and promotion terms and conditions (HEC, 2020). It's hoped that this improvement would make the TTS program attractive for PhD degree holders.

2.2.1 Modality of TTS

The TTS statues of Pakistan have been adapted from the tenure track statues published in the University of New Mexico faculty handbook. For appointment and promotion to higher rank in faculty, the candidate is assessed in terms of efficiency in four areas i.e., 1) Personal characteristics 2) Teaching 3) Service 4) Scholarship, Research, or other Creative work. Tenure track faculty members are appointed as Assistant Professor, Associate Professor and Professors.

2.2.1.1 Assistant Professor

For the appointment of Assistant Professor, a Ph.D. relevant terminal qualification from a recognized university is required. In addition, excellent written communication and presentation abilities are necessary for appointment as an Assistant Professor on Tenure Track (HEC, 2005). Assistant Professor should have command on the subject matter area of courses taught, and the candidate must show commitment to teaching. The Assistant Professor continues to improve

knowledge, teaching skills and professional presentation through professional organization via creative work and publications. TTS offers higher perks and privileges to the faculty members than conventional BPS. The promotion of TTS faculty is also fast as compared to BPS faculty.

As a general rule, the length of service in the rank of Assistant Professor before being considered for promotion to the rank of Associate Professor is six years. Recommendations for promotion after first term review should be carefully weighed and justified by the administrative officer for making such recommendation. However, in consultation with the HEC, the institute can modify tenure track rules in special circumstances, but these changes are to be minor and may not change the fundamental spirit of tenure track process. These changes must not compromise the merit and quality of higher education.

2.2.1.2 Associate Professor

To be eligible for appointment or promotion to an Associate Professorship, the candidate is required to have a PhD. terminal degree from recognized university/institution in the relevant field. In addition, the faculty is required to have 6 years' experience post-PhD/terminal degree or minimum of 4-years of post-PhD experience with at least 6 years of experience prior to the PhD.

The experience to be counted is of teaching or research in a recognized university or a post-graduate institution or professional experience in the relevant field in a national or international organization. As a general rule, the length of service in the rank of Associate Professor before being considered for promotion to full professor is four years. Recommendations for promotion in less time should be carefully weighed and justified by the administrative officer for making the recommendation. In addition, 10 research publications are also required for promotion to Associate Professor, with at least four research publications in the past 5 years in reputed HEC recognized journals.

2.2.1.3 Professor

A faculty member who is appointed as Professor on TTS is expected to have had an impact on the field of study. In addition, here another thing is added that such an appointment will be pivotal for nurturing many other qualities like teaching, research, and it would be taken as a pivotal source to enhance other aligned attributes as well. The professor should be keen about the university education, the relevant problems, and their possible solutions. It is also worth

mentioning that professors in any university are the key players, and they contribute to the development of the entire faculty.

In order to be appointed or promoted to Professor on TTS, a faculty member is required to have a PhD, relevant terminal degree from recognized local or foreign reputable university/institution along with 11 years Post PhD experience, or 7 years in those cases where a prior PhD experience is of 12 years. The experience should be of teaching or research in the relevant domain in the particular field from national or international organization. Furthermore, 15 research publications (with at least 5 publications in the past 5 years) in international journals recognized by the HEC is also a requirement.

As per the prescribed rules of the HEC, four years' experience is a requirement for the promotion to the post of Associate professor. While in a few cases where there is an earlier promotion is recommended, it would require a strong justification from the concerned officials (HEC; 2005).

2.3 Basic Pay Scale (BPS)

BPS system is the most commonly adopted method of appointment in public sector universities in the country. Prior to the TTS, all public university faculty members were on the BPS system. Presently, BPS faculty is 28257 out of 50249 total faculty, this is the highest number, in which 30% are PhDs and 70% are non-PhDs. In the past, under the BPS System, faculty positions at entry level did not require a PhD degree. Mostly BPS faculty are non-PhDs, in which 44 % are MS/M.Phil. (18 years of education) degree holders and 26 % are Master/Bachelor (17 & 16 years of Education) degree holders. It is a significant portion of university professors that still lack the necessary qualifications to teach in universities. Many Masters and Bachelors (16&17 years education) could not improve their qualification due to several reasons.

Table 2.4: PhD and Non-PhD BPS faculty in public sector HEIs during 2018-19

Degree	Faculty	Percentage
PhD	8456	30
MS/M.Phil. (18 years of Education)	12441	44
Bachelor/Master (17&16 Years of Education)	7360	26
Total	28257	100

Source: HEC, 2018-19

Presently, 56% faculty are on BPS out of total faculty, whereas, rest of faculty are on TTS, IPFP, Private Sector and contractual. Because of poor pay and lack of performance incentives, this structure was deemed insufficiently appealing. Promotions is made solely on the basis of seniority. Regardless of higher education or outstanding achievements in research or education, everybody had to stand in line. Since there were no senior positions available, many had to retire as |Assistant Professors (Banuri, 2020; HEC, 2018-19). A competitive research environment has been created after the introduction of the TTS system in universities. However, the BPS faculty has been concerned with the low salaries and slow promotion criteria. However, it is not possible to shift all BPS faculty to the TTS overnight.

2.3.1 Structure of BPS

The majority of faculty in Pakistan's public sector universities are on BPS mode of appointment. The BPS faculty in Pakistan are provided with a pensionable employment and medical benefits while the TTS has no pension facility, administrative post and medical benefits.

Following are the eligibility criteria for faculty appointments and promotions in all subjects in all HEIs/DAIs, excluding Engineering, Information Technology, Computing Sciences, Medical Sciences, Law, and Arts & Design /Studio Practice.

2.3.1.1 Lecturer

Minimum Qualification for Lectures in BPS mode of appointment is First-Class MS/MPhil/equivalent degree awarded after 18 Years of schooling within the relevant area from

HEC recognized University/Institution with no 3rd division in the academic career. For lecturer position experience and publications are not required.

2.3.1.2 Assistant Professor

Minimum Qualification for Assistant Professor in BPS mode of appointment is PhD in relevant subject from HEC recognized University/Institution. For Assistant Professor position, no experience is required as well as there is no publications' requirement.

2.3.1.3 Associate Professor

Minimum Qualification for Associate Professor is PhD within the applicable discipline from an HEC identified University/Institution. Further prerequisite requirements for the position of Associate Professor are 10-years teaching and research experience in an HEC recognized University or a postgraduate institution, or professional experience in the relevant subject in a National or International organization, or 5-years post-PhD teaching and research experience in the HEC recognized University or a post-graduate Institution or professional experience in relevant field in national or international organization. The faculty ought to have 10 publications (with at least four research papers are published in HEC recognized journal in the last 5 five years)[3].

2.3.1.4 Professor

Minimum Qualification for the appointment or promotion of Professor in BPS mode of appointment is PhD from HEC recognized university in the relevant discipline. For the position of Professor, the requirements are 15-years teaching and research experience in a HEC recognized university or post graduate institution or professional experience from national or international organization, or 10-years post-PhD. Teaching and research experience in a HEC recognized University or foreign university, or a post-graduate Institution or professional experience in the relevant discipline in a National or International organization. The applicant should have 15 publications in the HEC recognized journals (at least 5 research papers are published in last five years).

[3] https://hec.gov.pk/english/services/universities/QA/Pages/Faculty-Appointment-Criteria.aspx

2.4 Faculty in Pakistani Universities

Universities in Pakistan appoint teaching faculty mainly on Basic Pay Scale (BPS), Tenure Track System (TTS), private sector, contractual and visiting faculty. In universities, there are 50249 full time teaching faculty, 56% faculty are on BPS, 7% are on TTS, 32 % faculty are in Private Sector HEIs, 0.64% are on Interim Placement of Fresh PhDs (IPFP), and 4% are contractual faculty (HEC, 2019). Apart from that, a total of 9436 faculty members work on part-time in both public and private sector HEIs, which is 15.80% of the total faculty in HEIs during 2018-19.

Table 2.5: Number of Full Time Faculty members by Scale Type during 2018-19

Scale Type	PhD	Non-PhD	Total
BPS	8456	19801	28257
TTS	3410	N.A	3410
Private	3551	12631	16182
Contractual	508	1569	2077
IPFP	323	N.A	323
Total	16248	34001	50249

Source: HEC, 2018-19

In universities, during 2019, 16248 are PhDs faculty and 34001 are non-PhDs faculty. In terms of percentage, 32.3% are PhD faculty and 67.7% are Non-PhD. 52% of PhD faculty are in BPS and 21% of PhD faculty are in TTS. Similarly, 22% of PhD faculty work in private sector universities. The share of private sector of PhD faculty is not encouraging. It is recommended that the private sector ought to increase PhD faculty in private sector universities. The private sector has great potential to improve the key progress indicators of the higher education sector. The HEC, on the other hand, urges universities to hire more PhD professors, and recommends that the TTS should be the mode of appointment.

2.5 Concluding Remarks

The HEC has introduced the TTS policy with additional monetary benefits and rapid promotion relative to the prevailing BPS to enhance the research productivity of the university professoriates. It is one of the important initiatives of HEC which has created research culture in Pakistani universities. Working under the TTS is completely based on personal choice over BPS. This is the important aspect of both modes of hiring. The choice between these two brings about the problem of self-selection bias which is very important to tackle it out while we are formulating the empirical modelling to estimate their impacts. Hence, the chapter has described the structure of both TTS and BPS to understand them comprehensively.

Chapter 03:

Essay 01

Flourishing the Higher Education in Pakistan: An Exploratory Analysis of the Role of Higher Education Commission (HEC)

Abstract

The paramount aim of the underlying study is to explore the efficacy of the Higher Education Commission (HEC) through evaluating the effectiveness of the key initiatives which have been taken by the HEC to flourish higher education and research environment in Pakistan. Using exploratory analysis, the study unleashes that the higher education and research culture has improved since 2002 owing to the HEC's effective initiatives. These include, but are not limited to, increasing the capacity of in-service teaching faculty, induction of PhD faculty in public and private sector universities, award of indigenous and foreign scholarships, and provision of research grants, all of which had a positive influence on higher education through capacity building. A commendable increase in the number of universities along with the induction of highly qualified faculty, specifically the induction of indigenously produced PhDs, has been witnessed. Apart from these, the HEC has played an instrumental role in helping to improve the gender parity by 45% in the education sector. Moreover, in order to trace out what problems the HEC has been facing to implement its reforms, we conducted Key Informant Interviews (KIIs) to the HEC officials who have remained part of policy implementation. The KIIs discloses that the deteriorating budgetary allocation, less cooperation from public sector universities, and questioning the HEC's autonomy are the major challenges among others to the HEC in promoting an effective and inclusive higher education in Pakistan. The KIIs suggest that the autonomy of the HEC should not be compromised, and the liaison between universities and the HEC should be increased.

Key Words: *HEC, Educational Research and Development, KIIs, Exploratory Analysis*

3.1 Introduction

Education is considered as one of the key determinants of the quality of human capital. Specifically, higher education results in boosting research and development activity, which ultimately sets nations on higher economic growth and development trajectory. Higher level of innovations through creating a research environment, transforms countries into knowledge economies (Sukhdev, 2020; Marginson, 2010; Brinkley, 2006). Higher education is supposed to play a significant role in shaping the knowledge economy of any country. The existing literature highlights that knowledge-based economies, or alternatively countries with high quality human capital, have experienced higher levels of economic growth and development. Improvement in quality of higher education leads to better quality of human capital which ultimately contributes significantly to economic growth (Vidotto *et al.,* 2017; Lutz and Samir, 2011; Durrani and Forbes, 2003; Lucas, 1993).

Despite many challenges, higher education has witnessed tremendous growth and development since the inception of Higher Education Commission (HEC) in Pakistan (Qazi *et al.,* 2014). The HEC ordinance was passed in 2002 by Government of Pakistan to promote higher education in Pakistan. In addition, the Commission was empowered to formulate policies, guidelines, and priorities for universities in order to advocate, and publicize the need for tertiary education in the country. The Commission has been granted a complete authority and power to reform Pakistan's higher education system. According to an HEC report (2015-16), the HEC has been successful in increasing enrollment, hiring well-qualified faculty, increasing the research and educational collaborations at national and international levels, improving the ranking positions of universities at international level, and producing high quality human capital through indigenous and foreign scholarship programs.

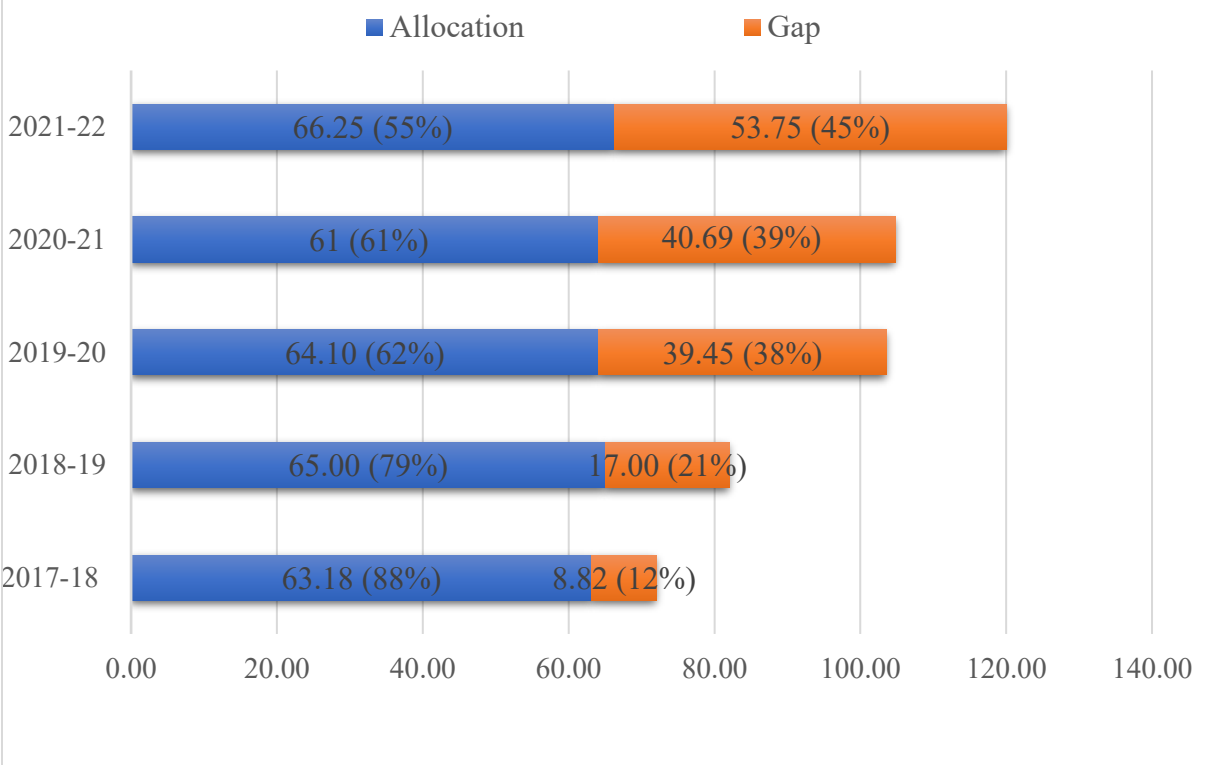
The HEC has taken various initiatives to revive teaching, curriculum, research, and the quality of higher education. The most important initiatives, are introduction of Tenure Track System (TTS), Interim Placement for Fresh PhDs (IPFP), International Research Support Initiative Program (IRSIP), National Research Program for Universities (NRPU), Local Challenge Fund (LCF), Technology Transfer Support Fund (TTSF), Grand Challenge Fund (GCF), Innovative & Collaborative Research Grant (ICRG), Technology Development Fund

(TDF), RAPID Research & Innovation Initiative (RRII), Problem Based Applied Interdisciplinary Research Program (PBAIRP), Outstanding Research Awards, Travel Grants for Presentation of Research Papers, HEC digital library, the establishment of new HEIs, establishment of Quality Enhancement Cells (QECs), establishment of the Office of Research Innovation and Commercialization (ORICs), establishment of Business Incubation Centers (BICs), and initiation of the indigenous and foreign scholarship schemes (HEC, 2015-16 and 2019).

Owing to the above-mentioned diversified initiatives, the HEC has changed the paradigm of higher education in Pakistan by promoting access, quality, and relevance of quality education. These initiatives have eventually created an impact on the quality of higher education sector in respect of access to higher education, teaching, curriculum, research (Jahangir, K. 2008; HEC, 2015-16). However, the HEC is also facing numerous challenges such as limited budgetary allocation, obstacles related to institutional autonomy, and lack of cooperation from some renowned public sector universities. Specifically, expansion of financial capacity is one of the most significant demands by HEC in order to implement the policy agenda to flourish higher education.

The HEC has been demanding higher budgetary allocation from every incumbent government of Pakistan. For instance, HEC demanded a budgetary allocation of PKR 120 billion, but only PKR 66.25 billion are allocated for the fiscal year of 2021-22 by federal government of Pakistan. Figure 3.1 demonstrates that the HEC budget ranges between PKR 63 billion to PKR 66 billion during the fiscal years 2017-18 to 2021-22 (Government of Pakistan). The graph also shows the gap of around PKR 53.75 billion (45%) during fiscal year 2021-22 in allocated and demanded budget by the Higher Education Commission. The figure also reveals that the gap between recurring demand and the allocated budget has increased tremendously (from 12% to 45%) in the last five years. In a nutshell, the government is allocating less funding to higher education, which does not meet universities demands.

Figure 3.1:Budgetary Allocation and Gap (Budget Demand) to HEC by Federal Government of Pakistan



Source: HEC 2021, Government of Pakistan

Given these limitations, the role of the HEC is inevitable in promoting higher education in the country. Consequently, the underlying study aims to conduct an exploratory analysis of the achievements of the HEC since it came into existence in 2002. Primarily, the focus of this study is to (i) identify the key reforms taken by the HEC to flourish higher education and research environment in Pakistan, (ii) to highlight the achievement made by the commission in this regard, and iii) to explore the key challenges the HEC is facing currently through in-depth interviews of key informants.

3.2 Data and Methodology

The nature of analysis and methodology followed in this essay is exploratory. The data utilized for descriptive analysis have been collected from both secondary and primary sources. The former are various relevant reports published by the HEC, and Government of Pakistan on a

range of indicators which include information on HEC reforms, higher education enrollment, establishment of Higher Education Institutions (HEIs), faculty hiring, PhD produced, and some other indicators which measure the achievement of HEC. The data has further been presented in graphs and tables to depict trends over the years, and to draw some meaningful conclusions.

In addition to the secondary data, primary data is gathered through conducting in-depth Key Informant Interviews (KIIs) with the HEC senior officials. The objective is to ascertain the nature of problems and bottlenecks the HEC is facing in implementing its policy agenda and to track the performance of the HEC in achieving its targets. All 25 respondents have been playing active roles in policy making, and they belong to all the four provinces i.e., Punjab, Sindh, Khyber Pakhtunkhwa, and Baluchistan.

In line with the objectives of the study, questions have been asked and verified through a checklist after detailed discussion with each of the respondents. The checklist includes three sections: i) questions related to the HEC goals and their accomplishment, ii) challenges the HEC is facing, and iii) questions regarding the effectiveness of Tenure Track System (TTS), mode of hiring, and policy. Therefore, the first two sections of the checklist are specific to the objectives of the study. These questions are related to the major challenges faced by HEC, the role of the HEC in developing linkages of universities with industry, its role in placement of PhD degree holders, measures the HEC is taking to improve the quality of education and research, and questions pertaining to the issues regarding budgetary allocation to the HEC. Furthermore, some questions regarding targets set by the HEC and their achievement have also been asked. In a nutshell, the overarching objective of the interviews is to critically investigate the role of the HEC in implementing an effective higher education policy agenda in Pakistan to improve the quality of education. Therefore, we have provided a situational analysis of the reforms implemented by the HEC and its achievements over the years. Later, certain conclusions have been drawn from the interviews to HEC officials.

3.3 Reforms by HEC and its Achievements: Situational Analysis

This section conducts situational analysis regarding what types of reforms the HEC has implemented and their accomplishment. The situational analysis has been conducted through demonstration of graphs and tables.

3.3.1 Key Reforms by Higher Education Commission (HEC).

The HEC has formulated multiple reforms to expand higher education and research environment in Pakistan. Some notable reforms are outlined as follows.

3.3.2 Faculty Development Programs

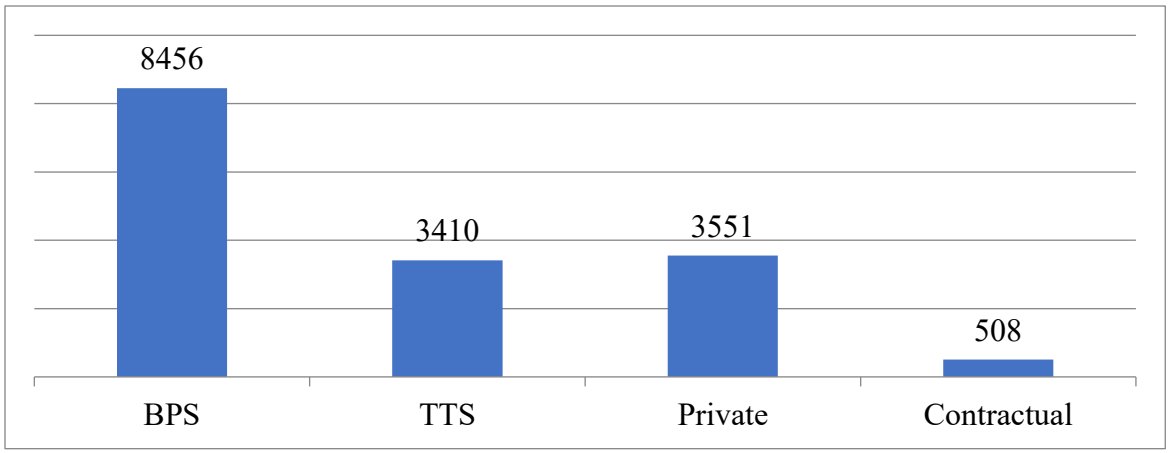
Human resource development is one of the most important components of the HEC reform process. shortly after its formulation, the HEC has made vital and significant progress in order to launch faculty development programs with twofold objectives of increasing institutional capacity and encouraging research activities. This also aimed to improve the academic qualification of the university teachers (HEC, 2015-16; Naqvi, 2010). Initially it was targeted, for 60 public sector universities, that each university must have faculty members of 300 to 400 PhDs, while at department level at least 15 to 20 PhDs before it can be considered as a legitimate "university". To develop a qualified cadre of bright young women and men, additional 15000 to 20,000 individuals were to graduate from foreign universities in the subjects of national priority over the next five years to carry out research and teaching activities at universities. The group was also supposed to provide consultancy to boost up industry in the country (HEC, 2003-04).

The HEC has reformed the mode of hiring of faculty at public sector universities and implemented Tenure Track System (TTS) against the conventional system of Basic Pay Scale (BPS). The new Tenure Track System (TTS) provides additional incentives to the teachers being inducted as well as existing faculty members at a university. The primary objective of the TTS is to promote quality higher education and research productivity by incentivizing teachers keeping in view the classical incentive theory.

Figure 3.2 demonstrates that 3410 PhD teaching faculty members are employed under TTS while 8456 teachers are working under BPS at public sector universities. Similarly, 3551

PhD faculty are hired by private universities, while 508 faculty members are working on contractual basis (HEC, 2020).

Figure 3.2: Number of PhD Faculty in Public Universities by Mode of Hiring



Source: (HEC, 2020)

Such faculty development programs have a positive impact on the induction of PhD faculty in public universities. As table 3.1 demonstrates, out of 7840 faculty members in higher education institutions (HEIs), there were only 2281 PhD in 2002-03, making it only 29.09% of total faculty members. Table 3.1 demonstrates that after the establishment of the HEC in 2002, a significant increase in the number of PhD faculty has been witnessed by HEIs. Similarly, an overall increase in total full-time faculty is also experienced by HEIs from 2002-03 to 2018-19. In 2020, 32.5% PhD faculty in universities and degree awarding institutions in the country. However, the target in MTDF-II was to have 40% of PhD faculty in HEIs by the end of 2015.

Table 3.1:Number of PhD and Non-PhD Faculty in Higher Education Institutions (HEIs)

Year	Ph.D. Faculty	Non-PhD faculty	Total Full Time Faculty	% PhD Faculty
2018-19	16478	35016	51494	32.00
2017-18	14507	32683	47190	30.74
2016-17	13975	33854	47829	29.22
2015-16	11960	31314	43274	27.64
2014-15	10133	27295	37428	27.07
2013-14	9475	25121	34596	27.39
2007-08	3,683	13,069	16,752	22.00
2002-03	2,281	5,559	7,840	29.09

Source: (HEC, 2020)

HEIs produce1600 PhD graduates per year (HEC, 2020). KIIs have informed that PhD faculty has increased enormously due to various reforms opted by the HEC. However, the desired level is yet to be achieved due to i) constrained level of funding, ii) brain drain at local and international level, iii) the over usage of non-PhDs visiting faculty in private universities, and iv) non-availability of required level of PhDs in specific subjects.

3.3.3 Local and International Scholarship Schemes

To fulfill the need of PhD faculty at universities, the HEC has started different indigenous and foreign scholarship schemes. Under Indigenous scholarship scheme, over 5000 scholarships have been awarded with special emphasis on the quality of PhDs. The objective of this scheme was to increase the PhD faculty in universities. This mega project was approved by the Executive Committee of the National Economic Council (ECNEC) on August 11, 2003. The total amount of the project was Rs.6402.767 million. A total of 5000 scholarships were awarded in five years. Almost every field of study in this endeavor, including science & technology,

humanities, agriculture, and life sciences, have been addressed (HEC, 2020). The list of local and foreign scholarships is presented in table 3.2.

Table 3.2: List of Scholarships Offered by HEC

Local Scholarship
• 5000 Indigenous PhD Fellowships • Development of Science & Technology Manpower through Indigenous 300 PhD Scholarships • Merit Scholarship Scheme for PhD Students in Science and Technology (200 Scholarships) • Scholarships for PhD Studies in Social Sciences, Arts and Humanities for University Teachers • Five Information Technology related HRD Scholarship Programs/Projects
Foreign Scholarships
• Overseas Scholarship Scheme for PhD in Selected Fields • PhD Scholarships for Sciences and Engineering in Germany • PhD Scholarships in Science, Technology and Engineering in Austria (Phase-I) • PhD Scholarships in Natural and Basic Sciences, Austria (Phase-II) • PhD in Natural & Basic Sciences in France • PhD Scholarships for Engineering Sciences, China • PhD Scholarships for Basic Sciences, China • Development of High-Level Science &Technology Manpower through Split PhD Program • Post-Doctoral Fellowship Program for University Teachers • MS/MPhil leading to PhD Scholarship in Engineering, Natural and Basic Sciences/Humanities/Social Sciences for the Teachers of Weaker Universities • Partial Support for PhD Studies Abroad • HRD Program for Strengthening of Universities/Institutes of Higher Learning • Strengthening the Existing Teaching Faculties of Public Universities and

Degree Awarding Institutes of Pakistan through Jointly Sponsored Scholarships Program of HEC & Asian Institute of Technology (Thailand) • Short Term Foreign Faculty Hiring Program / former Expatriate Faculty Hiring Program • Reclamation of Talented Pakistanis Working for Promotion of Teaching and Research in Professional Universities (Reverse Brain Drain) • Visiting Scholar Program • Transfer of Knowledge through Expatriate National Program

Source: (HEC, 2020)

According to HEC (2020), nineteen scholarship projects have successively been implemented by Higher Education Commission to increase the PhD faculty in universities. There are nine foreign scholarships and fellowship programs and ten indigenous programs being offered by the HEC.

3.3.4 In-Service Training Programs

Since its establishment in 2002, HEC has been making every attempt to foster academic vitality by offering educational and in-service training programs which maintain updating the skill level of university faculty. The empirical and theoretical literature emphasized on the importance of the training and skill development programs for employees (McConnell *et al.,* 2009). Therefore, in order to update the skill level of university faculty, the HEC has launched in-service training programs. National Academy of Higher Education (NAHE) project was launched by the HEC to enhance standard of teaching and learning at the universities in Pakistan. The NAHE organized trainings, workshops, and national conferences for the university faculty to improve the quality of teaching, research, learning methods and governance in higher education institutions (HEIs) in Pakistan. Moreover, faculty development programs have been commenced in order to enhance the capacity of faculty members. The faculty development programs contain such modules: i) professional development, ii) research methodologies, iii) testing & assessment, iv) curriculum planning & development, and v) teaching & communication skills, vi) international computer driving license, and vi) instructional resources. These programs have indicated beneficial influences on skill development of the faculty members of universities (HEC, 2020).

Apart from these, HEC has initiated the English Language Teaching Reforms Initiative (ELTR) in 2004 in order to improve the quality of teaching and learning at universities. For the English and Social Sciences faculty of colleges and universities, this was the first ever unique language-based program. This reform aimed at capacity building of English language and social sciences teaching faculty in colleges and universities in Pakistan for sustainable development. Two phases were completed under this initiative of HEC. Phase I catered to 1398 faculty members of colleges and universities. After completion of the ELTR Phase I, the HEC launched Phase II in 2010. The initial target was 1400 English faculty to be trained through short-term and long-term courses. Besides, many seminars and workshops have been arranged for faculty members of universities to align them with the latest development in teaching, pedagogical skills, and other contemporary issues. 20421(40%) faculty members of public and private sector universities participated in various short and long-term training programs (HEC, 2020).

The above discussion reveals that the HEC has formulated multiple reforms to enhance the enrollment, the number of PhD graduates, to promote research among students and faculty members. These reforms include in-service training programs, local and international scholarships, and faculty development programs. The most notable program regarding faculty development is the implementation of the TTS mode of hiring against prevailing BPS in public sector universities.

3.4 Capacity Building in Higher Education Institutions (HEIs) and the HEC

This section discusses the impact of reforms (discussed in the previous section) on the capacity building of HEIs in term of their numbers, enrollment rates, and PhD graduates.

3.4.1 HEC and Higher Education Institutions (HEIs)

According to HEC (2003), in 1947, Pakistan had only one university, The University of the Punjab, with the student enrollment of 644. There was no private university at that time. It was the fourth university that was established under the British colonial rule in the subcontinent. The British rulers established the first three universities at their strongholds of Bombay, Calcutta and Madras. After the war of independence in 1857, the University of the Punjab came into existence as result of a long-drawn struggle of the educators. The second university, established

in Pakistan in 1951, was the University of Sindh. In 1960, there were only 5 HEIs operating in the country.

Table 3.3: Number of Universities and Degree Awarding Institutions: Pre-and-Post HEC

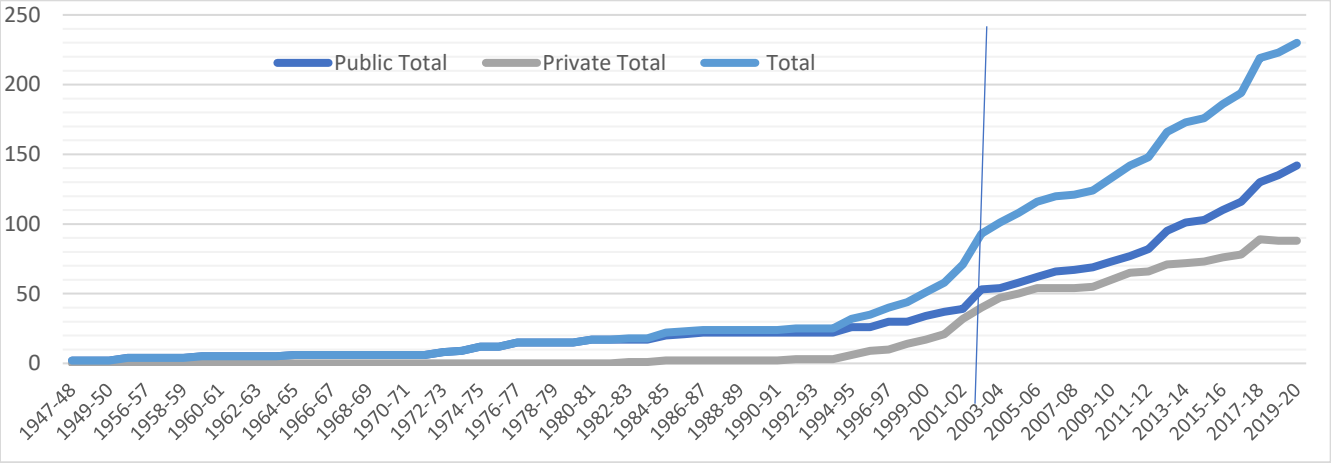
Year	Universities		DAIs		Total
	Public	Private	Public	Private	
Before the Establishment of HEC					
1947	1	0	0	0	1
1960	4	0	1	0	5
1980	15	0	2	0	17
1990	19	2	3	0	24
2002	47	27	7	13	94
After the Establishment of HEC					
2010	62	41	11	19	133
2020	124	60	18	28	230

Source: HEC, Pakistan

Table 3.3 contains the information on the number of universities and (degree awarding institutions) DAIs before and after the establishment of HEC (the year 2002) as the table shows a rapid growth in the number of Higher Education Institutions (HEIs) across Pakistan can be witnessed after the year 2002. The number has grown from 94 universities and DAIs in 2002 to 230 in 2020. It is an undeniable fact that Pakistan has witnesses an increase in establishment of new institutions since the inception of the Higher Education Commission (HEC) in 2002.

Likewise, figure-3.3 presents the bifurcation of HEIs into public and private sector universities in Pakistan. Trend analysis demonstrates that after the establishment of the HEC, an overwhelming increase in both public and private universities has been witnessed during 2002-03 to 2019-20. The number of public sector universities is higher than the private sector universities. the inception of HEC is plausibly of the key determinants of this increase in the number of public universities since 2002.

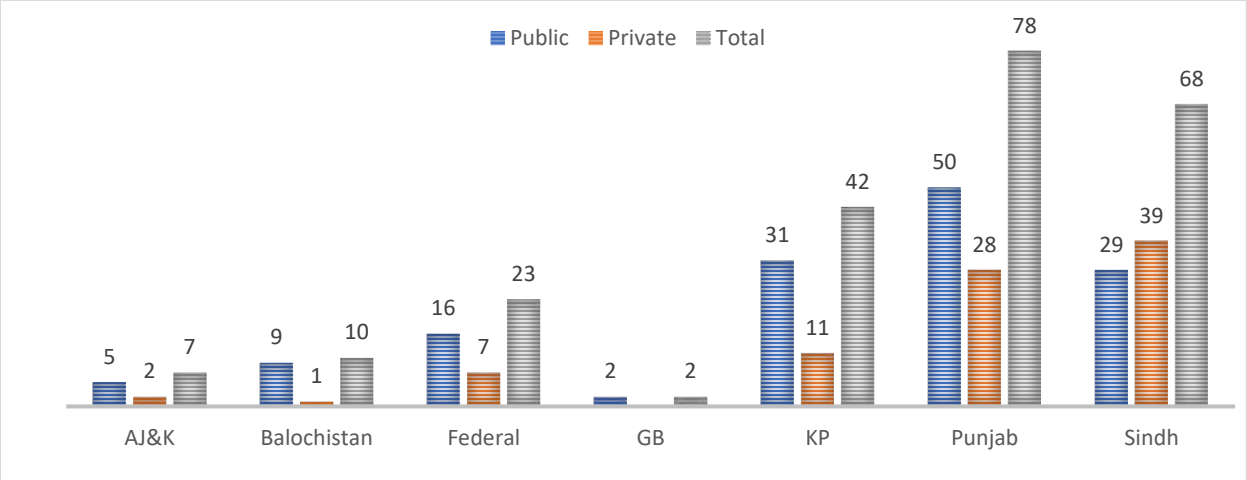
Figure 3.3: Number of HEIs Chartered from 1947-48 to 2019-20



Source: (HEC, 2020)

The underlying research identifies the construction of HEIs by provinces and other parts of the country in order to estimate the regional differences. Figure 3.4 highlights that Punjab province seems at top of the list wherein 78 HEIs have been established. The analysis for subsequent regions reveals that Sindh province has 68, Khyber Pakhtunkhwa has 42, Islamabad has 23, Balochistan has 10, Azad Jammu and Kashmir has 7 and Gilgit-Baltistan has 2 universities and degree awarding institutions.

Figure 3.4: Public and Private Sector HEIs at Sub-national Level in Pakistan during 2019-20



Source:(HEC, 2020)

This section determines the positive impacts of HEC policies on construction of HEIs in Pakistan which are precursor to boost up the higher education in Pakistan.

3.4.2 HEC and Higher Education Enrollment

A country with a population of approximately 220 million people is the sixth largest in the world. Pakistan. the country has limited natural resources and a struggling economy. 64 percent of its population comprises of young i.e., aged less than 30, and 29 percent of its population are between 15 and 29 years of age. Currently, Pakistan is the country which has the youngest population in the world and this trend is forecasted to continue till 2050 (World Bank, 2019)[4]. Therefore, providing proper opportunities through education to youth to turn them into an asset for the country is the most desirable objective for the policy makers in Pakistan (UNDP, 2018).

The HEC aims to provide and increase opportunities of equitable access for gender balanced and quality higher education to a larger part of the youth (17-23 years old) to enable them to participate in the development of the country. The foundation of the agenda of economic development is to invest in society to polish their cognitive skills, talents, and enhance their constructive competencies (HEC, 2014). Higher education sector of Pakistan has shown satisfactory progress in term of access to higher education. In 2002, only 2.5% of aged 17 to 23 years had access to higher education; by 2019, that number has risen to 11.5%. The HEC has steered numerical expansion of universities and degree awarding institutions from 94 HEIs in 2002 to 230 in 2020, increased enrollment from 0.0276 million in 2002 to 1.99 million in 2020, and it increased gender parity from 36% in 2002 to 45% in 2020 (HEC, 2020). Hence, table 3.4 presents annual increase in enrollment in public and private sector HEIs in Pakistan during 2001-02 to 2019-20. However, enrollment of affiliated colleges is not included in this data. The increase in enrollment over the years represents the demand in Pakistan for higher education. Despite its rapid growth, Pakistan lags behind India, Bangladesh, and Sri Lanka in terms of higher education access. To improve access to higher education in Pakistan, more practical and calculated efforts are needed (HEC, 2020).

[4] https://data.worldbank.org/indicator/SP.POP.1564.TO.ZS?locations=PK

Table 3.4: University Level Enrolment in Pakistan (Million)

Year	Male	Female	Total
2001-02	0.17	0.10	0.27
2002-03	0.20	0.13	0.33
2003-04	0.24	0.18	0.42
2009-10	0.52	0.43	0.95
2011-12	0.56	0.48	1.04
2012-13	0.62	0.52	1.14
2013-14	0.68	0.56	1.24
2014-15	0.72	0.58	1.30
2015-16	0.76	0.64	1.39
2016-17	0.84	0.65	1.49
2017-18	0.88	0.70	1.58
2018-19	1.03	0.82	1.85
2019-20*	1.09	0.9	1.99

Source: (HEC, 2020); *provisional

Table 3.5 presents percentage distribution of university enrollment in terms of region, university sector, and gender. It demonstrates that, in public and private sector universities, female students and students from Balochistan, Khyber-Pakhtunkhwa, and Sindh are underrepresented. The estimates highlight those female students from Balochistan in private and public institutions are 20% and 31% respectively. Similarly, 21% and 27%, respectively, are female students from Khyber-Pakhtunkhwa in private and public universities, while Sindh registered female students by 34% and 39% in public and private universities respectively. Thus, in these regions, female students are severely underrepresented, and their lack of access to higher education is a major concern.

In Punjab, female enrollment in private and public universities is 38% and 51%, respectively, while female students in Islamabad are observed by 41% and 50% in public and private universities respectively. Likewise, in Azad Jammu and Kashmir, female enrollment is

55% and 52% respectively (table 3.5). Two public sector universities run in Gilgit Baltistan, 50% male students and 50% female students are registered in these universities (HEC, 2019).

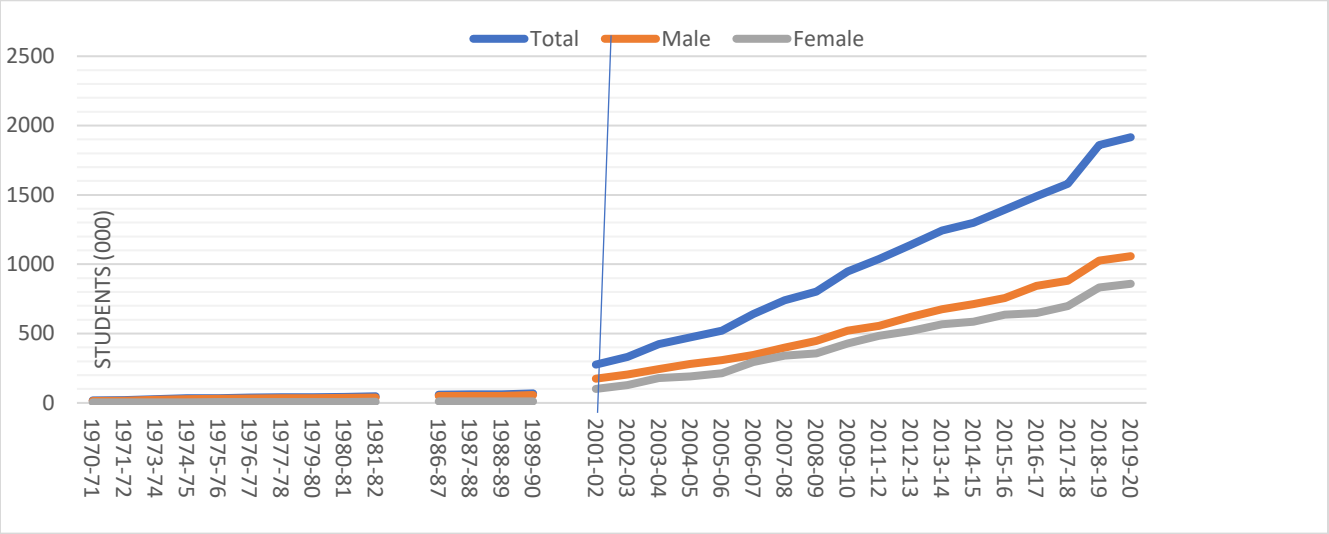
Table 3.5: Percentage Distribution of University Enrolment by Region, Sector, and Gender during 2018-19

Province/Region	Public		Private		Total	
	Male	Female	Male	Female	Male	Female
AJK	48	52	45	55	48	52
Balochistan	69	31	80	20	70	30
Federal	50	50	59	41	50	50
Gilgit Baltistan	50	50	0	0	50	50
Khyber Pakhtunkhwa	73	27	79	21	75	25
Punjab	49	51	62	38	53	47
Sindh	61	39	66	34	63	37
Total	53	47	65	35	55	45

Source: (HEC, 2020)

Figure 3.5 presents enrollment from 1971 to 2020, the graph shows sharp increase in enrollment after inception of the HEC. It is evident that the HEC is succeeded in refurbishing enrollment in HEIs. Despite of these reforms, positive shocks are needed to enhance enrollment to compete with the world in general and with South Asian countries in particular.

Figure 3.5: Enrollment in Pakistani HEIs by Gender over the Years



Source: (HEC, 2020)

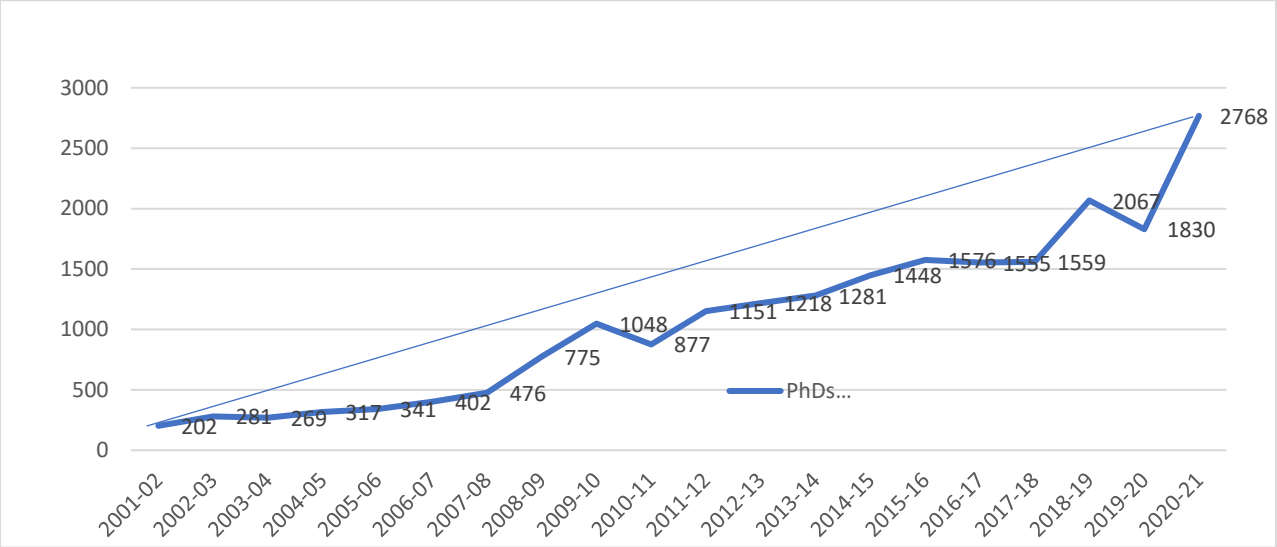
3.4.3 Producing PhDs

The HEC policies have brought a substantial increase in the university faculty in general and indigenously produced PhD graduates in particular. Moreover, the impact of the different HEC scholarships schemes implemented during last two decades is evidently demonstrating a sizeable increase in PhD graduates. Figure-3.6 exhibits that during 2002-03, 281 PhDs have been produced which have reached 2768 during the year of 2020-21.

The linear trend line helps to comprehend that after 2008-09, an overwhelming increasing trend for PhD completions is evidently observed which could be attributed to increase in budgetary allocation (in absolute term) of the HEC as compared to the previous years.[5]

[5] The HEC budget, in absolute terms, increased from 3.4 billion PKR in the year 2002-03 to 66.12 billion PKR in 2021-22.

Figure 3.6: Number of PhD Produced in Pakistan during 2000-01 to 2020-21



Source: Pakistan Economic Survey (2020-21) & HEC (2020)

Table 3.6 gives details about discipline wise PhD produced in the country since 1947 to date. It demonstrates that 6152 and 6229 PhDs have been produced in Physical Sciences and Social Sciences disciplines respectively. Similarly, 5266 PhDs have been produced in Biological, Medical Sciences and Pharmaceutics disciplines. Whereas only 1387 PhDs in the discipline of Engineering & Technology have been produced, along with 1266 PhDs in Management Sciences and Business Education. Therefore, the number of PhD graduates in the field of Engineering & Technology and Management Sciences need to be increased to cater to the high market demand in the country.

Table 3.6: Discipline wise PhDs Produced (P) by Pakistani HEIs since 1947

Disciplines	Female	Male	Total
Agriculture and Veterinary Sciences	470	2274	2744
Arts & Humanities	862	1910	2772
Biological, Medical Sciences and Pharmaceutics	2484	2782	5266
Management Science and Business Education	330	936	1266
Engineering & Technology	204	1183	1387
Honorary	4	125	129
Physical Sciences	2092	4060	6152
Social Sciences	1968	4261	6229
Total	8414	17531	25945

Source: (HEC, 2021)

3.4.4. Research and Development

The HEC has launched a series of research projects to promote the research culture in Pakistan. The promotion of university teaching faculty is linked with research paper publications which instigate the faculty to enhance their research activities. Despite this, at least one research paper publication has been made compulsory for PhD scholars before award of PhD degree. As a result, number of research publications have been increased since the year of 2002 onward (HEC, 2020). Moreover, the HEC has launched some programs related to research grants. In this regard, the key initiatives are outlined as: National Research Program for Universities (NRPU), Pak-France PERIDOT Research Program which for Pakistani researchers and PhD students visit France and carry out research in the universities in France, Scientific Instrumentation, Business Incubation Centers (BICs), Office of Research, Innovation and Commercialization (ORICs), Technology Development Fund (TDF), China Pakistan Economic Corridor (CPEC)-Collaborative Research Grant, Pak-TURK researchers mobility grant program, Grand Challenge Fund (GCF), Local Challenge Fund (LCF), Innovative & Collaborative Research Grant (ICRG), and Problem Based Applied Interdisciplinary Research Program (PBAIRP). These programs have created competitive environment in universities. Thousands of research proposals have

been received by the HEC. This shows high demand for funding and competitive research culture in universities (Khan, B. K., Mustafa, G., & Nawaz, A. 2021, HEC, 2020).

3.5 What HEC Thinks: Discussion on Interviews of HEC Officials

The previous section comprises discussion on situational analysis. Now, in order to learn the reasons of success and failure in achieving some of the HEC goals, we have conducted the key Informant Interviews (KIIs) with the HEC officials. The responses of Interviewees were carefully noted and managed. There were 25 interviews conducted with 25 officials of the HEC, including 02 Advisors, 04 Director Generals, 05 Directors, 06 Deputy Directors and 08 Assistant Directors. Each interview lasted for approximately one hour. The officials were from different divisions including Quality Assurance Division (QAD), Quality Assurance Agency (QAA), Higher Education Data Repository (HEDR), Human Resource Division (HRD) and Administration and Coordination (A&C) Division etc., covering the entire spectrum. This was an exciting experience of conducting interviews of HEC officials, when there was any ambiguity about the response of the respondent , he or she was approached again for clarification. Following are the main outcomes we have obtained from KIIs.

3.5.1 HEC Targets and Its Achievements

HEC Take on Access to Higher Education: The interviewed HEC officials disclose that 2.329 million enrollment target was set till 2020 in HEC Vision 2025, but this target is not achieved, the actual enrollment during 2020 has been observed as 1.99 million, which demonstrates the failure to achieve the targeted level. The respondents have shared multiple reasons behind failure in not achieving the desired level of enrollment: i) every incumbent government intends to support the HEC, but due to financial and economic constraints governments fail to support the HEC what governments have been pledging, ii) the HEC funds are static over the past few years, and iii) the failure of establishing new universities and sub campuses at required level, and iv) students' affordability.

Quality of Education in Universities: The HEC respondents admitted the concerns related to quality enhancement. They disclosed the reasons of deteriorating quality of education: i) some public universities are not fully cooperating with HEC, ii) most of the universities do not implement the HEC policies regarding quality enhancement since HEC is an advisory body not a

regulatory body, and iii) governance and leadership issues in universities which are also affecting the performance of universities.

Faculty Development: In various documents of the HEC, it has been emphasized on the need for the enhancement of PhD faculty in universities. In this regard, in MTDF-II (2010-2015) and HEC vision 2025, it has been stressed that there must be 40% PhD faculty of total faculty in universities. Currently, 32% PhD faculty are there in universities, which is evidently showing the missing of target. The HEC officials have informed that PhD faculty has increased enormously due to various reforms opted by the HEC. However, the desired level is yet to be achieved due to i) constrained level of funding, ii) brain drain at local and international level, iii) the over usage of non-PhDs visiting faculty in private universities, and iv) non-availability of required level of PhDs in specific subjects.

3.5.2 Major Challenges to HEC

The outcomes from Key Informant Interviews (KIIs) regarding what challenges the HEC has been facing in the pursuance of effective policy agenda to boost up the higher education in Pakistan. They have revealed a few key challenges such as i) insufficient funding allocation to HEC, ii) lack of political will to prioritize higher education by incumbent governments, iii) lack of commitment by the universities to follow the commissions' recommendations, iv) apprehensions regarding the autonomy of the HEC from political governments which may become a predicament for the commission to implement their effective agenda to boost up higher education in the country.

3.5.3 University-Industry Linkages and Placement of PhD Degree Holders

The KIIs were asked about the role of the HEC to link the educational research with industry. They revealed that for this purpose, the Commission is making efforts such as: i) assisting the universities to establish Office of Research, Innovation and Commercialization (ORICs) to commercialize the academic research. In this connection, HEC has established 77 ORICs in universities ii) helping to establish Business Incubation Centers (BICs). Similarly, HEC has established 35 BICs in universities, and iii) expanding the internship related opportunities for students during their study in industries.

Apart from these, the KIIs were asked about the steps taken by the HEC to fix the problem of placement of PhD degree holders. They reported that the HEC has been offering Interim Placement for all Fresh PhDs (IPFP) to accommodate the fresh PHD degree holders. The introduction of TTS is also helpful in absorbing the fresh PhD degree holders. The KIIs also disclosed that ORICs, in particular, has been playing an important role in boosting research activities in universities.

3.6 Concluding Remarks

Since its inception in 2002, the HEC has implemented its policy agenda to bring key reforms in higher education to improve access, relevancy, and quality of higher education in Pakistan. This essay has three specific objectives i.e., i) to identify the key reforms taken by the HEC to flourish higher education and research environment in Pakistan, ii) to highlight, the achievements and failure of HEC geared towards increasing higher education and research activities in Pakistan, and iii) to explore the challenges faced by the HEC to implement its higher education policy agenda in Pakistan.

For this, we have employed situational analysis through secondary and primary data. The secondary data includes the HEC published reports and Pakistan Economic Surveys, while primary data through conducting the Key Informant Interview (KIIs) is collected from the HEC officials who have been playing a pivotal role in policy making.

Exploratory analysis demonstrates that the HEC has implemented multiple reforms in order to improve the productivity and quality of university teaching faculty. For that purpose, the HEC has launched numerous indigenous and international scholarships, training programs, and TTS mode of hiring which have triggered increase in PhD faculty in public and private sector universities. Since the inception of the HEC, an increase in establishment of universities and induction of PhD faculty members in rising number of universities has been witnessed (Khan, B., Mustafa, G., & Nawaz, A. 2021).

Similarly, an increase in enrollment rates at university level has been observed from 2002 to 2020 owing to reforms implemented by the HEC, specifically an increase in females' enrollment has been notably observed which may be helpful to enhance the gender parity by 45%. On average, 1000 to 1800 PhDs have been produced annually from 2008-09 to 2019-2020

with the courtesy of multiple indigenous and foreign scholarships by the HEC. Despite these achievements, the Commission has initiated multiple programs to foster research environment, and collaboration amongst the local and international researchers.

one of the missing areas of university-industry linkage is the limited collaboration between academia and industry in research and development (R&D) activities. While universities in Pakistan play a significant role in producing graduates with theoretical knowledge, there is often a disconnect when it comes to translating that knowledge into practical applications in the industry. Many Pakistani universities lack the infrastructure, funding, and support to actively engage in R&D projects with industry partners. Additionally, there is often a lack of awareness and understanding among industry stakeholders about the benefits of collaborating with universities, which leads to missed opportunities for mutual growth and innovation. Bridging this gap and fostering stronger university-industry linkages through collaborative R&D efforts could lead to more relevant research, technology transfer, and industry-driven innovations, ultimately contributing to Pakistan's economic and technological advancement.

The KIIs demonstrate that the Commission has failed to achieve some of the desired outcomes despite multiple successes. i) lacking political will by the political leaders and rulers, ii) squeezing budgetary allocation for higher education, iii) lacking cooperation from public universities, and iv) intimidating the autonomy of the HEC by incumbent political regimes, Furthermore, they have recommended that a task force of educational experts, comprising the representatives from all provinces/regions need to be constituted to devise a comprehensive and systematic future strategy for the higher education in Pakistan.

Chapter 04:

Essay 02

Does Incentive Increase Research Productivity? An Assessment of the Effectiveness of Tenure Track System in Pakistan

Abstract

The Higher Education Commission (HEC) has launched an incentive-based appointment system, Tenure Track System (TTS), relative to the existing Basic Pay Scale (BPS) mode of appointment in order to incentivize university research. Therefore, the underlying chapter evaluates the impact of university faculty decisions to opt for TTS or BPS on their academic productivity. To test this question empirically, we randomly surveyed 359 teaching faculty members of different public sector universities across the country. We estimate Heckman treatment effect model to evaluate the effect of the intervention, of introducing TTS, by HEC. The estimated results suggest that TTS-based intervention has significantly increased the research productivity of the treatment group as compared to the control group (BPS group). Moreover, the analysis shows that TTS-based intervention improves quality-oriented productivity among the treatment group.

Key Words*: Research Productivity, citation, H-Index, quality, faculty, Policy Intervention, TTS*

4.1 Introduction

The quality of human capital plays a significant role in economic growth and development of both developing and developed countries, those countries which have brought in shaping their human capital are experiencing relatively higher economic growth and living standard (Osiobe, 2019; Zhu and Li, 2017; Mincer, 1984). Angrist *et al.,* 2019 argue that countries with better Human Development Index (HDI) experience higher economic productivity. Keeping in view the significance of human capital in the growth processes, many countries have initiated a variety of reforms (public-private partnership, infrastructure development, etc.) to boost up research quality. Similarly, some countries[6] have introduced incentive-based reforms to expand research capacity of the university faculty. These incentives include monetary rewards, promotions, public acknowledgments, and performance-based incentives (Campos-Mercade, 2020; Eaton *et al.,* 2020; Killeen; 1982). The incentive theory implies that the extension of incentives to employees has a positive effect on the productivity of beneficiaries. Similarly, incentives to the teaching faculty of universities could have beneficial impacts on the research productivity of the targeted group (Xu *et al.,* 2008).

Pakistan has introduced various reforms in the last two decades to incentivize university research. In this regard, the Higher Education Commission (HEC) of Pakistan has been established in 2002 which has introduced different reforms to increase the enrollment rate in higher education, these reforms also aim to attract capable and qualified faculty from both within and outside Pakistan. In this regard the HEC has introduced a new mode of appointment, Tenure Track System (TTS), parallel to the existing system known as Basic Pay Scale (BPS). The HEC's underlying objective of introducing TTS, in 2003, was to increase research productivity, attract qualified Ph.D. faculty/researchers and increase the academic performance of the faculty of the public sector universities (HEC, 2005).

Out of 125 public sector universities the TTS has been implemented in 71 universities either fully or partially till 2019. During 2018-19, 21% of PhD faculty were on TTS while 52%, 2%, 3% of PhD faculty were on BPS, IPFP and contract respectively. The HEC has released Rs. 20.6 billion tenure track funds to universities/Institutes/Centers. However, the HEC has faced

[6] USA, South Korea Nigeria, UK, Canada, Pakistan etc

socio-economic constraints while implementing the TTS (HEC, 2020). Currently, HEC encourages universities to hire new faculty purely on TTS. Thus, universities advertise most of the faculty positions solely on TTS (Khan & Jabeen, 2019). Despite significant funding and monitoring of the TTS by HEC, no impact evaluation study of this intervention has been conducted so far. This study evaluates the impact of TTS as compared to conventional BPS on research performance and teaching quality.

4.2 Objective of the Study

The specific objectives are outlined as follows.

- To construct a composite index to measure research productivity of university professoriate faculty members.
- To evaluate the impact of TTS policy on research productivity of university professoriates faculty members.
- To examine the impact of TTS policy on research productivity by decomposing the composite research productivity index: research activities at international and national level, book-writing, H-index, and PhD produced.
- To compare the impact of TTS relative to BPS on research productivity index with respect to designation of faculty members and different disciplines (e.g., Social Sciences, Natural Sciences, and etc.).

4.3 Significance of the Study

To the best of my knowledge, this study is the first to empirically analyzed and evaluate the impact of TTS on research productivity as compared to BPS in Pakistan. Since HEC has spent billions of rupees[7] on higher education while having a limited budget, this study aims to, potentially, guide the policy on higher education to efficiently utilize and distribute resources. In addition, the study would provide enriched information about directions through which research productivity and exposure can be increased at the national and international levels.

[7]Which is still not enough given, specifically, the limited budget of HEC and, broadly, narrow budget allocations to education. As discussed in detail in chapter 3.

The subsequent part of the chapter goes as follows: Section 4.4 sheds light on the literature review while theoretical framework is discussed in section 4.5. Discussion on a description of data collection and variables construction is presented in section 4.6. Specification of empirical model is provided in section 4.7. the results are discussed in section 4.8 while section 4.9 concludes the chapter.

4.4 Related Literature

In this section, critical review of the related literature presented, we aim to narrow down the prevalent related literature regarding the effectiveness of TTS policy on qualitative impact of research productivity vis-a-vis both internal and external factors, Similarly, the review will help to find literature gap on the subject. To begin with, it has come under general observation that incentive-based projects make individuals perform better and more proactively (levy, 2013). Similarly, performance of the faculty members in the field of research highly depends on the incentives such as high pay, promotion, and viable environment for individuals. This is equally applicable in educational contexts, especially, perhaps, in the area of academic research productivity. The lifeblood, credibility, and future of an educational discipline depend on the continual growth of knowledge through research (Liaw *et al.,* 2020).

There is a vast amount of literature that captures research productivity across disciplines. Quality research productivity is mostly considered as the basis of the recruitment of academic faculty, formulation of annual reviews, and in the promotion and allocation of grants. It has been an acknowledged criterion for the academic faculty to refer to the differential impact of their publications in their curriculum vitae (Kwiek, 2020). In this context, HEC also investigates the academic growth of the faculty through their research productivity. These academic members seek to produce enough proof through excellent research output in order to maintain their services, contract renewal, tenure, and advancement. (Griffith and Altinay 2020). The universities retain and promote those faculty members who frequently publish books and research articles in peer-reviewed journals, present at refereed conferences, receive competitive grants, or who engage in other forms of discovery such as obtaining patents (Blume & Candela, 2018; Lechuga & Lechuga, 2012).

To get a personal promotion, faculty members are expected to produce quality research. The present study is trying to gauge the impact of the research output on of TTS faculty members individually, region and gender across different disciplines in different universities. It needs to be weighed out whether the TTS faculty members in Pakistan are given the right milieu to undertake research projects as they are expected to do so. Expectations of faculty research productivity indeed differ across disciplines and higher education institutions in Pakistan (Zubair *et al* 2015). In Pakistan, universities recruit faculty on tenure track system depending upon their large graduate programs and award research / scholarship doctoral degrees On the other hand, it is also an acknowledged fact that even though each institution outlines its own research, teaching, and service expectations in faculty handbooks, studies have shown that meeting those expectations are often not practical for full time faculty (Cloete *et al*., 2011; Fawzi and Al-Hattami, 2017; Hagan *et al.,* 2019; Hesli and Lee, 2011; Pinto and Huizinga, 2018; Quimbo and Sulabo, 2014; Teater and Mendoza, 2018; Webber K.L, 2011; White *et al.,* 2012).

The factors that influence university faculty research performance has reviewed research articles published in the two and a half decades (i.e., from 1960-1985) in the United States about the exploration of factors influencing university professors research publications, these factors can be divided into individual factors and environmental factors. The individual factors include IQ, motivation, perception of stress, age, and gender. On the other hand, environmental factors include university reputation, resource allocation, academic colleagues, and research field (Creswell, 1985). In the present context, it is to delve into the applicability and relevancy of these individual (intrinsic) and environmental (extrinsic) factors on the quality research productivity of the TTS faculty members. It is suggested that future studies apply diversified and interdisciplinary methods to explore the effect of institutional and research field differences on university professors research performance. So, it will be pertinent to explore whether these factors apply to the present study. It is also important to evaluate the impact of organizational climate on university professor's research performance. University reputation represents the whole university's atmosphere. However, professor's perceptions of environmental effects on individuals inside the campus should not be neglected. The relevant literature suggests that organizational climate significantly influences internal individuals' behavior and performances inside universities. The graduate student's ability and confidence in conducting research as well as research assistants' ability significantly influence university professor's research article

production. The university professors psychological perception and background variables, such as stress, motivation, gender, and age, influence their research production, environmental factors, such as research support culture, good research space and facilities, and good colleague interaction, are also important variables for predicting university professors research production (Moran & Volkwein, 1988; Kotrlik, Bartlett, Higgins, and Williams 2000; Blackburn and Bentley 1993). A survey conducted of 320 university professors who taught at 10 business schools in mid-western universities USA to explore their perceptions about important factors of research production. The research findings clarify that assistant professors tend to be motivated by external rewards, such as promotion, administrative position, and money, but associate professors tend to be influenced by their internal psychological feelings (Chen, Gupta, and Hoshower, 2006). In the present context, it will be very proximate to evaluate the personal or individual perceptions of the TTS faculty members on the effectiveness of the TTS program. Moreover, the research has also demonstrated that research article production has a negative relationship with years of employment at universities. There has been no significant difference between research field and gender. Hence, it will be interesting to see if the TTS faculty members research vary across age, gender, discipline. Kyvik and Smeby (1994) have found a positive relationship between graduate student behavior and professors research performance. For professors who worked in the fields of natural sciences, medicine, and engineering, when their graduate students' theses related to their research field, their research production significantly increased. So, in the context of the present study, this study will try to explore these intrinsic and extrinsic factors influencing the TTS faculty members research productivity.

It is important to find the contemporary needs of the global higher education sector. It has been seen that modern higher education has changed significantly in the last two decades. These changes have been ushered by the governmental policies to improve the efficiency and effectiveness of the teachers in various fields, these policies are targeted at enhancing research productivity. (Billot, 2010; Brew, Boud, and Malfroy 2017; Penprase, 2018). Pakistan's Higher Education Commission is no exception to this as it has launched TTS program for the university teachers with an aim of the enhancement of quality research output. The present study is aimed at gauging the impact of TTS program at various levels. The quality research productivity has become a requirement for research institutions, as well as for faculty members in all types of institutions (Lucas and Murry 2011). These new trends have attracted scholarly attention to

understanding individual-level research productivity and some external factors that lead to its increase (Hemmings and Kay 2016; Nygaard, 2017). As it has been seen that national governments and higher education institutions (HEIs) in many developing countries allocate significant resources to research initiatives and programmes. Some of these initiatives include conducting research methodology workshops and seminars on how to write an effective research proposal on how to get research papers published. The Higher Education Commission of Pakistan's learning and Innovation Division has also been proactively busy in training faculty members in the field of research methodology and productivity. It is necessary to cite a few recent studies that have identified different organizational factors that may predict faculty members' research performance (Hedjazi and Behravan 2011).

In the same way, it has highlighted more than ten factors for an effective research environment. These include research emphasis, group climate, governance mechanisms, availability of resources, and HR practices (Bland & Ruffin, 1992). There have been more studies which have focused on the suitable research environment for research productivity. Mallinckrodt and Gelso (2002) have found that a better research environment is a key predictor for research productivity among researchers. Similarly, there are a few empirical studies which show that the research training initiatives and programmes improve research productivity (Anandarajah *et al.,* 2016; Konstantakos *et al.,* 2010; Kurahara *et al.,* 2012; Rothberg *et al.,* 2014).

In the review of related literature, the intrinsic factors that play a key role in the research activities of the university faculty members. As one of the objectives of the present study is to study the effect of TTS policy on research productivity at the individual level. The personal motivation, stress level and emotional challenges of the university TTS faculty members that either spur or curb them in their research activities. While aiming at one important factor regarding analyzing the quality of research under the TTS, the study would investigate the impact of their research on their personal growth and university research productivity. The study would evaluate some of the extrinsic factors like promotion, monetary incentives, and social progress of the TTS faculty members whether it is linked with their research productivity. Looking into one more important objective, that is to study the effect of TTS policy on research productivity at subject level.

4.5 Theoretical Framework

Human Capital Theory (Becker, 1962; Almendarez, 2010) and the Incentive Theory (Skinner B.F. 1957) of motivation forms the theoretical framework of this study. Although Adam Smith adequately confirmed this in his analysis of sharecropping contracts more than two centuries ago, it is only in recent decades the incentive theory has emerged to place the problem at the center of economic thought (Laffont, and Martimort, 2002).

Human Capital Theory relates to the TTS and BPS faculty in the field of higher education in the country (Manjounes, 2016). When comparing TTS and BPS professors, the incentive theory of motivation (ITM) relates to the incentives provided to TTS academics in the form of higher salary, rapid promotions, and a more encouraging environment in universities. Human capital theory (HCT) is more concerned with people, whereas incentive theory (ITM) is more concerned with motivation to achieve desired goals. The TTS was introduced in 2003 and incentivizes research-oriented university professors with higher pay, promotion, and viable environment as compared to BPS.

Human capital refers to a worker's innate or acquired stock of skills or attributes that add to his or her "productivity". This term is general, which has both benefits and drawbacks. One of the most fundamental concepts in labour economics is to see workers' marketable knowledge, skills, and abilities, as a form of capital in which they can invest in several ways. This viewpoint is important in understanding configuration of earnings, wages, and investment incentives. Human capital theorists also emphasize the importance of education and training as a prerequisite for participation in the global economy. (Acemoglu and Autor 2016; Almendarez, 2010).

Motivation theory posits that any action we take is in search of what we most want or require at the time. People act upon incentives. No matter what they do, be it work, a hobby, a picnic, sports, meeting with friends, nothing comes from nowhere. Activities are always caused by something, and that something is called an incentive (Ana, 2019). The underlying assumption of the incentive theory is that “Individuals are motivated towards certain action by external incentives/rewards and punishment”. The incentive theory of motivation relates to the TTS since the faculty are being hired on high salaries, incentive of rapid promotion, encouraging

environment. TTS faculty are bound to achieve the targets within the stipulated time. The TTS faculty with incentives behave in harmony with goal of the university.

4.6 Data and Variables Specification

4.6.1 Data source

The study utilizes a primary data set which was collected through a survey. A questionnaire was devised for collection of data from faculty members. The questionnaire was thoroughly reviewed by Dr. Anwar Shah, Dr. Javed Iqbal, Dr. Amanat Ali, Dr Muhammad Nasir, Dr. Ghulam Samad and Dr. Faiz ur Rehman senior faculty members of School of Economics, Quaid e Azam University, Islamabad and Pakistan Institute of Development Economics, Islamabad. After their insightful feedback and necessary modification, the questionnaire was finalized. The survey questionnaire was designed to focus on indicators of research productivity and other control variables of the study. The unit of analysis is university teachers including assistant professors, associate professors, and professors from public sector universities in Pakistan.

4.6.1.1 Survey Methodology

To survey university teachers, we obtained information from HEC and respective university's websites about the TTS and BPS professors. Out of total faculty members, both BPS and TTS, the study picked 1500 faculty members randomly. Due to the spread of COVID-19, we could not access the university teachers in physical meeting for interview. Therefore, the survey conducted via designing the questionnaires through online Google Form, taking details of selected 1500 university teachers from respective university website and HEC.

In order to receive responses from sampled teachers, the study has been waiting for their response for three weeks. So, we obtained positive response from 359 teachers out of selected 1500 teachers at public sector universities. It is important to note that the data was collected only from professors working at public universities because the TTS is only implemented in public universities.

4.6.1.2 Sample Distribution

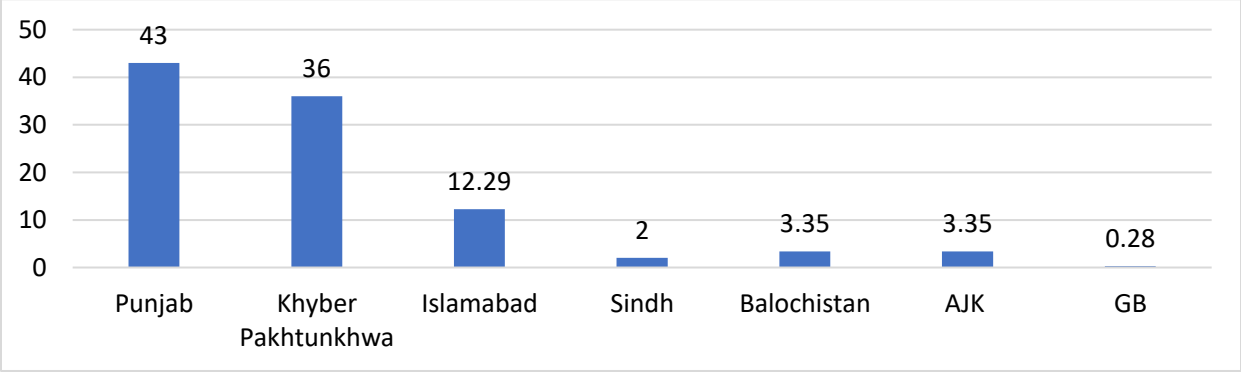
Out of the total sample of 359, TTS teachers are 239. Our survey is broadly representative of each designation. For instance, the share of Assistant Professors in the total faculty at public universities is 66.28% whereas our survey contains 65.36% assistant professors. The share of associate professors in the total faculty at public universities is 18.18% whereas our survey contains 23.7% associate professors. Similarly, Professors has the reasonable share in the survey. This little discrepancy is due to the result of non-response from the faculty in certain designations.

Table 4.1: Percentage Sample Distribution of Mode of Appointment by Designation:

Designation	Surveyed BPS Faculty (%)	Surveyed TTS Faculty (%)	Share in Surveyed Faculty (%)	Share in Total Faculty (%)
Assistant Professor	20.95	44.41	65.36	66.28
Associate Professor	7.54	24.27	23.74	18.18
Professor	4.75	9.21	10.89	15.53
Total	33.24	66.76	100	100

Moreover, sampling distribution indicates that 43% of total sample size is from Punjab province, 36% from KPK, 12.29% from Islamabad, 3.35% from Balochistan and 2% percent from Sindh. The remaining professors in the sample belong to Gilgit Baltistan and AJK as shown in figure 4.1.

Figure 4.1: Percentage (%) Sample Distribution by Provinces



Furthermore, the sampling decomposition by discipline suggests that 18.11% of total sample belongs to social sciences, 9.75% to business and management, 14.76% belongs to physical sciences, 14.48% to agriculture and livestock, 12% to biological sciences, and 9.19% of the sample belongs to mathematics and statistics. Table 4.2 presents detailed information about the share of different disciplines in the sample.

Table 4.2: Sampling Distribution by Disciplines

Disciplines	Freq.	Percent
Social Science	65	18.11
Business & Management	35	9.75
Engineering	12	3.34
Physical Science	53	14.76
Agriculture and Veterinary	52	14.48
Biological Sciences	43	11.98
IT & Computer Sciences	25	6.96
Mathematics & Statistics	33	9.19
Others	41	11.42

The collected data contains detailed information of teachers' designation, and nature of the mode of appointment, and multiple indicators of the research productivity.

4.6.2 Research Productivity

The analysis includes six indicators for research productivity, namely composite research productivity index, index for international level research contributions, index for national level research activities, H-index, PhD produced, and authorship of books. A bit detailed discussion on these indices is as follows.

Index of International Research Activities: five indicators are used to construct the index for measuring research activities at international level by TTS and BPS teachers. Such

indicators are given in the following table 4.3. These indicators are combined by using principal component analysis (PCA) to obtain weights Bro et al (2014)[8].

Table 4.3: Indicators for International Level Research Activities

Sr.	Question	Relative weight
1	In how many Committees/Societies etc. you are a member at International Level	0.20
2	Number of International Award Received (UN, US, UK etc.)	0.22
3	Number of International Collaboration /exchange programs (outbound at least 15 days)	0.20
4	Number of International Research Projects earned	0.16
5	Number of research papers presented in international conferences in foreign	0.22

The higher estimated value of the index for international research activities means greater research productivity. The average value of this index is 1.178127 with standard deviation of 1.686972, while the minimum value is estimated as 0 and maximum value is estimated as 11.57116 (see table 4.6).

***Index of National Research Activities*:** the index for national level research activities is measured on the basis of seven indicators which demonstrate national level research activities. These indicators are presented in table 4.4. PCA has been applied to combine the indicators of index of national level research activities. The estimated index represents the increasing value of the index that indicates higher performance, while low values indicate poor performance.

[8] Principal component analysis (PCA) is a variable reduction statistical technique. It reduces a larger number of variables into a smaller set of artificial variables while retaining as much information as possible. This smaller set is called principal components. PCA is extremely useful when working with data sets that have a lot of features.

Table 4.4: Indicators for National Level Research Activities

Sr.	Questions	Relative weight
1	In how many committees you are a member at National Level (Except University)	0.11
2	In how many committees you are a member at university	0.13
3	Number of National Award Received e.g., Research Productivity Award	0.16
4	Number of University Industrial Linkages programs through ORICs	0.07
5	Number of National Research Projects earned	0.15
6	Number of research papers presented in conferences in Pakistan	0.20
7	Number of conferences organized	0.16

The average value of this index is 2.25 with standard deviation of 3, while minimum value is 0 and maximum value is estimated as 36 (see table 4.6).

H-index, PhD Produced, and Authorship of Books: apart from above-discussed indices, the study has employs three indicators to represent research productivity, these indicators include H-index, PhD produced, and authorship of books. H-index is representing the research publications and citations which directly showing the research productivity.

Composite Index for Research Productivity: finally, the study has constructed a composite index which represents all form of research performance. This index is computed on the basis of all indices and indicators which are discussed above.

Table 4.5: Composite Index for Research Productivity

Sr.	Indicators	Relative weight
1	Index for international research activities	0.28
2	Index for national research activities	0.29
3	H-index	0.24
4	Number of PhD produced	0.15
5	Number of books as author	.037

These indices include index for international research productivity, index for national research productivity, H-index, PhD produced, and authorship of books. PCA has been applied to construct composite index. Its values lie between 0 and 10. The higher values indicate the overall greater performance.

Table 4.7: Summary Statistics of variables/indices under consideration

Variable	Obs.	Mean	Std. Dev.	Min	Max
Composite index	359	0.624128	0.761888	0	7.218368
International research productivity	359	1.178127	1.686972	0	11.57116
National level research productivity	359	2.249424	2.999629	0	36.02352
Number of PhD produced	359	1.824513	4.152789	0	35
Number of books as author	359	0.94429	3.180284	0	50
H-index	359	12.3072	50.643	0	233
Total citation	359	722.883	3813.124	0	68464
Total publication	359	47.56825	92.95842	0	1200
Teaching experience (years)	359	11.62173	6.695715	1	36
Age	359	41.43175	6.673151	29	62

Table 4.6 contains the information of summary statistics of the core variables which we have used for analysis.

4.6.3 Empirical Model

Before discussing the empirical intricacies in depth there is an important thing to mention is that decision to choose BPS or TTS is purely based on choice of the employee. This can cause the problem of self-selection bias. Heckman (1976) has identified that presence of the self-selection bias which makes the results biased. Therefore, before going into the specification of the model, we need to fix the self-selection bias. Literature on the subject suggests the implementation of Heckman models to capture the self-selection bias and then its impacts on the outcome variables. However, at the same time we have to evaluate the impacts of tenure track policy implemented by the HEC. We have to choose between the standard Heckman selection

model or some other methodologies, which have been developed for impact evaluation of the policies such as Treatment Effect models, regression discontinuity, propensity score matching etc. (Mustafa *et al.,* 2019).

The Heckman treatment effect models are considered important statistical tools to evaluate the impact of policy in the presence of selection bias (Heckman 1978). Given the objectives of the ongoing research essay, we would apply Heckman type treatment effect regression models, which are the extended form of the original Heckman (1976) model. The Heckman type of treatment effect models are considered as the important statistical tools to evaluate the impact of policy and selection bias as well (Heckman 1978). So, in the underlying study, we evaluate the impact of TTS mode of hiring on teacher's research productivity. There are two prime reasons to apply this model. Firstly, to tackle the self-selection bias due to the decision of the teachers to opt TTS or BPS, and so this decision may bring non-randomness. Hence in such a situation, if we do not tackle sample selection bias, it may give biased results (Greene, 2012). Secondly, to evaluate the causal impact of the HEC's intervention (TTS) on teachers' research productivity through estimating the average treatment effects for both who have opted for TTS and BPS modes of hiring. For the empirical purpose, Greene (2012) has suggested a treatment effect regression model, which is termed as Heckman type model. Because it provides an average treatment effect, and even it also suggests the presence of the sample selection bias.

4.7 Model Specification

The treatment Effect Model is a Heckman type model, which follows analysis in two steps. In the first step, the treatment/selection equation is estimated, and the outcome equation is estimated in the second step. The conventional Heckman Selection model provides the presence of selection bias while the treatment effect model provides average treatment effect and selection bias as well. Hence, the specification of the first step is stated in equation 4.1.

First stage: (treatment equation) $T = x_i^{'}\beta + \mu$ (4.1)

It is observed only when T >0.

In equation 4.1, T is a treatment variable. It takes 1 for TTS based hired teachers, and 0 for BPS. Likewise, x_i' is a vector of explanatory variables like teaching experience, gender, designation, and regional dummies like at what province university is located? β is a vector of coefficients and μ_i is a random disturbance term. In sum, the above equation estimates what factors affect the decision to opt for BPS or TTS mode of employment. If we closely noticed, equation 4.1 is like a Probit model.

In the second stage, the outcome model is estimated as follows.

Second stage (outcome equation): $$y_i^* = w_i^* \alpha + \varepsilon_i \quad (4.2)$$

Here, y_i^* is an outcome variable, which is research productivity. The model is estimated for each of the 6 indicators/indices of research productivity. These are: i) composite index for research productivity, ii) index for international research activities, iii) index for national research activities, iv) H-index, v) number of Ph.D. produced, and vi) the number of books as authorship. Likewise, w_i is a vector of independent variables which are teaching experience, gender of the teacher, discipline (social sciences, engineering, agriculture, physical sciences, mathematics, business and management, IT& computer science, and others where social science has been kept as the reference category) and designation of the teachers like the assistant professor, associate professor, and full professor.

Hence, the above outcome variable would give us an estimation of average treatment effect (ATE) which is estimated as the difference between the outcome variable (Research Productivity). If ATE>0, then it will suggest that TTS policy is beneficial and it has a positive effect on the research productivity of the university level teachers, and vice versa.

4.8 Results and Discussion

This section discusses the estimated effect of TTS policy on teachers' research productivity.

4.8.1 Correlates of TTS Mode of Appointment

As discussed in the previous section, we have implemented a treatment effect model to estimate the impact of TTS policy on university teachers' research productivity. Hence in our

case the Heckman type treatment effect model works in four different ways. a) What factors influence the decision to opt for the TTS or BPS mode of hiring? b) It estimates whether self-selection bias exists or not. c) it estimates the average treatment effect, which is the difference between the potential outcome mean (POM) of the treatment group (e.g., TTS) and potential outcome mean (POM) of the control group (e.g., BPS). And d) Other factors which impact the outcome variable. So, this section will discuss the factors which influence the decision to opt for the TTS or BPS by teachers.

Table 4.7 comprises the estimated results of the treatment equation 4.1, which is a type of Probit model. The estimated results (table 4.7) from the first step of the treatment effect model indicate that gender has not statistically significant impact on the decision to opt whether TTS or BPS. The insignificant impacts show that gender of the teachers does not have any significant role in his/her decision making to choose the TTS or BPS model of employment. Similarly, the age of the university teacher does not have any significant impact on his/her decision to choose whether for TTS or BPS.

Teaching experience has negative and statistically significant impact on the likelihood of opting for the TTS mode of hiring relative to BPS. The estimated results (table 4.7) indicate that teachers who have higher teaching experience are less likely to choose TTS incentive-based hiring. They prefer to choose the BPS mode of hiring rather than TTS. The reason could be that they want to gain permanent job rather than highly paid but not- permanent, TTS based job.

Table 4.7: Estimated Result of Selection/Treatment Model

HEC (TTS=1, 0 otherwise)	Coefficient	S. E	t-statist	p-value
Gender	-0.0034	0.165	-0.02	0.984
Teaching experience	-0.0717***	0.018	-4.13	0.000
Age	0.0264	0.017	1.55	0.122
Assistant professor	-0.1811	0.295	-0.61	0.540
Associate professor	0.0221	0.294	0.08	0.940
Balochistan	2.0325***	0.652	3.11	0.002
Islamabad	0.8563**	0.428	2.00	0.045
Khyber Pakhtunkhwa	0.8941**	0.388	2.30	0.021
Punjab	0.6572*	0.384	1.71	0.087
Sindh	0.9447	0.642	1.47	0.142
Constant	-0.4713	0.798	-0.59	0.555
Sample Selection				
Inverse mills ratio (lambda)	-0.6149**	0.251	-2.45	0.014
Rho	-0.7480			
Sigma	0.822			

The designation of the teacher, i.e., assistant professor, associate professor, and professor does not have any significant effect on the decision to go for TTS. Table 4.7 shows that designation dummies do not have any statistically significant impacts on treatment variables.

The provincial dummies have a statistically significant influence on the treatment variable. Such dummies which have significant influences include Balochistan, KPK, Punjab, and Islamabad. However, Sindh province has insignificant impacts.

Moreover, the inverse mills ratio has been found significant which confirms the presence of sample selection bias, which implies that Heckman type treatment effect model is logical and intuitive in our case. Table 4.7 contains an inverse mills ratio is -0.6149, while it is statistically significant at 5%, which exhibits the presence of selection bias.

4.8.2 Impact of TTS on Teachers' Research Productivity

As discussed in the previous section, the second step of the Heckman treatment effect model is to estimate the outcome equation. In this study, we have set six outcome variables: i) composite index for research productivity, ii) index for international research activities, iii) index for national-level research activities, iv) H-index, v) number of Ph.D. produced, and vi) the number of books as authorship. We estimate the model with a composite index of research productivity combining all these indicators and separately as well for each of the six indicators/indices.

Table 4.8 indicates that TTS policy has a positive and significant impact on the overall composite index of research productivity. It demonstrates that the average treatment effect score for the composite index of research productivity is estimated to be 1.147 (shown in table 4.8), which is highly statistically significant. The positive influence demonstrates that other things remaining the same, those teachers who are hired based on TTS are containing 1.147 (table 4.8) higher score of research productivity as compared to those who are hired on the BPS mode of hiring. The estimated result (see table 4.8). reveal that the TTS policy is beneficial in terms of research productivity.

We can further decompose this composite index into its indicators. Model /Column (2) for international level of research activities indicates that the average treatment effect score is observed as 2.791 which is highly statistically significant. It reveals that the TTS teachers are more contributing to research activities as compared to BPS teachers.[9] Furthermore, the average treatment effect score for national-level research performance indicates that TTS teachers have a 2.60 average treatment effect score, which implies that TTS teachers are estimated as performing more than BPS teachers as far as research activities are concerned.

[9] The detail of the indicators of international research activities is discussed in table 4.3.

Table 4.88: Impact of TTS on Research Productivity

VARIABLES	(1) Composite index performance	(2) Index for International performance	(3) Index for national performance	(4) H-index	(5) PhD produced	(6) Books authorship
Average treatment	1.147***	2.791***	2.604*	7.67	3.815*	0.0665
effect (TTS vs. BPS)	(0.412)	(0.957)	(1.499)	(5.137)	(2.053)	(1.569)
Gender (1= male)	0.107	0.256	0.701*	0.372	-0.331	0.463
	(0.105)	(0.244)	(0.385)	(1.312)	(0.526)	(0.404)
Teaching experience	0.0602***	0.108***	0.144***	0.531***	0.302***	0.0544
	(0.00881)	(0.0205)	(0.0320)	(0.107)	(0.0439)	(0.0335)
Disciplines						
Business	0.118	0.315	0.180	-1.227	0.262	0.351
	(0.146)	(0.337)	(0.597)	(2.013)	(0.793)	(0.652)
Engineering	0.120	0.555	-0.0646	3.431	-0.0962	-0.154
	(0.221)	(0.511)	(0.901)	(3.040	(1.198)	(0.982)
Physical sciences	0.345***	0.366	1.476***	4.301**	1.807**	0.520
	(0.133)	(0.307)	(0.540)	(1.827)	(0.718)	(0.588)
Agriculture &veterinary	0.243*	0.464	0.176	4.45**	0.913	1.706***
	(0.135)	(0.312)	(0.549)	(1.85)	(0.731)	(0.598)
Biological sciences	0.291**	0.209	1.319**	6.18**	1.713**	0.628
	(0.141)	(0.326)	(0.576)	(1.947)	(0.765)	(0.628)
IT & computer science	0.140	0.473	-0.0556	1.328***	0.166	0.106
	(0.161)	(0.372)	(0.666)	(0.235.)	(0.882)	(0.729)
Mathematics & Statistics	0.170	0.160	0.323	4.60**	1.662**	-0.211
	(0.149)	(0.344)	(0.609)	(2.06)	(0.810)	(0.665)
Others (disciplines)	0.183	0.102	0.972*	0.763	0.540	1.376**
	(0.137)	(0.316)	(0.569)	(1.92)	(0.753)	(0.624)
Constant	-1.104***	-2.388***	-2.229*	-3.230	-4.844***	-0.647
	(0.367)	(0.854)	(1.348)	(4.61)	(1.843)	(1.415)
Observations	358	358	358	358	358	358

Model (4) contains the estimated results for H-index, which is a standard measure for research productivity. However, the problem with the H-index is that it does not estimate the quality parameters. It only reflects numbers. The results (table 4.8) indicate that the average treatment effect is found insignificant for H-index, which indicates that there is no significant difference between BPS and TTS concerning performance by H-index. Similarly, there is no significant impact on book authorship, which means that TTS policy does not influence the performance estimated by the number of books as authors at the national and international level.

When it comes to the number of Ph.D. students produced, again TTS teachers (table 4.8) are found to have a higher average treatment effect score of 3.815. It implies that on average, TTS teachers are producing up to 4 more PhDs as compared to their counterparts BPS teachers. As a part of their duties, TTS faculty members are expected to prioritize research, and the success of their research has an impact on how far they move in their careers. As a result, TTS faculty members are more inclined to participate actively in research activities, such as supervising PhD students, which could lead to the production of more PhDs.

Overall, the above discussion indicates that TTS policy does have significant and positive impacts on teachers' research productivity. The analysis, however, reveals that TTS significantly and positively affects the qualitative aspect of research for example research activities and collaboration at both national and international levels.

Apart from HEC TTS policy, some other factors (shown in table 4.8), such as teaching experience has positive and significant impact on all outcome variables except publication of books. Teaching experience may enhance the ability, understanding and exposure of the teachers, which may lead to higher research productivity of the teachers. Moreover, the gender of the teaching has only significant impact in the case of national level research activities and H-index of the teachers, while for rests of the outcomes the impacts of gender come out statistically insignificant.

The study has used the dummy variables of disciplines as independent variables, these include business and management, biological sciences, engineering, agriculture, IT and computer, mathematics and statistics, and others while keeping social science as the reference category. We acknowledge that certain disciplines may have comparative advantage to score high on different indicators like citations, publications, and H-index. Therefore, the results should be viewed and understood in this context.

The estimated results (table 4.8) indicate that business, management and engineering disciplines perform low in research productivity indices as compared to base category Nonetheless, physical and biological sciences perform high in overall composite research productivity index, national level research activities, and number of PhD produced as compare to the base category Teachers who belong to agriculture sciences also contributed in overall

research activities, and number of books written. Similarly, teachers of IT & computer science have done positively and significantly performed in H-index, while mathematics and statistics perform well in producing PhD students. The academic culture and environment within TTS faculty positions emphasize research productivity and recognition, with expectations for publication and research output being more pronounced. This can create a conducive atmosphere for research and scholarly activities, which contribute to higher research productivity among TTS faculty. It is worth mentioning that field specific effect, the unique circumstances and dynamics within each institution and faculty position should be considered when assessing research productivity.

4.8.3 Average treatment effect (ATE) through interactive treatment effect model

After discussing the impacts of HEC TTS policy through average treatment effect without interactive terms, now the study moves to analyze the influence of TTS policy with interaction term of gender, teaching experience, designation of the teachers, and by disciplines. This section only discusses the estimated model for composite index of research productivity. Moreover, the segregated analysis of each individual indicator of research productivity is presented in tables given in appendix.[10]

Table 4.9 indicates that gender of both BPS and TTS does not have any significant impact on overall composite index. Nonetheless, the gender of BPS faculty has significant influence on international research activities (see Annex table 4.10), while gender of TTS has significant impact on national level research productivity and book authorship (see Annex table 4.11 & table 4.12). it means that male faculty members under BPS are performing well in international research activities as compared to their female counterparts. Similarly, male TTS faculty are performing well in national research activities and book writing as compared to female teachers who are TTS faculty members.

[10] Tables 4.10, 4.11, 4.12, and 4.13 are presented in the appendix.

Table 4.9: Interactive Results for Composite Index for Research Productivity

	Coef.	Std. Err.	z	P>z
Interaction term of Gender with HEC				
BPS	0.0927	0.1196	0.78	0.438
TTS	0.0527	0.1052	0.5	0.616
Interaction term of experience with HEC				
BPS	0.0320**	0.0144	2.22	0.026
TTS	0.0545***	0.0192	2.84	0.004
Interaction of disciplines and HEC				
Business & management*BPS	0.1566	0.1153	1.36	0.174
Business & management*TTS	0.0631	0.1538	0.41	0.682
Engineering*BPS	-0.6675**	0.3328	-2.01	0.045
Engineering*TTS	0.5289*	0.2872	1.84	0.066
Physical science*BPS	0.3836	0.2523	1.52	0.128
Physical science*TTS	0.2687**	0.1304	2.06	0.039
Agriculture*BPS	0.2727	0.2019	1.35	0.177
Agriculture*TTS	0.1783	0.2301	0.77	0.438
Biological sciences*BPS	0.0933	0.1695	0.55	0.582
Biological sciences*TTS	0.2051	0.1472	1.39	0.163
IT & Computer*BPS	0.0520	0.1108	0.47	0.639
IT & Computer*TTS	0.2776	0.2273	1.22	0.222
Math & Statistics*BPS	0.0301	0.1855	0.16	0.871
Math & Statistics*TTS	0.0965	0.2068	0.47	0.641
Others*BPS	0.1086	0.0930	1.17	0.243
Others*TTS	0.4305**	0.1953	2.2	0.027
Interaction of designation with HEC				
Associate professor*BPS	0.0663	0.2139	0.31	0.756
Associate professor*TTS	0.2929**	0.1366	2.14	0.032
Professor*BPS	0.7250***	0.2741	2.65	0.008
Professor*TTS	0.7065***	0.2624	2.69	0.007
Overall HEC				
BPS	-0.920***	0.2544	-3.62	0.000
TTS	0.0926	0.1926	0.48	0.631

The findings for teaching experience both TTS and BPS are showing that teaching experience has positive and significant impacts on overall research productivity composite index, however, TTS hold higher coefficient than BPS. In sum, overall teaching experience shows positive and beneficial impacts on overall research productivity for both BPS and TTS faculty members (shown in table 4.9). Similarly, table 4.10 is given in appendix also demonstrates the positive and significant impacts for international level research activities for both TTS and BPS. Moreover, the teaching experience of TSS has more strong and positive impacts on other outcome variables of the research productivity.[11]

Similarly, the results from the interaction term of disciplines with treatment variable indicates that TTS faculty of engineering, biological and physical sciences are showing higher performance in overall composite research productivity as compared to the BPS (shown in table 4.9). Similarly, results presented in appendix for this chapter are showing that overall TTS faculty are showing relatively higher performance in engineering, biological and physical sciences, and even in agriculture as well as compared to the BPS faculty (see appendix of this chapter).

Likewise, the designation of the teacher is showing that professors of both BPS and TTS are showing higher performance in overall composite research productivity, while associate professors of TTS are also showing the higher performance as compared to BPS associate professors relative to assistant professors. Hence, in nutshell, (table 4.9), TTS professors of all designation are performing well, but from BPS only professor level teachers are performing well the rest of the findings are given in appendix.

The TTS provides a clearer path for career progression based on performance, allowing faculty members to advance through various positions (such as associate professor, and professor) in accordance with the quality of their research output. This gives TTS faculty members more incentive to prioritize research and work towards professional progress. The BPS system favors seniority over other factors, and limited research production may correlate with career promotion.

[11] Tables 4.10, 4.11, 4.12, and 4.13 are presented in the appendix.

4.9 Concluding Remarks

The main concern of this chapter was to evaluate the impacts of TTS policy on university teacher's research productivity in Pakistan. For empirical purpose, we have collected data from 359 university teachers from all over Pakistan. From HEC, the study has collected the information of BPS and TTS teachers and 1500 teachers are contacted for responses. Only 359 teachers responded to the questionnaires which contained the information of their designation and university related. Moreover, detailed information of teachers' research productivity has been contained through those questionnaires. The study has applied Heckman type treatment effect model to obtain empirical results. In this study, we have set six outcome variables: i) composite index for research productivity, ii) index for international level research activities, iii) index for national level research activities, iv) H-index, v) number of PhDs produced, and vi) number of books as authorship. We have estimated separate models for these mentioned outcome variables. The impact is estimated by average treatment effect.

Overall, the estimated results indicate that TTS teachers have good performance in all indicators of the research productivity. This indicates, TTS policy causes an increase in research quality of the teachers instead of H-index which measures number of papers and citation. Finding of the study indicate that within TTS mode faculty, biological and physical sciences are found as having more productive in terms of research activities as compared to the social sciences. Similarly, TTS professors of all designation are performing well, but from BPS only professor level teachers are performing well. Moreover, other factors such as teaching experience and gender also have impacts on the outcome variables which are indicators of research productivity. The performance and career advancement of TTS academics is based on the quality of their research output. This is because they are hired with the intention of conducting research. BPS academics, on the other hand, might leave them with less incentives or resources for research.

The first stage results provide confirmation of the presence of the sample selection bias which arises through the decision to be employed through TTS or BPS. The results indicate that teaching experience, designation, and provincial location of the university were the important and statistically significant factors which influence the decision to opt TTS or BPS.

Chapter 05

Essay 03

Tenure Track System and Research Productivity: A University Level Analysis

Abstract

This research essay aims to evaluate the influence of Tenure Track System (TTS) mode of appointment by HEC on research productivity at university level. Primarily, the TTS provides additional monetary benefits to the professoriate against the prevailing mode of appointment, BPS at public sector universities. which ultimately is expected to boost up the productivity at university level. Therefore, this study extracts the data of 117 public sector universities from 2002-2017 by using the HEC digital library. The final data is unbalanced panel in nature. To measure research productivity, four indicators are used: i) H-index, ii) total number of published research papers, iii) total number of citations, and iv) total number of PhD produced at university level. For empirical purposes, university fixed effect model has been implemented to unleash the impact of percentage TTS faculty ratio to the total faculty on research productivity. The estimated results are suggestive of the positive and significant effect of TTS policy on research productivity at university level. Moreover, empirical research determines the improvement in all indicators of research productivity. The results remain robust to different specifications of multiple regression models.

Key Words: *research productivity, TTS faculty, Citation, H-Index, university, graduates,*

5.1 Introduction

5.1.1 Background

Universities are places where the process of creation and dissemination of knowledge takes place, which ultimately benefits the people in different forms. In addition, universities are supposed to be the factory of knowledge economy since research and development are one of the core objectives of the universities. The research productivity of the universities can be measured through numerous indicators such as research publications, carrying out research projects, and environment and culture of research. Research publications are considered as the key approach of communication through which empirical knowledge is disseminated, debated, and developed. Numerous studies have shown that countries that conduct high-quality research have higher level of innovation and inventions which leads economic development. (Sylwester, 2001; Hasan & Tucci, 2010; Lucas & Murry 2011; Savino *et al.,* 2017; Nygaard, 2017).

Universities are often supposed to be the epicenter of research and innovation. This mainly depend on the priority of government for education and research. These are sponsored by multiple public and private agencies, pure public funding, private and public partnerships, and collaboration through industrial extensions (Youtie & Shapira, 2008; Mok, 2008). Educational institutes in developing countries like Pakistan are heavily dependent on government funding. Pakistan is in acute need of better policies to optimally allocate their limited educational funds to research and innovation (Kosec *et al.,* 2017; Abbasi *et al.,* 2021).

Pakistan's higher education system has seen substantial changes in recent decades. Some of these transformations were encouraged by the government to boost the effectiveness and productivity in different areas, including strategies to improve quality of education and research efficiency. The launch of a new hiring system known as the Tenure Track System (TTS) is an excellent example of these endeavors. In Pakistan, universities mainly hire teaching faculty on TTS and BPS. TTS mode of appointment was introduced by HEC to increase research activities in public sector universities. In this regard, The HEC offers additional monetary incentives to TTS faculty as compared to the BPS such as lucrative salary packages. the objective of TTS mode of appointment is to enhance the research productivity of public sector universities in

Pakistan. This west borrowed system's aim was to encourage quality research and replace the old Basic Pay Scale (BPS) system with a new performance-based system. Over time, the TTS system was amended to cater to local conditions and to address unresolved cracks. The current TTS version has changed the mindset of academia towards research output and competitiveness for tenure, promotion, and recruitment. This changing attitude has influenced not only TTS inducted faculty but also BPS faculty as well as the research students who are planning their careers. Improvement in research activities have been observed in Pakistan. Recently, Pakistan has been ranked 32nd in overall research by SCImago Journal & Country Rank Index 2020[12]. However, there is a general perception among the scholars and experts that the TTS-based hired professors are producing quantity but not quality research.

Currently, HEC and public sector higher educational institutions are confronting the challenge of adopting the TTS system. Pakistan's has limited financial space to offer lucrative faculty hiring schemes and provide highly paid positions to scholars. However, the higher education sector has progressed tremendously during the last decade. Different initiatives have been taken to revive the teaching, curriculum, research as well as quality of higher education. As mentioned earlier, the introduction of the TTS hiring system is one of the most significant initiatives in this regard. This study aims to emphasize the use of different bibliometric indicators to evaluate the university level research performance of TTS-based hired faculty in all types of academic institutions of Pakistan. These indicators have become a vital part of the academic landscape and are extensively used to compare the performance of universities, journals, and researchers. Many of the promotions, appointments, institutes' rankings, and allocation of research funds are based on these indicators (Aksnes *et al.,* 2019; Froghi *et al.,* 2012).

A strand of literature is available that has examined the research productivity of educational institutes as well as individual-level faculty members across the world (Toutkoushian *et al.,* 2003; Altbach, 2015; Ghabban *et al.,* 2016; Nafukho *et al.,* 2019). However, very few attempts have yet been made that focused on Pakistani universities and the higher education system as they get more integrated with the international education systems. Moreover, there is a limited number of empirical studies available relating to the faculty research productivity in Pakistani universities. The study in hand is an attempt to fill these gaps by

12 For details: https://www.scimagojr.com/countryrank.php?year=2020

analyzing the impact of the TTS faculty hiring system, demographics, and other institutional characteristics on the university-level research productivity of Pakistani universities. In other words, the prime objective of the study is to assess the research productivity of universities where TTS is being offered. In order to achieve objectives of the study, the following research questions should be addressed: 1) Whether the TTS hiring system has any impact on the overall research productivity of universities? 2) What are the impacts of different institutional characteristics (like age, gender, research offices, and Ph.D. enrollment) on the research productivity of higher educational institutes? In order to define the research productivity of a particular university, we used different bibliometric indicators including the total number of research papers published, H-index, and the total number of citations of the university.

This study will help the stakeholders to understand about effectiveness of the TTS system on university productivity in general and research productivity in particular. It will also help to know whether the TTS system, which is borrowed from the west, is useful in developing countries like Pakistan.

The rest of the study is structured as follows. Section 5.2 deals with the review of existing literature on the productivity of academic research. Section 5.3 discusses the data and variable construction. Section 5.4 provides the research methodology of the study. Section 5.5 belongs to results and discussion. Section 5.6 concludes the study with suitable policy implications.

5.2. Literature Review

The literature indicates that a sizable work has been done in the advanced economies while evaluating the research productivity of universities. In developing countries like Pakistan, however, less effort has been put into assessing the research productivity. One of the reasons for this is that fund allocation to higher education has historically been comparatively low. Resultantly, low participation rates are observed in tertiary education in developing countries (Johnes G., *et al.,* 2020; sulo *et al.,* 2012). A number of factors directly or indirectly influence the research productivity. These factors include age, gender, human capital, family and social factors, teaching workload, opportunity costs, funding, environment, academic rank, tenure track duration, frequency of paper presentations, collaboration, research orientation, and individual orientation (Sax *et al.,* 2002; Durden and Perri 1995; Rodgers and Neri 2007; Fish and Gibbons 1989; Davis and Patterson 2001; Taylor *et al.,* 2006, Xie and Shauman 1998; Kotrlik, *et al.,* 2002).

As discussed earlier, university research productivity is dependent on many factors, such as funding, reputation, age, legitimacy, skilled faculty, and the amount of time allocated for research. Another important factors which have positive impact on the research publications, patents, licensing revenue and collaborations. If productive researchers are funded, they will be incentivized to publish more quality papers. universities have their own diversified systems to adopt the performance based funding and respond to it in different ways (Hall and Van Reenen 2000; Auranen and Nieminen 2010; Costas, Van Leeuwen, & Bordons, 2010; Sulo *et al.,* 2012; Cattaneo *et al.,* 2014; Lee, 2020). Consistent evidence is available that the award increases degree completion, placement in a post-doctoral or academic research position, research productivity and impact and network scale (Agarwal *et al.,* 2021; Graddy-Reed, Lanahan and D'Agostino 2021). Although financing is a significant factor in increasing a university's research efficiency, there are many other factors that are equally important, the researchers must be equipped with the appropriate competencies and analytical thinking (Abramo G. *et al.,* 2017).

Funding is significant but collaboration is much more so when it comes to increasing research efficiency. The increasing multidisciplinary and complex characteristics of scientific

research often makes it difficult for the researcher to acquire all the requisite skills to achieve scientific advancement. Collaboration is helpful in overcoming these shortcomings because it provides platform for interaction among researchers specializing in different disciplines Collaboration also facilitates the researchers in generating and presenting different ideas (Katz and Martin, 1997; Rigby and Edler, 2005; Beaver, 2001). The co-authorship in research publications is one of the best examples and evidence of the collaboration, through which the researchers publish in quality journals (Solla-Price, 1963).

Lee and Bozeman (2005) find that collaboration transmits and encourages scientific knowledge and technical human capital. To study the effect of variables on research performance and collaboration, two stage least square (2SLS) method was used to analyze the data. The research productivity was measured with normal count and fractional count of peer reviewed papers from 2001 to 2003. The data of publication record obtained from Science Citation Index Expanded (SCI-Expanded) through ISI web of sciences. The researchers identified by matching name, department and university and affiliation of each co-author from CV-survey and ISI web of sciences data. The fractional count is obtained by dividing each paper with the number of co-authors. In both cases, normal and fractional count the study finds significant effect of resources, collaboration strategy, citizenship, and different scientific fields. It is important that understanding individual and environmental variables is critical for maximizing the benefits of collaborations.

Soosaraei *et al* (2018) published a research article, data was extracted from ISI Web of Sciences to determine the relationship between research publication performance and the organizational and psychosocial work environment. The study concluded that highly active and productive researchers, centers, and departments are significantly influenced by the university and psychosocial working environment. Cooperative and participative leadership, specifying and coordinating a specific study orientation, having clear goals, and encouraging autonomy are all effective leadership traits that positively impact publication efficiency (Aboagye, 2021; Hesli, and Lee 2011; Dundar and Lewis 1998). Faculty development programmes are another significant aspect that boosts a university's research productivity. Universities three roles, namely teaching, research and extension, are thought to be inextricably linked. Teaching is usually the essential part of every institution. Research is the second major component of research

universities. Faculty members take full advantage of study to expand their expertise, which they then share with their peers, enriching their academic experience (Bernales 2006). Higher qualifications, research opportunities, rewards, research expertise and faculty advancement programmes, increased research cooperation, and professional linkages, which ultimately encourage and cultivate research culture in universities (Maria *et al.,* 2014).

Phillips and Russell (1994) examined the relationship between research self-efficacy, research training environment and research productivity, there is a positive relationship between research self-efficacy and research training environment and between research self-efficacy and research productivity.

Pasupathy and Siwatu (2014) find the relationship between research self-efficacy of faculty members and research output, there is weak correlation between research self-efficacy and research output. The correlational analysis revealed that there is correlation between research self-efficacy beliefs and publication of book chapters among faculty members who conducted qualitative and quantitative research. There is a correlation between research self-efficacy beliefs and research output among qualitative researchers and there is poor correlation between research self-efficacy and research output among quantitative researchers.

The unavailability of funds, the nonexistence of research leave, low research skills, additional teaching load, negativity in faculty's attitude towards research, deficiency in research skills, a small number of university own journals, absence of professional journals, non-availability of latest books serve as the major reasons behind low research productivity and caused a decrease in the research productivity of the university faculty members in Pakistan (Iqbal and Mahmood 2011). Particularly in some specialized subjects there is low research productivity, this can be improved and adopt potential strategies to facilitate where research output is low, such as, increase funding for research and structure capacity building program for early career researchers, establishment of research centers to guide the government policy actions and programs (Oluwasanu *et al.,* 2019).

The scientific work of Abouchedid and Abdelnour (2015) analyzed the research productivity of higher education institutions (HEIs) from six Arab countries for quantifying academic research output in the area of the Middle East and North Africa (MENA). The data for

the research was obtained (through questionnaires) from 310 institutions located in Morocco, the United Arab Emirates (UAE), Qatar, Lebanon, Jordan, and Saudi Arabia. Based on statistical methods, the findings reveal that the research output of the sampled Arab countries is relatively low just displaying a lack of knowledge sector in the region.

Ciaian *et al.,* (2018) analyzed the productivity of economics research in Slovakia, using bibliometric data of twenty-six years of citations of tenure track faculty members' mostly associate professors and full professors. The study found that the majority of tenure-track faculty members (93 percent) have done nothing and have a poor research productivity. The study suggested that the TTS staff don't have sufficient research skills to supervise PhD students, it is direly needed to improve the university system and to enable associate and assistant professors to publish in quality journals.

The balance in teaching and research for faculty increases research productivity. In the last two consecutive decades, unprecedented growth and expansion have been witnessed in research and higher education in high income, middle income, and low-income countries (Iqbal *et al.,* 2018; Hu and Gill, 2000; Sharobeam and Howard, 2002). Research conducted in which Panel data used to perform fixed effect panel analysis from 2008 to 2016, it is discovered that increasing a university's graduate productivity resulted in a higher number of research papers **(**Dickson *et al.,* 2019). The scholars in high ranked universities and those in accredited business school, has greater research productivity (Amara *et al.,* 2015; Abramo *et al.,* 2018; Mangematin and Baden-Fuller 2008).

Habib *et al.,* (2019) explored in a study that how intellectual property rights (IPRs), research and development (R&D) expenditures, and human capital (HC) influence total factor productivity (TFP) leading to economic growth. The panel data technique has been used for a sample of 16 countries classified into two groups of countries: one containing of BRICS countries and the other consisting of Central and Eastern European (CEE) countries. The obtained results of the research work display, expenditures on R&D, HC, and IPRs are statistically significant and are strong factors in the determination of changes in TFP and show positive results in all sample sets. Besides, it is found that IPRs alone are unable to speed up the growth of an economy, especially in the case of emerging nations.

Similarly, the study conducted by Kelchtermans and Veugelers, (2012) says the cumulative advantage effects in academic research by investing best performance in research and its persistence for a period of time the work was based on a panel dataset containing publications by the biomedical and exact scientist in 1992-2001 period. The study tried to analyze how researchers switch between productivity categories over time. The findings indicate that approximately 25 percent achieves top performance at least once, while 5 percent is at the top on a persistent basis. Besides, gender, rank, past performance, and hierarchical position are highly significant. Nafukho *et al.,* (2019) tried to make a thorough scientific inspection of the research productivity of faculty working at two prominent public sector universities of Kenya. The analysis of the study revealed that variations were found in the research productivity of faculty concerning institution, rank, terminal degree, the period of work experience, and gender. Moreover, the findings disclose that institutional features such as enrolment of Ph.D students, enrolment of students at the undergraduate level, and allocation of funds for research purposes significantly cause differences in research productivity of the faculty. Besides, the faculty's experience was found to be an insignificant factor in their research productivity.

It is observed in a study conducted in US; the study revealed that research productivity of 1699 tenure track faculty in 76 US social work doctoral programs mainly dependent on the rank of the faculty. The associate and full professors and college age, past performance contributed to research productivity (high h-index), (Thomas *et al., 2018).* The research productivity and tenure track faculty research productivity are the contemporary topics, which sought attention of the researchers. In another study, annual pay, teaching workload, and academic work for over 700 full-time lecturers and tenure track faculty members at 37 public sector Ph.D. awarded economics departments investigated. Around 15% of the faculty members were young and female, and they taught at the university where they earned their Ph.D. They were given more courses and a larger number of students to teach. The result suggests that full time lecturers are determined for teaching assignments rather than research work while tenure track faculty are determined for research work rather than teaching assignments. (Hilmer and Hilmer, 2020).

According to Sav (2019) the issue of substitution of tenure track system and non-tenure track system trigger various questions in United Stated about the outcomes specially the performance of students. It gained special attention in public controlled and funded universities

and considered as particularly crucial. Tenure track faculty is necessary for the improvement of graduation rates of students. Results of the study indicated that the tenure track faculty is the most effective and productive approach in the public or public funded universities of US. The study further concludes that tenure track system has a negative effect on the performance of students at doctoral level while has a positive impact on the performance of master level students. But the research productivity is differing in both levels. For the students of doctoral universities, the productivity of non-tenure-track faculty is estimated a productivity increase is 0.3 percent. Tenured faculty added 2.4 percent in productivity in the same universities. In the master level universities, the non-tenure-track faculty increased productivity by 0.1 percent but statistically insignificant. However, the tenured faculty added 2.8 percent productivity. Tenure-track professors have differing impacts at different levels of the university.

Allen and Sweeney (2017) conducted a research study which focuses on the two types of appointments done in US in educational institutes and what effects does that have on the research productivity in the colleges and universities. The two types of appointments are tenure and non-tenure tracks. Tenure appointments are traditional long-term contracts, while non-tenure is 3 years, performance-based contracts. The research is trying to answer the question: which type of appointments are producing more research productive and peer reviewed journal? The research was conducted keeping in view the rise of non-tenure track hiring in educational institutes for financial gains and more performance-based results. The study is conducted over 2 business schools in Florida. The only difference is appointment, one is tenure track and other is non-tenure. To investigate the potential effect of employment contracting approaches, this study controls for gender, race, faculty experience and academic discipline as potential factors of research productivity. The study includes 129 faculty members (46 non-tenured and 83 tenured) from both universities. To study the data set, regression analysis is used on it to investigate the primary variable of appointment type while controlling other variables that may influence the outcome. The research concluded that non-tenure track appointments published 0.44 percent fewer peer reviewed journals than tenure appointments. The findings of this study show that, controlling other variables that may influence research performance, tenure-granting faculty are more productive in their research than non-tenure track faculty.

Many studies focused on research factors that have a colossal impact on a university's research productivity and faculty individual performance. (Olson, 1994; Mody *et al.,* 2018;

Bonaccorsi *et al.,* 2017; Heng at al., 2020). Among these factors the researchers consider the trained and qualified faculty is the important one.

HEC introduced the TTS in public sector universities in the country, with an aim to attract qualified faculty and to increase the research productivity of the universities. The purpose of the ongoing research is to study the impact of TTS policy on research productivity at the university level in Pakistan. For the purpose a panel regression model is used to capture the effect of TTS faculty on research productivity at the university level. The results will aid academics and university administrators in better understanding the concept of TTS faculty role in research productivity of university and give guidance how to improve it.

5.2.1 Literature Gap

Previous studies on the subject examine the impact of TTS mode of appointment on university productivity have been carried out in the case of developed countries. This study will fill the gap to evaluate the impact of TTS mode of appointment on university productivity in Pakistan a developing country. Besides the previous studies that mainly restricted to cross sectional or time series data whereas, this study has used panel data set in order to investigate the impact of TTS of appointment on university productivity in Pakistan, Due to its advantages in terms of efficiency, control of confounding factors, ability to capture dynamics, and statistical power for causal inference, panel data is often considered more powerful in certain research contexts compared to cross-sectional or time-series data.

5.3 Data and Variable Construction

5.3.1 Data Source

Primarily, the main source of data of the underlying research is ISI web of sciences, Scopus, and Higher Education Commission. By using the digital library portal of HEC, we have extracted the data for required variables from different annual reports published by HEC. Such access to digital library enables us to extract the data from Thompson Reuters ISI Web of Science and Elsevier Scopus. The focus of the data collection was public universities since the treatment variable of the study is TTS which is only implemented in public universities. For empirical purposes, the available data for 117 public sector universities from 2002 to 2017 has been exploited. The pooled yearly and sampled university data make 1791 observations. Nonetheless, there are missing values and unavailability of information for certain years for some universities. Hence, final data is unbalanced panel data because some universities are old established before 2002 since HEC being inexistence and some universities have been coming into existence since 2002. Moreover, during estimating the model, there may be loss of some values due to missing values in utilized variables.

5.3.2 Variable Construction

5.3.2.1 Research Productivity

The ongoing research has measured research productivity by using four indicators: i) number of research papers published by a sampled university, ii) total number of citations of published research papers by a sampled university, iii) H-index, and iv) Number of PhD produced by a university. Among those, H-index needs more explanation of how it is generally measured and described which is discussed as follows.

Different researchers have proposed a wide range of indicators to measure institutional research productivity. An extensively used measure around the world is a summative index created by encompassing publications in peer-reviewed journals, books, and conference papers. For instance, the h-index is an indicator constructed on the citation and publication counts (Hirsch, 2010; Abramo & Angelo, 2014). Some other scholars proposed a series of factors that should be considered to evaluate the research productivity such as; memberships for research

collaborations (White *et al*., 2012), academic outcomes of faculty members like supervision of research students (Altbach, 2015), amount and number of grants received by the faculty members (Porter & Umbach, 2001; Altbach, 2015), and a supportive environment for research (Walker & Fenton, 2013) In this study, the main proxy we used to measure the research productivity is the h-index.

According to Hirsch (2005) "A scientist has index h if h of his/her N_p total publications have at least h citations each, and the other $(N_p - h)$ papers have no more than h citations each". For instance, a researcher has 5 papers with 1, 2, 6, 7, and 9 citations, then the h-index of this researcher is 3 because he/she has 3 papers with more than or equal to 3 citations. For university, it means the largest number of h such that at least h papers from that particular university are cited at least h times each. This index was created by physicist Hirsch (2005) to evaluate the research productivity of faculty members. Moreover, the h-index is highly correlated with different academic rankings of global universities such as Shanghai Ranking (Huang, 2012).

For robustness and comparative analysis, the study has used total number of research paper published, and total citations as separate measures to research productivity as available literature has also done following (Allison & Long, 1987; Xie & Shauman, 1998; Prpić, 2002; Hunter & Leahey, 2010; Cattaneo *et al.,* 2016; Lee, 2020). In addition, the study also measures PhD produced by Higher Education Institutions (HEIs) as productivity of the sampled universities. A brief description of these variables is presented in table 5.1.

5.3.3.2 Explanatory/Treatment Variable

The goal of this study is to evaluate the impact of TTS-based appointments by HEC on the professoriates' research productivity at the university level in Pakistan. The description of research productivity has been discussed in previous section, this sub-section lays down discussion on measurement of the independent variable or treatment variable of the on-going research. As the analysis is at university level (unit of analysis), we have employed independent variables in two ways to check the sensitivity and robustness of the findings: i) percentage ratio of the TTS faculty to the total faculty of university, and ii) a binary variable has been constructed where 1 is assigned if university has TTS faculty, otherwise 0. These both measures have helped

to estimate the influences of TTS policy on research productivity at university level. Moreover, these measures contribute to making the analysis robust.

As we have detailed discussion on the mechanism of TTS mode of appoint in chapter 02, which explains that TTS policy has been introduced by the HEC since its inception in 2002 against the prevailing mode of appoint known as Basic Pay Scale (BPS). Basically, TTS is a choice-based incentive which provides additional monetary benefits to the employee. Therefore, HEC expects that this incentive may increase the productivity of the appointees of TTS, which could increase the overall performance of universities as well.

5.3.3.3 Control Variables

As we have discussed that research productivity is dependent variable, and TTS appointment is explanatory or treatment variable, there are some other factors as well which have significant influences on research productivity at university level. The detailed description of employed such variables is given as follows.

Recurring grant: it is measured as the total annual grant (PKR million) which is allocated to the universities by HEC in order to maintain salaries, utilities bills, and other infrastructure related expenditures.

Research grant: One of the variables that can affect university's research productivity is the provision of grant. It is also measured as the total annual grant (PKR million) which is allocated to the universities by HEC in order to let flourish the research productivity and environment in universities.

Age of universities: it is measured in years on the basis of the year of establishment of the universities.

Size of universities: it is the annual accumulated total enrollment in sampled universities.

Presence of Business Incubation Center (BIC): it is a binary variable wherein 1 is assigned if sampled university has BIC, otherwise 0. This variable measures the prevalence of research facilities and environment. Business incubators are organizations that assist new and startup companies in their early stages of development by offering a range of specialized resources and services.

Table 5.1: A brief description of the variables

Variables	Brief Description of Variables	Unit
Dependent Variables		
Research papers	No. of total research papers in a university	Discrete
Citation	Total number of citations of published research paper in university	Discrete
H-index	University level H-index	index
PhD produced	Total number of PhD produced by a university	Discrete
Explanatory/ Treatment Variables		**Unit**
TTS Faculty Ratio	Total TTS faculty divided by total faculty in a university and multiplied by 100	%
TTS (*binary*)	1 is assigned to TTS faculty, and otherwise 0	Binary
Control Variables		**Unit**
University age	Number of years from establishment of university (base year)	Years
University size	It is indicated by total enrollment in a sampled university	Number
Research grant	Total research grant (PKR) to university by HEC	million
Recurring grant	Total recurring grant (PKR) to university by HEC	million
ORICs	1 is assigned if university has ORICs, 0 otherwise	Binary
BIC	1 is assigned if university has BIC,0 otherwise	Binary
QEC	1 is assigned if university has QEC, 0 otherwise	Binary
Old university	1 is assigned if university is established before 2002, otherwise 0	Binary
Provincial	Provincial dummies are generated for four provinces of Pakistan	Binary

Presence of Office of Innovation, Research and Commercialization (ORICs): a binary variable has been used to unleash the impacts of ORICs on university level research productivity wherein 1 is assigned if sampled university has ORICs, otherwise 0. Likewise, BIC, this variable

also measures the facilitation of research environment. Moreover, it also measures the facility of research collaboration amongst the researchers.

Quality Enhancement Cell (QEC): a binary variable has been used to unleash the impacts of QEC on university level research productivity wherein 1 is assigned if sampled university has QEC, otherwise 0.

Provincial Dummies: Although study maintains focus on estimation of university fixed effect model, but for sensitivity analysis, random fixed effect has been also used, wherein we have used provincial dummies for four provinces such as Punjab, Khyber Pakhtunkhwa (KP), Sindh, and Balochistan. The study has used Balochistan as reference group.

5.4 Empirical Model

The paramount objective of this study is to evaluate the impact of TTS incentive-based appointment on research productivity at university level. In case of the pooled data set (as in our case) two regression techniques, fixed effect, or random effect model, are usually employed to estimate the treatment effect (Asteriou & Hall, 2008; Wooldridge, 2015). Since The unit of analysis is public sector university, we have to implement university fixed effect or random effect models. To meet the objective of this research, university fixed effect approach seems more plausible as compared to university random effect because university fixed effect captures the unobservable heterogeneity across the universities which could provide more consistent and efficient estimates as compared to random effect. Such choice is also observed empirically as well by implementing the Hausman test. Bell and Jones (2015) also postulate that the fixed effects model is a better and found to be a more reliable method to control the unobserved heterogeneity since it enables connection between the unobserved effects and explanatory variables.

Hence, the study has implemented the university fixed effect model as an empirical strategy. For empirical purposes, the specification of the model is given as follows.

$$Y_{it} = \alpha_i + \beta TTS_{it} + \gamma X_{it} + \delta Z_{it} + \varepsilon_{it} \quad (5.1)$$

Where Y_{it} is the dependent variable of the model which represents the research productivity: i) total number of published research papers, ii) total number of citations, iii) H-

index, and iv) total number of PhD produced by university *i* indicates university while time is denoted by *t*. For each dependent variable the model has been estimated separately. TTS_{it} indicates the TTS faculty in university i in time t. The study uses TTS (independent variable) in two ways for estimating the model separately: a) percentage of TTS faculty to the total faculty in university i and time t, and b) binary variable whether public university has TTS faculty or not (1 for TTS, otherwise 0).

Likewise, X_{it} denotes control variables such as university size, age of university, and recurring and research grants whereas Z_{it} demonstrates the vector of research infrastructure as control variable such as ORICs, BIC, and QEC in university *i* and time *t* while ε_{it} is the disturbance term of the model. Fixed effect intercept term is denoted by α_i which captures the university level heterogeneity across the universities while $\beta, \gamma,$ and δ are the coefficients of the independent variables.

The study has applied two major specifications by changing the construction of independent variables. These two specifications are given as follows.

Log of TTS faculty ratio: we have used log of percentage TTS ratio to total faculty, and all other independent variables as well except binary variables. The specification for this construction is given as follows.

$$Y_{it} = \alpha_i + \beta_1 \log(\text{TTSR})_{it} + \gamma_1 \log(\text{age})_{it} + \gamma_2 \log(size)_{it} + \gamma_3 \log(Rcg)_{it} + \gamma_4 \log(Rsg)_{it} + \delta_i Z_{it} + \varepsilon_{it} \quad (5.2)$$

Equation (5.2), again Y_{it} denotes four indicators of research productivity which are without log form as we have discussed in equation 5.1, while log (TTSR) denotes log of percentage TTS faculty ratio, log (age) denotes log of university age, log (size) measures log of university size, log (Recg) denotes the log of recurring grant, and log (Rsg) indicates the log of research grant to universities. Moreover, Z_{it} denotes the dummy variables if universities have BIC, ORIC, and QEC separately. Model 5.2 is estimated for each dependent variable. For econometric analysis the following considerations have been kept in view.

i. When dependent variables total number of research papers are published, total number of citations, and total number of PhD produced are used as dependent

variables, the study has implemented Poisson fixed effect model. Moreover, the alternative of Poisson, the study has implemented Negative Binomial fixed effect model has applied due to discrete form of dependent variables. Standard econometrics has suggested that in the case of discrete variable is Poisson regression model is suggested. If the property of equal mean and variance is violated, Negative Binomial regression model should be estimated (Wooldridge, 2002).

ii. Apart from Poisson and Negative Binomial fixed effects, OLS fixed effect model is also estimated to uncover the differences in impact of TTS and BPS.

iii. When dependent variable is H-index, we applied OLS fixed effect model because it is not a discrete variable.

iv. Apart from fixed effect, we have applied university random effect as well to check the sensitivity of the analysis.

v. Moreover, we have also used the log of dependent variables to check what happens the results, but for this we have applied OLS fixed effect because of log of dependent variables.

When TTS is binary variable: the study also has implemented the binary variable of TTS where 1 is assigned if universities have TTS faculty, and otherwise 0. The rest of the structure remains the same.

All of the analytical procedure is repeated using binary TTS variable Hence, we estimate equation 5.3 where the dependent variable is Dummy $(TTS)_{it}$ instead of $\log (TTSR)_{it}$ in equation 5.2. The rest of the analysis follows the same structure and specification.

$$Y_{it} = \alpha_i + \beta_1\, Dummy\,(TTS)_{it} + \gamma_1 \log (age)_{it} + \gamma_2 \log (size)_{it} + \gamma_3 \log (Rcg)_{it} + \gamma_4 \log (Rsg)_{it} + \delta_i Z_{it} + \varepsilon_{it} \quad (5.3)$$

In above equation, remaining all setting is same as we have discussed for equation 5.2, only difference is that we have used binary form of the TTS variable which is denoted by *Dummy TTS*. Moreover, all econometric considerations we have taken in the case of previous equation, all those are also implemented for this equation as well.

It is worth mentioning that despite the use of aggregate data and fixed effects method to control unobserved heterogeneity, there still could be issues of selection bias. For instance, universities that decide to improve research productivity may also simultaneously decide to have a TTS intensive faculty. The TTS variable may pick up the effect of other changes that could be associated with research productivity. Hence, these could potentially affect the claim of causal effect of TTS on research productivity, and we will refrain from making these as such.

5.5 Results and Discussion

This section is replete with discussion on empirically obtained findings. As the objective of the research is to evaluate the impacts of TTS faculty induction by HEC on research productivity at university level, for this purpose, university fixed effect is implemented. We have estimated separate models for three indicators of research productivity additionally with number of PhD produced as we have discussed in previous section. The following sections presents the detailed description of the estimated empirical models.

5.5.1 Impact of TTS Faculty Induction on Research Productivity

Primarily, research productivity is measured with H-index. In the academic community, the h-index has attained considerable acceptance and recognition. We have estimated the models for log of H-index and without log specification. Moreover, these models are estimated separately for log of TTS faculty ratio and binary variable whether university contains TTS faculty or not. Our premier discussion based on university fixed effect[13]. However, university random effect is also implemented to check the sensitivity of the findings.

Table 5.2 contains the estimated results for H-index from both university fixed and random effect. The estimated results for log of TTS faculty ratio on H-index are showing positive and significant influences when H-index is specified in both without and with log form. The estimated result of university fixed effect is demonstrated that one percent increase in TTS faculty relative to total faculty, other things remaining same, is associated with a 9% (i.e.,

[13] The application of Hausman test has suggested that university fixed effect gives more appropriate and efficient results as compared to the university random effect. the null hypothesis that random effect model is more efficient can be rejected on the basis of the values of Chi-Square = 39.63 and p-value = 0.0001 Similarly, the Hausman test is applied for all other outcome variables where university fixed effect is estimated.

0.0925) increase in overall H-index when H-index in log form. Similar sort of the findings is estimated from the implementation of the university random effect, which demonstrates that these findings are robust and are not sensitive to changing the alternative technique.

Apart from log of TTS faculty ratio, the estimated results (shown in table 5.2) obtained from binary variable whether university contains TTS faculty or not. The university fixed effect is also indicating the positive and significant impacts of binary TTS faculty variable on H-index at university level. Such results seem quite strong and more significant as compared to the log of TTS faculty ratio. The results demonstrate that other things remaining the same, those universities which have TTS faculty are showing on average, 21% higher improvement in H-index. The result indicates that the TTS faculty has greater participation in research activities as compared to BPS faculty.

Table 5.2: Impacts of TTS Policy by HEC on H-index

	University Random Effect				University Fixed Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	**H-index**	**Log H-index**	**H-index**	**Log H-index**	**H-index**	**Log H-index**	**H-index**	**Log H-index**
TTS faculty (1=TTS, 0=other)			3.460***	0.270***			2.918*	0.214**
			(1.328)	(0.0969)			(1.487)	(0.103)
Log TTS faculty ratio	2.278***	0.0912*			2.216***	0.0925*		
	(0.705)	(0.0474)			(0.745)	(0.0493)		
Log university age	0.532	0.267*	0.555	0.282*	-1.326	0.189	-1.566	0.216
	(1.427)	(0.150)	(1.596)	(0.152)	(1.963)	(0.174)	(2.120)	(0.181)
Log university size	0.429	0.0680	0.417	0.0624	-0.238	0.0464	-0.0664	0.0431
	(0.688)	(0.0637)	(0.777)	(0.0715)	(0.800)	(0.0838)	(1.007)	(0.0943)
Log research fund	1.399***	0.0711**	1.578***	0.0674**	1.019**	0.0469	1.137**	0.0444
	(0.496)	(0.0337)	(0.509)	(0.0336)	(0.465)	(0.0305)	(0.442)	(0.0308)
Log recurring fund	3.184***	0.244***	3.681***	0.223**	4.446***	0.328***	5.182***	0.295***
	(0.954)	(0.0945)	(1.214)	(0.0918)	(0.926)	(0.0966)	(1.219)	(0.0985)
ORICs (1=yes, otherwise 0)	-0.293	0.0230	-0.331	0.0120	-0.360	0.0103	-0.321	0.00568
	(0.886)	(0.0640)	(0.846)	(0.0626)	(0.830)	(0.0634)	(0.761)	(0.0631)

	University Random Effect				University Fixed Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	**H-index**	**Log H-index**	**H-index**	**Log H-index**	**H-index**	**Log H-index**	**H-index**	**Log H-index**
BIC (1=yes, otherwise 0)	3.016**	0.0966	3.515**	0.111	2.747*	0.0904	3.124*	0.0947
	(1.508)	(0.0951)	(1.686)	(0.0950)	(1.446)	(0.0995)	(1.611)	(0.100)
QEC (1=yes, otherwise 0	-1.574**	0.0350	-1.359*	0.0510	-1.783**	0.0255	-1.569**	0.0389
	(0.713)	(0.0735)	(0.698)	(0.0750)	(0.748)	(0.0739)	(0.744)	(0.0770)
Old university (1=yes)	4.897**	0.110	4.629*	0.127				
	(2.465)	(0.179)	(2.632)	(0.186)				
Punjab	0.512	-0.0161	0.630	-0.0143				
	(2.702)	(0.187)	(2.803)	(0.192)				
KP	-3.372	-0.119	-3.068	-0.122				
	(2.585)	(0.172)	(2.635)	(0.177)				
Sindh	-3.387	-0.389	-4.379	-0.354				
	(3.282)	(0.283)	(3.684)	(0.277)				
Constant	-25.51***	-1.076**	-28.52***	-0.996**	-15.04**	-0.825	-19.86**	-0.730
Observations	465	465	465	465	465	465	465	465
Number of universities	71	71	71	71	71	71	71	71

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Similarly, the estimated impacts of binary TTS faculty variable are found positive and significant from estimated university random effect. In short, on the whole, empirically estimated results are making it evident that TTS policy by HEC has beneficial impacts on H-index at university level which is the proxy of research productivity by underlying research. It implies that other things remaining the same; the TTS policy is a potentially contributing factors in enhancing the research productivity at university level.

Estimated results of the control variables (shown in table 5.2) indicate that research and recurring grants for universities by the HEC has statistically significant and positive impacts on improving the research productivity at university level. Unlike this, on the whole, university age, university size, and other factors are not showing as significant impacts as research and recurring grants are demonstrating the influences on H-index. The establishment of quality enhancement cell (QEC), and business incubations center (BIC) also has positive and significant impacts on H-index.

5.5.2 Impact of TTS Policy on Number of Publications

In the previous section, we estimated the impact of TTS policy on H-index. This section sheds light on the impacts of TTS policy on total number of published research papers, which further helps us to analyze the sensitivity of H-index. Number of published research papers is discrete variable in nature; therefore, we have applied Poisson and Negative Binomial fixed effects also to check the sensitivity of influences while in the case of log form of the number of published papers, we remain on OLS fixed effect.

The estimated results obtained from OLS fixed effect indicate that log of TTS faculty ratio has positive and significant impact on the number of total published research papers at university level. The findings imply that other things remaining the same, one percent increase in TTS faculty has caused 10% increase in total published research papers at university level. Such increase comes off owing to one percent increase in TTS faculty ratio at university level. Moreover, when dependent variable is without log form, impact of TTS policy is also statistically significant. The underlying research also estimates the university random effect model in order to test the sensitivity; on the whole, findings demonstrate that results are similar in terms of sign and significant (shown in table 5.3).

Table 5.3: Impacts of TTS Policy on Number of Published Research Papers

	OLS Random Effect				OLS Fixed effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	**No. research paper**	**Log (no. research paper)**	**No. research paper**	**Log (no. research paper)**	**no. research paper**	**Log (no. research paper)**	**No. research paper**	**Log (no. research paper)**
TTS Faculty			43.80	0.276*			-4.526	0.135
(1=yes, 0=no)			(32.01)	(0.163)			(53.06)	(0.154)
Log TTS fac. ratio	69.15***	0.163**			75.12***	0.103*		
	(20.47)	(0.0692)			(25.54)	(0.061)		
Log age	-15.52	0.830***	-29.75	0.825***	-80.74	0.752***	-115.4	0.737**
	(31.25)	(0.285)	(40.21)	(0.295)	(68.55)	(0.278)	(79.14)	(0.279)
Log size	31.08*	0.269*	22.09	0.274*	13.32	0.215	25.56	0.225
	(18.58)	(0.141)	(19.25)	(0.155)	(26.53)	(0.175)	(30.56)	(0.186)
Log research fund	50.12***	0.118***	70.63***	0.128***	7.115	0.0702**	15.73	0.0756**
	(18.34)	(0.0407)	(23.88)	(0.0437)	(13.28)	(0.0323)	(14.28)	(0.0343)
Log recurring fund	61.56**	0.604***	92.91**	0.634***	108.7***	0.773***	175.3***	0.808***
	(25.27)	(0.188)	(38.28)	(0.197)	(30.79)	(0.150)	(47.97)	(0.154)
ORICs (1=yes)	-17.94	0.0954	-15.89	0.0913	-14.92	0.0809	-9.100	0.0823
	(28.20)	(0.146)	(32.93)	(0.147)	(27.16)	(0.141)	(29.80)	(0.141)
BIC (1=yes)	-1.369	-0.0531	30.62	-0.0172	-26.59	-0.0588	-8.847	-0.0379
	(41.18)	(0.170)	(53.00)	(0.173)	(39.12)	(0.169)	(49.35)	(0.173)
QEC (1=yes)	-74.52***	-0.157	-72.2***	-0.140	-75.8***	-0.154	-74.4***	-0.144
	(18.52)	(0.112)	(20.61)	(0.114)	(17.94)	(0.117)	(20.54)	(0.120)
Old university	50.20	-0.510	41.44	-0.514				
	(42.29)	(0.345)	(42.99)	(0.359)				
Punjab	-13.10	0.0842	-15.13	0.114				
	(60.17)	(0.354)	(65.16)	(0.367)				
KP	-85.02	-0.252	-77.92	-0.226				
	(56.65)	(0.407)	(58.35)	(0.423)				
Sindh	-29.98	-1.186*	-85.29	-1.236**				
	(58.94)	(0.606)	(73.12)	(0.618)				

	OLS Random Effect				OLS Fixed effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	**No. research paper**	**Log (no. research paper)**	**No. research paper**	**Log (no. research paper)**	**no. research paper**	**Log (no. research paper)**	**No. research paper**	**Log (no. research paper)**
Constant	-867.5***	-4.7***	-989.6**	-5.01***	-493.8*	-5.02***	-838.3**	-5.257***
	(216.9)	(0.990)	(252.6)	(1.015)	(247.7)	(1.228)	(335.1)	(1.252)
Observations	465	441	465	441	465	441	465	441
No. of university	71	67	71	67	71	67	71	67

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Apart from log of TTS faculty ratio, binary variable form of the TTS faculty demonstrates insignificant impacts in the case of fixed effect model while random effect indicates significant impact on the number of research papers. These insignificant could be due to the misspecification of the econometric technique because number of papers published is a discrete variable.

Table 5.4: Application of Poisson Regression Model on No. of Published Research Paper

No. of Research pap.	**University Random Effect**				**University Fixed Effect**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Poisson	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**
TTS faculty (1=TTS, 0=other)			0.179***	1.196***			0.179***	1.196***
			(0.0188)	(0.0225)			(0.0188)	(0.0225)
Log TTS faculty ratio	0.144***	1.155***			0.144***	1.155***		
	(0.00742)	(0.00857)			(0.00744)	(0.00859)		
Log university age	0.969***	2.636***	0.839***	2.314***	0.980***	2.663***	0.846***	2.330***
	(0.0456)	(0.120)	(0.0461)	(0.107)	(0.0460)	(0.122)	(0.0465)	(0.108)
Log university size	0.0747***	1.078***	0.151***	1.163***	0.0697***	1.072***	0.148***	1.160***
	(0.0218)	(0.0235)	(0.0218)	(0.0254)	(0.0219)	(0.0235)	(0.0219)	(0.0255)
Log research fund	0.0508***	1.052***	0.0564***	1.058***	0.0504***	1.052***	0.0559***	1.057***
	(0.00860)	(0.00905)	(0.00863)	(0.00913)	(0.00860)	(0.00904)	(0.00863)	(0.00912)
Log recurring fund	0.695***	2.003***	0.803***	2.233***	0.695***	2.004***	0.804***	2.234***
	(0.0209)	(0.0419)	(0.0211)	(0.0472)	(0.0210)	(0.0420)	(0.0212)	(0.0474)
ORICs (1=yes, otherwise 0)	0.0488**	1.050**	0.0604***	1.062***	0.0495**	1.051**	0.0610***	1.063***
	(0.0228)	(0.0239)	(0.0228)	(0.0242)	(0.0228)	(0.0240)	(0.0228)	(0.0242)
BIC (1=yes, otherwise 0)	-0.0248	0.975	-0.0205	0.980	-0.0257	0.975	-0.0212	0.979
	(0.0303)	(0.0295)	(0.0303)	(0.0297)	(0.0303)	(0.0295)	(0.0303)	(0.0297)
QEC (1=yes, otherwise 0	-0.158***	0.853***	-0.195***	0.823***	-0.158***	0.854***	-0.195***	0.823***
	(0.0251)	(0.0214)	(0.0255)	(0.0209)	(0.0251)	(0.0214)	(0.0255)	(0.0210)

No. of Research pap.	University Random Effect				University Fixed Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Poisson	IRR	Poisson	IRR	Poisson	IRR	Poisson	IRR
Old university (1=yes)	-0.695**	0.499**	-0.675**	0.509**				
	(0.295)	(0.147)	(0.300)	(0.153)				
Punjab	-0.468	0.626	-0.479	0.619				
KP	-0.554	0.575	-0.501	0.606				
Sindh	-1.054**	0.349**	-1.203***	0.300***				
Constant	-2.691***	0.0678***	-3.555***	0.0286***				
Observations	465	465	465	465	440	440	440	440
No. of universities	71	71	71	71	58	58	58	58

IRR=incidence rate ratio, standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

As the number of research papers published is discrete variable if it is without log form, we have applied Poisson and Negative Binomial regression models to estimate the impacts of TTS.

Table 5.6 encompasses impact the results estimated from the application of Poisson regression[14]. The empirical results are suggestive that effects of both log of TTS faculty ratio and binary TTS faculty are found highly significant and positive impacts on number of research paper published at university level. In order to trace out the sensitivity analysis, Poisson random effect is also executed which demonstrates the similar strong evidence as the case of fixed effect Poisson regression model. So, the main findings for impacts of TTS policy on number of research papers is based on Poisson fixed effect model. These findings substantiate that other thing remaining same, TTS policy by the HEC has advantageous and significant influences on the research productivity in terms of number of research paper published at university level. These results (shown in table 5.4) remain robust which are found positive and statistically significant for both definition of the TTS faculty variable-log of TTS faculty ratio and binary variable of TTS faculty.

The study has applied Negative Binomial regression model (shown in table 5.9 in appendix in the end of this chapter) as well in order to check the sensitivity of the results obtained from Poisson regression model, because there is a strong assumption of Poisson which should not be violated: equality of mean and variance. Hence, the execution of Negative Binomial university fixed effect is also establishing the positive and significant effects on research productivity in terms of publication of number of research papers. Again, these positive effects are found for both percentage of TTS faculty ratio and binary variable whether university has TTS faculty or not.

The effects of control variables are showing (table 5.4) that university age, university size, research, and recurring grants by the HEC are showing the positive and significant impacts on the publication of research papers at university level. Similarly, the establishment of ORICs, BIC, and QEC are also demonstrating the positive and significant impacts on research

[14] In the case of log specification of the number of publications we estimate Poisson and Negative binomial regression.

productivity at university level. Moreover, provincial dummies also showing the impacts in the case of random effect models for both types of the description of TTS policy variables.

5.5.3 Impacts of TTS Policy on Total Number of Citations

Similar to discussion on results obtained for number of research papers published at university level, the study has followed the same econometric strategies, because the nature of the variable is same as the case of research paper published.

Table 5.5 contains the estimated results obtained from OLS fixed effect. The estimated results demonstrate that log of TTS faculty ratio is showing positive and significant impacts on research productivity which is also indicated by number of citations. The findings obtained from OLS fixed effect imply that other things remaining same, one percent increase in TTS faculty ratio is causing around 17% increase in the citations of university. It highlights that total faculty ratio increase causes the increment in research productivity in terms of research publications which also enhances the citation of the publications. Although these are not much highly significant findings in the case OLS fixed effect.

Similarly, the binary variable whether university contains any TTS faculty or not is also showing the positive and significant impacts on the number of citations. The findings obtained by using TTS binary variable indicate that other things remaining constant, the citations of research publications are 43% higher for those universities which have TSS faculty relative to those universities which do not have any TTS faculty (shown in table 5.5). In order to check the sensitivity, random effect model is also applied which have similar sort of findings as we have discussed for fixed effect model. In addition, the description of TTS policy variables also showing positive and significant impacts on increase in citations.

Findings for control variables disclose that research and recurring grants for universities by the HEC has statistically significant and positive impacts on improving the number of citations which is also a proxy of research productivity. Unlike this, by and large, university age, university size, and other factors are not showing as significant impacts as research and recurring grants are demonstrating the influences on H-index (shown in table 5.5). The establishment of quality enhancement cell (QEC), and business incubations center (BIC) also has positive and significant impacts on the number of citations.

Table 5.5: Effects of TTS Policy on Number of Citations

	Random Effect				OLS Fixed effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	**Citation**	**Log Citation**	**Citation**	**Log Citation**	**Citation**	**Log Citation**	**Citation**	**Log Citation**
TTS faculty (1=TTS, otherwise 0)			729.6*	0.583***			628.4	0.438*
			(424.0)	(0.219)			(571.2)	(0.230)
Log TTS faculty ratio	671.2***	0.241**			755.7**	0.179*		
	(247.0)	(0.0958)			(288.3)	(0.0968)		
Log university age	-231.5	0.677*	-244.3	0.704*	-965.9**	0.506	-1142**	0.539
	(231.8)	(0.396)	(283.0)	(0.409)	(460.3)	(0.445)	(555.8)	(0.465)
Log university size	103.9	0.143	76.78	0.136	-95.61	0.0882	-14.24	0.0895
	(152.1)	(0.135)	(162.1)	(0.155)	(150.5)	(0.171)	(179.6)	(0.197)
Log research fund	241.6	0.120	347.5*	0.121	77.91	0.0652	134.6	0.0658
	(148.5)	(0.0760)	(186.3)	(0.0767)	(130.7)	(0.0692)	(149.5)	(0.0695)
Log recurring fund	501.4**	0.668***	721.6**	0.653***	840.7***	0.866***	1,239**	0.844***
	(213.3)	(0.238)	(324.8)	(0.240)	(254.4)	(0.236)	(414.6)	(0.242)
ORICs (1=yes)	-9.182	0.0351	-6.748	0.0177	-18.27	0.0100	11.13	0.00449
	(282.0)	(0.148)	(309.1)	(0.146)	(249.2)	(0.149)	(275.0)	(0.147)
BIC (1=yes)	676.3	0.187	870.4	0.228	579.8	0.171	725.9	0.192
	(593.5)	(0.201)	(708.1)	(0.203)	(536.2)	(0.209)	(653.8)	(0.212)
QEC (1=yes)	-589.2**	0.0182	-548.4***	0.0538	-649***	0.00352	-597***	0.0321
	(151.4)	(0.152)	(162.5)	(0.163)	(162.0)	(0.158)	(171.4)	(0.167)

	Random Effect				OLS Fixed effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Citation	Log Citation	Citation	Log Citation	Citation	Log Citation	Citation	Log Citation
Old university	1,154**	0.251	1,017*	0.264				
	(538.1)	(0.448)	(542.3)	(0.467)				
Punjab	-119.3	0.0477	-104.5	0.0575				
	(637.6)	(0.429)	(666.8)	(0.442)				
KP	-1,097*	-0.523	-1,006	-0.514				
	(653.3)	(0.398)	(647.9)	(0.415)				
Sindh	-269.6	-1.027	-700.3	-1.007				
	(696.9)	(0.738)	(852.1)	(0.723)				
Constant	-4,82***	-2.577**	-59***	-2.583**	-1,236	-2.064*	-3,522	-2.099
Observations	465	465	465	465	465	465	465	465
No. of university	71	71	71	71	71	71	71	71

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Again, this variable is also discrete in nature, so we have applied Poisson fixed effect model to unleash the impacts of TTS policy on number of citations. Table 5.6 contains the findings estimated from the implementation of Poisson regression. The estimated results are suggestive that effects of log of TTS faculty ratio are found highly significant and positive impacts on number of citations at university level.

Similarly, the effects of TTS binary variable whether the university contains TSS faculty or not has also demonstrated the positive and significant impacts on number of citations at university level. On the whole, these results appeared to be highly significant and strong as compared to the OLS fixed effect (shown in table 5.5).

In order to trace out the sensitivity analysis, Poisson random effect is also applied, which has demonstrated similar evidence as the case of fixed effect Poisson regression model. Again, the main findings for impacts of TTS policy on number of research papers is based on Poisson

fixed effect model. These findings substantiate those other things remaining same, TTS policy by the HEC has beneficial and significant impacts on the number of citations at university level. These impacts are found robust even though we changed construction of the TTS faculty variables-log of TTS faculty ratio and binary variable of TTS faculty (shown in table 5.6).

We have applied Negative Binomial regression model as well in order to check the sensitivity of the results obtained from Poisson regression model, because there is a strong assumption of Poisson which should not be violated: equality of mean and variance. Hence, the execution of Negative Binomial university fixed effect is also establishing the positive and significant effects on research productivity in terms of citation (table 5.10 in appendix of this chapter). Again, these positive effects are found for both percentage of TTS faculty ratio and binary variable whether university has TTS faculty or not.

Likewise, the total number of papers published the impacts of control variables show that university age, university size, research, and recurring grants by the HEC are showing the positive and significant impacts on the citations at university level. Similarly, the establishment of ORICs, BIC, and QEC are also demonstrating the positive and significant impacts on quality of research productivity at university level which is estimated by number of citations. In addition, provincial dummies also showing the impacts in the case of random effect models for both types of the description of TTS policy variables (shown in table 5.6).

In sum the discussion weaved up on three indicators of the research productivity are suggesting that by and large, TTS policy by the HEC has significant impacts on research productivity at university, which is evidently beneficial policy by the HEC.

Table 5.6: Results obtained from Poisson Regression Model for Number of Citations

	Random Effect Models				Fixed Effect Models			
Citation	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
VARIABLES	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**
TTS faculty (1=TTS, 0=other)			0.494***	1.638***			0.494***	1.639***
			(0.00545)	(0.00892)			(0.00545)	(0.00893)
Log TTS faculty ratio	0.149***	1.161***			0.149***	1.161***		
	(0.00206)	(0.00239)			(0.00206)	(0.00239)		
Log university age	1.247***	3.480***	1.435***	4.198***	1.249***	3.486***	1.436***	4.205***
	(0.0146)	(0.0508)	(0.0153)	(0.0644)	(0.0146)	(0.0509)	(0.0154)	(0.0646)
Log university size	-0.451***	0.637***	-0.368***	0.692***	-0.452***	0.637***	-0.369***	0.691***
	(0.00696)	(0.00444)	(0.00702)	(0.00486)	(0.00696)	(0.00443)	(0.00702)	(0.00485)
Log research fund	0.0404***	1.041***	0.0463***	1.047***	0.0403***	1.041***	0.0463***	1.047***
	(0.00277)	(0.00289)	(0.00280)	(0.00293)	(0.00277)	(0.00289)	(0.00280)	(0.00293)
Log recurring fund	0.504***	1.655***	0.419***	1.521***	0.504***	1.655***	0.419***	1.521***
	(0.00607)	(0.0101)	(0.00633)	(0.00963)	(0.00608)	(0.0101)	(0.00634)	(0.00963)
ORICs (1=yes, otherwise 0)	0.110***	1.116***	0.103***	1.109***	0.110***	1.116***	0.103***	1.109***
	(0.00754)	(0.00841)	(0.00753)	(0.00835)	(0.00754)	(0.00841)	(0.00753)	(0.00835)
BIC (1=yes, otherwise 0)	0.0530***	1.054***	0.0489***	1.050***	0.0529***	1.054***	0.0488***	1.050***
	(0.00936)	(0.00987)	(0.00935)	(0.00982)	(0.00936)	(0.00987)	(0.00935)	(0.00982)

	Random Effect Models				Fixed Effect Models			
Citation	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
VARIABLES	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**
QEC (1=yes, otherwise 0	-0.149***	0.861***	-0.0897***	0.914***	-0.149***	0.861***	-0.0897***	0.914***
	(0.00715)	(0.00615)	(0.00724)	(0.00662)	(0.00715)	(0.00615)	(0.00724)	(0.00662)
Old university (1=yes)	-0.286	0.751	-0.438	0.646				
	(0.345)	(0.259)	(0.342)	(0.220)				
Punjab	-0.412	0.662	-0.583	0.558				
KP	-1.452***	0.234***	-1.487***	0.226***				
Sindh	-1.160**	0.314**	-1.303**	0.272**				
Constant	4.295***	73.30***	3.551***	34.86***				
Observations	465	465	465	465	453	453	453	453
Number of id_uni	71	71	71	71	60	60	60	60

IRR=incidence rate ratio, Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5.5.4 Impact of TTS Policy on Number of PhD Produced

Similar to discussion on results obtained for H-index, number of research paper published, and number of citations at university level, this section has followed the same empirical strategies as we have conducted for the aforementioned indicators.

Table 5.7 comprises the estimated results obtained from OLS fixed effect. The estimated findings suggest that log of TTS faculty ratio is showing positive and significant impacts on number of PhD produced when it is without-log and with-log forms. The findings obtained from OLS fixed effect imply that other things remaining same, one percent increase in TTS faculty ratio is causing around 19% increase in number of PhD produced at university level. These results highlight that total faculty ratio increase provides incentive to produce more PhD in order to gain monetary benefits.

Similarly, the binary variable whether university contains any TTS faculty or not is also showing the positive and significant impacts on the number of PhD produced without log for while it appears to be statistically insignificant when dependent variable is in log form. Findings for binary variable further demonstrate that random effect model is also showing similar sort of the results as we have estimated by using fixed effect model.

On the whole, we could conclude that the impacts of TTS policy are sensitive to the change in description of independent variable if we apply OLS fixed effect. Nonetheless, TTS policy is still disclosing the beneficial impacts although statistically the findings are not as strong as we have witnessed for previously discussed indicators of research productivity. However, if we look at the nature of dependent variable, it seems discrete; hence for such situations Poisson regression model seems more appropriate.

As we have discussed in previous discussion, there are some other factors which have impacts on the number of PhD produced. Such control variables disclose that research and recurring grants for universities by the HEC has statistically significant and positive impacts on improving the number of citations which is also a proxy of research productivity. Unlike this, by and large, university age, university size, and other factors are not showing as significant impacts as research and recurring grants are demonstrating the influences on number of PhD produced

(shown in table 5.7). The establishment of quality enhancement cell (QEC), and business incubations center (BIC) also has positive and significant impacts on the number of citations.

Table 5.7: Impacts of TTS Policy on Number of PhD Produced

	OLS Random Effect				OLS Fixed Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	**PhD produce**	**Log PhD produce**	**PhD produce**	**Log PhD produce**	**PhD produce**	**Log PhD produce**	**PhD produce**	**Log PhD produce**
TTS faculty (1=TTS)			13.45***	0.137			14.32***	0.0932
			(5.043)	(0.139)			(5.133)	(0.153)
Log TTS faculty	8.996***	0.184***			10.6***	0.190***		
	(2.410)	(0.0434)			(2.559)	(0.0475)		
Log university age	-4.522	0.631**	-3.609	0.616**	-19.96**	0.532	-21.04**	0.471
	(4.002)	(0.254)	(4.178)	(0.266)	(9.347)	(0.349)	(9.951)	(0.362)
Log university size	0.145	0.0397	-0.00684	0.0489	-2.249	-0.0381	-1.443	-0.0136
	(1.908)	(0.0908)	(1.899)	(0.0914)	(2.207)	(0.101)	(2.851)	(0.106)
Log research fund	3.076***	0.107**	3.910***	0.130**	2.034	0.0904*	2.590*	0.108*
	(1.146)	(0.0511)	(1.231)	(0.0562)	(1.367)	(0.0511)	(1.480)	(0.0555)
Log recurring fund	5.957***	0.313***	7.700***	0.398***	11.44**	0.400***	14.85***	0.526***
	(2.201)	(0.109)	(2.615)	(0.129)	(3.724)	(0.133)	(4.230)	(0.155)
ORICs (1=yes)	8.292	-0.146	8.111	-0.137	7.488	-0.148	7.665	-0.138
	(7.167)	(0.135)	(7.408)	(0.143)	(6.609)	(0.136)	(7.069)	(0.145)
BIC (1=yes)	-8.950	0.164	-6.879	0.205	-8.743	0.157	-6.949	0.197
	(9.354)	(0.200)	(9.896)	(0.208)	(8.626)	(0.200)	(9.306)	(0.209)
QEC (1=yes)	-7.510***	-0.207**	-6.65***	-0.197*	-8.71***	-0.219**	-7.67***	-0.209**
	(2.348)	(0.101)	(2.261)	(0.104)	(2.533)	(0.0998)	(2.426)	(0.104)
Old university	22.61***	0.475	20.66**	0.424				
	(8.641)	(0.358)	(8.731)	(0.371)				
Punjab	5.384	0.0399	5.693	0.0537				
	(6.990)	(0.332)	(6.988)	(0.332)				

	OLS Random Effect				OLS Fixed Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	**PhD produce**	**Log PhD produce**	**PhD produce**	**Log PhD produce**	**PhD produce**	**Log PhD produce**	**PhD produce**	**Log PhD produce**
KP	-5.938	-0.155	-4.813	-0.110				
	(6.172)	(0.297)	(5.856)	(0.291)				
Sindh	4.171	-0.612	0.398	-0.772*				
	(11.66)	(0.398)	(11.72)	(0.402)				
Constant	-55.00***	-3.53***	-67.1***	-4.01***	3.659	-2.58***	-18.96	-3.27***
Observations	465	465	465	465	465	465	465	465
No. of university	71	71	71	71	71	71	71	71

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Again, number of PhD is discrete in nature, so the underlying study has applied Poisson fixed effect model to unfold the effects of TTS policy on number of PhD produced. Table 5.8 contains the findings estimated from the implementation of Poisson regression.

The estimated results are suggestive that effects of log of TTS faculty ratio are found highly significant and positive impacts on number of PhD produced at university level. In addition to Poisson estimates, the study has given incidence rate ratio (IRR) also to further interpret the coefficients of the estimates. Such positive impacts are showing that due to increase in TTS faculty, other things remaining same, number of PhD's degree holders have increased significantly in Pakistan. These effects are looking stronger and highly statistically significant as compared to the simple OLS fixed effect models.

Similarly, the influences of TTS binary variable (i.e., whether the university contains TSS faculty or not) has also demonstrated the positive and significant impacts on number of PhD produced at university level (shown in table 5.8). By and large, these results appeared to be highly significant and strong as compared to the OLS fixed effect.

Furthermore, the study has estimated whether the influences of TTS policy are sensitive to changing the description of variables or not by using Poisson random effect model (shown in table 5.8), which has demonstrated the similar evidence as the case of fixed effect Poisson regression model. These findings substantiate those other things remaining same, TTS policy by

the HEC has beneficial and significant impacts on the number of PhD produced at university level. These impacts are found robust even though we changed construction of the TTS faculty variables—log of TTS faculty ratio and binary variable of TTS faculty.

Table 5.8: Impact of TTS Policy on Number of PhD Produced

	University Random Effect				University Fixed Effect			
PhDs produced	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
VARIABLES	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**
TTS faculty (1=TTS, 0=other)			0.393***	1.482***			0.392***	1.480***
			(0.0456)	(0.0676)			(0.0459)	(0.0679)
Log TTS faculty ratio	0.192***	1.212***			0.194***	1.214***		
	(0.0201)	(0.0243)			(0.0202)	(0.0246)		
Log university age	2.346***	10.45***	2.424***	11.29***	2.380***	10.81***	2.458***	11.68***
	(0.150)	(1.571)	(0.155)	(1.750)	(0.155)	(1.672)	(0.160)	(1.869)
Log university size	-0.316***	0.729***	-0.233***	0.792***	-0.354***	0.702***	-0.263***	0.769***
	(0.0594)	(0.0434)	(0.0604)	(0.0479)	(0.0614)	(0.0431)	(0.0624)	(0.0479)
Log research fund	0.0984***	1.103***	0.0976***	1.103***	0.0958***	1.101***	0.0949***	1.100***
	(0.0212)	(0.0234)	(0.0214)	(0.0236)	(0.0212)	(0.0234)	(0.0214)	(0.0236)
Log recurring fund	0.202***	1.224***	0.220***	1.247***	0.212***	1.236***	0.230***	1.258***
	(0.0518)	(0.0634)	(0.0534)	(0.0665)	(0.0529)	(0.0654)	(0.0547)	(0.0688)
ORIC (1=yes, otherwise 0)	0.132***	1.141***	0.141***	1.151***	0.132***	1.141***	0.142***	1.153***
	(0.0504)	(0.0576)	(0.0504)	(0.0580)	(0.0504)	(0.0576)	(0.0504)	(0.0581)
BIC (1=yes, otherwise 0)	-0.121	0.886	-0.106	0.899	-0.124	0.884	-0.109	0.897
	(0.0814)	(0.0722)	(0.0814)	(0.0732)	(0.0814)	(0.0719)	(0.0814)	(0.0730)
QEC (1=yes, otherwise 0	-0.0568	0.945	-0.0495	0.952	-0.0559	0.946	-0.0497	0.952
	(0.0603)	(0.0570)	(0.0615)	(0.0585)	(0.0604)	(0.0571)	(0.0615)	(0.0586)
Old university (1=yes)	-0.621	0.538	-0.699	0.497				
	(0.491)	(0.264)	(0.495)	(0.246)				
Punjab	-0.373	0.689	-0.384	0.681				

	University Random Effect				University Fixed Effect			
PhDs produced	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
VARIABLES	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**	**Poisson**	**IRR**
KP	-0.708	0.493	-0.627	0.534				
Sindh	-1.893***	0.151***	-2.050***	0.129***				
Observations	465	465	465	465	379	379	379	379
No. of university	71	71	71	71	45	45	45	45

IRR=incidence rate ratio, Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Similar to the previous discussion, we have applied Negative Binomial regression model to check the sensitivity of the results obtained from Poisson regression model if the assumption of Poisson which should not be violated: equality of mean and variance (shown in table 5.11 In Appendix in the end of this chapter). Therefore, the implementation of Negative Binomial university fixed effect is also establishing the positive and significant effects on number of PhD produced.

The impacts of control variables show that university age, university size, research, and recurring grants by the HEC are showing the positive and significant impacts on the citations at university level. Similarly, the establishment of ORICS, BIC, and QEC are also demonstrating the positive and significant impacts on number of PhD produced at university level which is estimated by number of citations.

5.6 Concluding Remarks

This chapter has evaluated the impact of Tenure Track System (TTS) policy on research productivity at the university level. Multiple regression models with different specifications have been estimated using pooled data collected from HEC and multiple other sources. Primarily, TTS policy has direct influences on the productivity of the university teachers who have been inducted through TTS policy by the HEC. Our explanation behind higher research productivity is that TTS incentivizes professors to participate in research and related activities more than the conventional mode of employment i.e., Basic Pay Scale (BPS). Basically, this research objective is the extension of third research essay where the main focus is to identify the impacts of TTS policy on university professoriates' research productivity in Pakistan by conducting a survey to university teaching faculty. Nonetheless, the underlying research essay uses the data taken from the HEC which is pooled data from 2002 to 2017 for public sector universities.

Four indicators of research productivity have been taken for analysis: i) H-index, ii) number of published research papers, iii) number of citations, and iv) number of PhD produced. while two descriptions have been taken to measure the TTS policy— log of TTS faculty ratio and binary variable whether university contains TTS faculty or not. The application of university fixed effect demonstrates that log of TTS policy ratio encompasses positive and statistically significant impacts on research productivity at university level. The study identifies that the induction of TTS faculty is evidently contributing to the improvement of four dependent variables such as H-index, increment of published research papers, increase in citations while commendable level of increase has been witnessed in number of PhD produced.

The results remain robust to alternative appropriate econometric techniques such as university random effect, and other extensions such as Poisson and Negative Binomial regression models. Furthermore, the effects of TTS binary variable also show a significant and positive impacts of TTS policy on all indicators of research productivity.

Chapter 06

Conclusion and Policy Recommendation

The underlying chapter is furnished with the conclusion of the whole thesis and containing some policy recommendation on the basis of obtained results. Moreover, it outlines some limitations of the study and how it can be improved for further studies. Following is the scheme of this chapter.

Section 6.1 concludes the whole thesis; section 6.2 comprises the policy recommendations which are obtained through the empirically estimated results; and section 6.3 is designed to outline the limitations of the study.

6.1 Conclusion

The contemporary era is considered to be the era of knowledge economy which has brought about economic development and growth in countries. The knowledge economy is primarily influenced by the quality of human capital. Those countries which have increased the expenditures on research and development (R&D) are more likely to experience higher productivity and improved living standards due to inventions and innovation. It is observed that poor countries have poor quality of human capital. Unfortunately, Pakistan places among those countries which are experiencing lower ranking in terms of quality of human capital. Successive incumbent governments have been intending to improve the level of education in Pakistan. Specifically, enrollment in higher education has increased tremendously since the establishment of Higher Education Commission (HEC) and it has done commendable work in boosting higher education in Pakistan through opting different reforms—launching scholarships for students and incentivizing the teachers through mode of hiring against the existing hiring system usually called Basic pay Scale (BPS) in public universities. HEC has introduced Tenure Track System (TTS) which contains higher salary packages as compared to BPS for university teachers. The objective of the incentive is to improve the quality of research and development of the teachers as well as public universities in Pakistan. Given such motivation, the underlying dissertation aims at investigating the three research essays regarding the impacts of TTS and higher education policy in Pakistan.

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The first essay aims at conducting the exploratory analysis of the overview of education policy in Pakistan and what is the trend analysis of its impacts on the economy of Pakistan. For empirical purposes, I obtained the data from HEC, and different other sources. And trend analysis has been opted as methodological framework. The study has reviewed the constitutional developments and provisions to understand the historical development regarding education policy. HEC has played an important role in boosting higher education. HEC started its reforms in 2002 and set targets to improve access, relevancy and improve the quality of higher education. It is also given mandate of transforming Pakistan from an agriculture economy to a knowledge-based economy. HEC struggled a lot to achieve the targets, but the targets were over ambitious. The number of universities, teaching faculty (both PhD and Non-PhD), academic papers, citations, H-Index, and other educational facets improved quantitatively, but efficiency did not rise to the desired degree. HEC also raise female enrollment, from 36% in 2002 to 45% in 2020. Similarly, enrollment increased from 0.27 million in 2002 to 1.99 million in 2020. The number of HEIs increased from 94 in 2002 to 230 in 2020.

The Second essay aims at estimating the influences of university teachers' decision to opt TTS mode of appointment on their research productivity as compared to prevailing mode of appointment namely BPS. The second essay weaves up other research activities in addition to H-index and research publications at individual levels. For that purpose, we conducted an online survey to the university teachers; we obtained information about teaching faculties of universities for both TTS and BPS from HEC. We picked 1500 teachers (assistant professor, associate professor, and professor) randomly, and did email to selected teachers. We waited for their responses for 15 days, and only 359 responses were received. So, the final sample for analysis remains 359 teachers. The designed questionnaire contains detailed information of TTS selection, and research productivity parameters which comprises all sort of research activities at both international and national level. Basically, this essay maintains more focus on measurement of quality work related to research activities of the sampled teachers. For this purpose, an index is calculated which covers international level research activities, and similarly, index for local or national level research activities, and other indices are calculated. Such includes number of PhD produced, book writing, and H-index. Finally, a composite index is measured by combining all these mentioned indices with the help of Principal Component Analysis (PCA). For empirical purposes, Heckman type treatment effect model is applied to obtain the counterfactual impacts of TTS on research productivity as compared to

BPS faculty at public sector universities. Hence, the estimated results demonstrate that TTS hired teachers (assistant professor, associate professor, and professor) are contributing more to research productivity parameters as compared to BPS. Moreover, the impacts are decomposed at discipline wise. The results are demonstrative that teachers of physical sciences are contributing relatively higher in terms of research productivity indices as compared to social sciences.

The third essay maintains focus on estimating the impacts of TTS policy on research productivity at university level. For empirical purposes, we have collected unbalanced panel data of universities and relevant to TTS faculty from HEC, which contains 2002 to 2017. The outcome variables are H-index, number of research papers published, and citations. University fixed effect (UFE) has been applied to obtain empirical evidence regarding influences of TTS faculty at university level. Empirically obtained results indicate that those universities which have higher ratios of TTS faculty are experiencing higher level of research productivity in terms of H-index, research papers and overall citations at university levels.

6.2 Policy Recommendations

As discussed, the empirical findings of this dissertation have highlighted that TTS mode of appointment has shown positive and significant impacts on research productivities at both university and teacher levels. Such findings have some policy implications which are outlined as follows.

1. Historical analysis of higher education in first essay has documented the positive association between HEC formation and higher education in Pakistan. On the basis of this finding, it is suggested that HEC may be given more administrative and financial independence and autonomy, which may help to promote higher education in Pakistan.

2. Findings of second essay substantiate the results of first and third essays at individual level (teachers). It finds that an intervention in the form of TTS is positively correlated to faculty research productivity. However, the weak link in this spot is the faculty collaboration with the international academia and industries. Thus, it is recommended that both universities and HEC may help the faculty to extend the research collaboration at international level.

3. Finally, the third essay has revealed a positive impact of the share of TTS faculty relative to the BPS on research productivity at university level, on the whole. Thus, this finding recommends that universities and HEC may provide better incentives to the faculty to develop a sustainable research culture.

6.3 Limitations of the Study

We have tried our best to conduct underlying study, given some limitations. Such limitations are outlined as follows.

1. First essay is primarily based on exploratory type study we make focused on HEC achievements, and we have Key Informants Interviews (KIIs) from HEC officials, but the study is missing other stakeholders like students, faculty, and other education experts, for future research this gap could be removed or bridged up.

2. The sampling design of the second essay is not university wise faculty ratio. However, the underlying study sends email to 1500 faculty members randomly regardless of university differentiation due to the spread of COVID-19. So, out of 11866 PhD faculty in public sector universities in Pakistan, we have been able to collect data from 359 sample size. The sampling technique could be more plausible if we did it as aforesaid.

3. The lack of appropriate instruments at university level, the study could not move to instrumental variable approach and applies university fixed effect model to capture the university level heterogeneity.

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Appendix A

Variables Description

Name	Definition
H-Index	"A scientist has index h if h of his/her N_p publications have at least h citations each, and the other $(N_p - h)$ papers have no more than h citations each" (Hirsch, 2005). The same definition is applicable for the university-level h index.
No. of Citations	Total number of citations a university or higher educational institute received in a particular year.
No. of Publications	Total number of research papers published by a university or higher educational institute in a particular year.
TTS Faculty	Total number of professors, associate professors, and assistant professors hired in a particular university or higher educational institute on the basis of TTS faculty mode of appointment in a particular year. In fact, it is the ratio of TTS faculty to the total faculty in a particular university during a particular year.
TTS Funding	Millions of rupees funds allocated for salaries to the TTS faculty member of a particular university or educational institute in a particular year.
Research Project Funds	Millions of rupees funds allocated to the TTS faculty member of a particular university or educational institute for different research projects in a particular year.
Age of the University	Difference between the university or educational institute year of establishment and survey year.
Recurring Grants	Millions of rupees provided by HEC as grants to the public sector universities educational institute in a particular year.

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Name	Definition
No. of Ph.D. Scholars	Total number of enrolled Ph.D. scholars in a particular university or educational institute in a particular year.
ORICs Office	It is equal to 1 if a particular university or educational institute has Office of Research Innovation and Commercialization (ORICs), otherwise zero.
Incubation Center	It is equal to 1 if a particular university or educational institute has Business Incubation Centre (BIC), otherwise zero.
Male Faculty	Total number of full-time male faculty members in a particular university or educational institute in a particular year.
Female Faculty	Total number of full-time female faculty members in a particular university or educational institute in a particular year.
University Size	Total number of students enrolled in a particular university or educational institute in a particular year.
Punjab	It is equal to 1 if the university or educational institute is located in Punjab, otherwise zero.
KPK	It is equal to 1 if the university or educational institute is located in KPK, otherwise zero.
Sindh	It is equal to 1 if the university or educational institute is located in Sindh, otherwise zero.
Balochistan	It is equal to 1 if the university or educational institute is located in Balochistan, otherwise zero.
FATA	It is equal to 1 if the university or educational institute is located in FATA, otherwise zero.

Table 4.10: Appendix-B: Interactive Results for International Quality

International quality	Coef.	Std. Err.	z	P>z
interaction term of Gender with HEC				
BPS	0.3611*	0.2183	1.65	0.098
TTS	0.1156	0.2569	0.45	0.653
interaction term of experience with HEC				
BPS	0.0666*	0.0394	1.69	0.091
TTS	0.0856**	0.0346	2.47	0.013
Interaction of disciplines and HEC				
Business & management*BPS	0.2344	0.2480	0.95	0.345
Business & management*TTS	0.2812	0.3 591	0.78	0.434
Engineering*BPS	-0.5345	0.6131	-0.87	0.383
Engineering*TTS	1.2037**	0.5586	2.15	0.031
Physical science*BPS	0.6617	0.4312	1.53	0.125
Physical science*TTS	0.2816	0.3165	0.89	0.374
Agriculture*BPS	0.9212*	0.5502	1.67	0.094
Agriculture*TTS	0.1758	0.3750	0.47	0.639
Biological sciences*BPS	0.3576	0.5327	0.67	0.502
Biological sciences*TTS	0.0353	0.2826	0.12	0.901
IT & Computer*BPS	0.1647	0.2920	0.56	0.573
IT & Computer*TTS	0.7528	0.5650	1.33	0.183
Math & Statistics*BPS	0.1469	0.5753	0.26	0.798
Math & Statistics*TTS	0.0787	0.5991	0.13	0.896
Others*BPS	-0.1661	0.2328	-0.71	0.475
Others*TTS	0.4906	0.5606	0.88	0.382
Interaction of designation with HEC				
Associate professor*BPS	0.1793	0.3655	0.49	0.624
Associate professor*TTS	0.6855**	0.2914	2.35	0.019
Professor*BPS	0.8078	0.6430	1.26	0.209
Professor*TTS	0.8035	0.6038	1.33	0.183
Overall HEC				
BPS	-1.6051**	0.8511	-1.89	0.059
TTS	0.3292	0.4594	0.72	0.474

Table 4.11: Appendix C Interactive Results for National Quality

	Coef.	Std. Err.	z	P>z
interaction term of Gender with HEC				
BPS	0.3493	0.3322	1.05	0.293
TTS	0.6014**	0.3316	1.81	0.07
interaction term of experience with HEC				
BPS	0.0593	0.0458	1.3	0.195
TTS	0.0569	0.0378	1.5	0.133
Interaction of disciplines and HEC				
Business & management*BPS	-0.0523	0.4686	-0.11	0.911
Business & management*TTS	0.0430	0.4404	0.1	0.922
Engineering*BPS	-3.1804**	1.7536	-1.81	0.07
Engineering*TTS	0.6630	1.0169	0.65	0.514
Physical science*BPS	-0.1404	0.5667	-0.25	0.804
Physical science*TTS	1.4556**	0.5681	2.56	0.01
Agriculture*BPS	0.7670	0.6530	1.17	0.24
Agriculture*TTS	-0.2615	0.4768	-0.55	0.583
Biological sciences*BPS	-0.1914	0.6770	-0.28	0.777
Biological sciences*TTS	1.2167**	0.5848	2.08	0.037
IT & Computer*BPS	0.0240	0.5238	0.05	0.963
IT & Computer*TTS	-0.1329	0.4794	-0.28	0.782
Math & Statistics*BPS	1.5714	1.9679	0.8	0.425
Math & Statistics*TTS	-0.9625***	0.3270	-2.94	0.003
Others*BPS	0.4918	0.4855	1.01	0.311
Others*TTS	1.3906	0.6451	2.16	0.031
Interaction of designation with HEC				
Associate professor*BPS	0.0056	0.5290	0.01	0.992
Associate professor*TTS	1.3205	0.4851	2.72	0.006
Professor*BPS	3.6523	1.7162	2.13	0.033
Professor*TTS	0.8900	0.6739	1.32	0.187
Overall HEC				
BPS	0.3384	1.1467	0.3	0.768
TTS	0.3625	0.4884	0.74	0.458

Table 4.12: Appendix D: Interactive Results for Book Authorship

	Coef.	Std. Err.	z	P>z
interaction term of Gender with HEC				
BPS	0.4291	0.4210	1.02	0.308
TTS	0.4037**	0.1866	2.16	0.031
interaction term of experience with HEC				
BPS	0.0618	0.0485	1.27	0.203
TTS	0.0490	0.0329	1.49	0.136
Interaction of disciplines and HEC				
Business & management*BPS	0.7178	1.0266	0.7	0.484
Business & management*TTS	-0.0038	0.2659	-0.01	0.989
Engineering*BPS	-0.1604	0.9617	-0.17	0.868
Engineering*TTS	-0.2435	0.2400	-1.01	0.31
Physical science*BPS	1.5617	1.0350	1.51	0.131
Physical science*TTS	0.1191	0.1975	0.6	0.547
Agriculture*BPS	3.8686	3.1412	1.23	0.218
Agriculture*TTS	0.6655*	0.3954	1.68	0.092
Biological sciences*BPS	-0.1874	0.3359	-0.56	0.577
Biological sciences*TTS	0.4670*	0.2782	1.68	0.093
IT & Computer*BPS	-0.1414	0.3984	-0.36	0.723
IT & Computer*TTS	0.3813	0.3369	1.13	0.258
Math & Statistics*BPS	-0.5023	0.4088	-1.23	0.219
Math & Statistics*TTS	-0.2193	0.1997	-1.1	0.272
Others*BPS	2.0891**	0.9696	2.15	0.031
Others*TTS	0.7839	0.5201	1.51	0.132
Interaction of designation with HEC				
Associate professor*BPS	1.2691	1.7308	0.73	0.463
Associate professor*TTS	-0.3575*	0.1990	-1.8	0.072
Professor*BPS	0.0581	0.9987	0.06	0.954
Professor*TTS	0.1979	0.3818	0.52	0.604
Overall HEC				
BPS	-0.9628	0.6663	-1.45	0.148
TTS	-0.2740	0.4055	-0.68	0.499

Table 4.13: Appendix-E: Interactive Results for PhDs Produced

	Coef.	Std. Err.	z	P>z
interaction term of Gender with HEC				
BPS	0.4072	0.8534	0.48	0.633
TTS	-0.6007	0.4059	-1.48	0.139
interaction term of experience with HEC				
BPS	0.0604	0.0966	0.62	0.532
TTS	0.0881*	0.0501	1.76	0.078
Interaction of disciplines and HEC				
Business & management*BPS	-0.3855	1.2831	-0.3	0.764
Business & management*TTS	-0.3136	0.4178	-0.75	0.453
Engineering*BPS	-6.2922**	2.8076	-2.24	0.025
Engineering*TTS	0.6308	0.6028	1.05	0.295
Physical science*BPS	4.8219	3.4491	1.4	0.162
Physical science*TTS	0.5993	0.5048	1.19	0.235
Agriculture*BPS	1.0129	1.9846	0.51	0.61
Agriculture*TTS	-0.6317	0.4817	-1.31	0.19
Biological sciences*BPS	-1.3816	1.1063	-1.25	0.212
Biological sciences*TTS	0.9264*	0.5758	1.61	0.108
IT & Computer*BPS	-0.7427	0.7985	-0.93	0.352
IT & Computer*TTS	0.3741	0.7601	0.49	0.623
Math & Statistics*BPS	0.1219	1.5550	0.08	0.938
Math & Statistics*TTS	1.3731	1.1469	1.2	0.231
Others*BPS	-0.2503	0.7173	-0.35	0.727
Others*TTS	0.6609	0.8265	0.8	0.424
Interaction of Designation with HEC				
Associate professor*BPS	1.4929	0.9550	1.56	0.118
Associate professor*TTS	0.5451	0.3704	1.47	0.141
Professor*BPS	7.5768***	2.2908	3.31	0.001
Professor*TTS	5.8036***	1.6062	3.61	0.000
Overall HEC				
BPS	-0.3473	2.5643	-0.14	0.892
TTS	0.1672	0.7122	0.23	0.814

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Table 4.14: Appendix F: List of the Sampled Universities

S. No	University Name	responses
1	Allama Iqbal University, Islamabad	1
2	Abbottabad University of Science and Technology, Abbottabad	1
3	Abdul Wali Khan University, Mardan	18
4	Air University, Islamabad	9
5	BUITEMS, Quetta	3
6	Bahauddin Zakariya University, Multan	8
7	Bahria University, Islamabad	3
8	Benazir University Lyari, Karachi	1
9	COMSAT University, Islamabad	13
10	Fatima Jinnah Women University, Rawalpindi	4
11	GC University, Faisalabad	11
12	GC University, Lahore	4
13	Gomal University, D.I. Khan	1
14	Hazara University, Mansehra	29
15	Institute of Management Sciences, Peshawar	9
16	International Islamic University, Islamabad	8
17	Islamia College University, Peshawar	3
18	KUST, Kohat	17
19	Khushal khan Khattak university, Karak	1
20	Lahore College for Women University, Lahore	7
21	Mirpur University of Science & Technology, Mirpur	3
22	NUML, Islamabad	4
23	NUST, Islamabad	4
24	PIDE, Islamabad	1
25	PMAS-Arid Agriculture University, Rawalpindi	1
26	Quaid-i-Azam University, Islamabad	24
27	SBK Women university, Quetta	3
28	Sindh Agriculture University Tandojam	2
29	The Islamia University of Bahawalpur, Bahawalpur	56

S. No	University Name	responses
30	UET, Lahore	1
31	UET, Peshawar	7
32	University of Agriculture, Faisalabad	3
33	University of Agriculture, Peshawar	8
34	University of Azad Jammu & Kashmir, Muzaffarabad	3
35	University of Balochistan, Quetta	8
36	University of Education, Lahore	8
37	University of Gujrat, Gujrat	3
38	University of Haripur, Haripur	1
39	University of Health Sciences, Lahore	4
40	University of Karachi, Karachi	5
41	University of Kotli, Kotli	2
42	University of Malakand, Chakdara	18
43	University of Peshawar, Peshawar	4
44	University of Poonch, Rawalakot	3
45	University of Sargodha, Sargodha	7
46	University of Swat, Mingora	3
47	University of Haripur, Haripur	1
48	University of Okara, Okara	1
49	University of the Punjab, Lahore	14
50	Women University, Multan	1
51	Women University of Azad Jammu and Kashmir	2
52	Women university, Swabi	3

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Table 5.9: Appendix G: Impact of TTS Policy on Number of Research Papers

Research Paper	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Negative Binomial	IRR	Negative Binomial	IRR	Negative Binomial	IRR	Negative Binomial	IRR
TTS Faculty (1=yes, 0=no)			0.228***	1.256***			0.190**	1.209**
			(0.0751)	(0.0943)			(0.0748)	(0.0904)
Log TT, fac, ratio	0.187***	1.205***			0.160***	1.173***		
	(0.0338)	(0.0408)			(0.0339)	(0.0398)		
Log age	0.667***	1.948***	0.633***	1.884***	0.661***	1.937***	0.638***	1.892***
	(0.136)	(0.266)	(0.139)	(0.261)	(0.138)	(0.267)	(0.140)	(0.265)
Log enrollment	0.0827	1.086	0.100*	1.106*	0.0760	1.079	0.0908	1.095
	(0.0569)	(0.0618)	(0.0583)	(0.0645)	(0.0567)	(0.0612)	(0.0580)	(0.0635)
Log research fund	0.0547*	1.056*	0.0648**	1.067**	0.0514	1.053	0.0618**	1.064**
	(0.0330)	(0.0349)	(0.0321)	(0.0342)	(0.0320)	(0.0337)	(0.0311)	(0.0331)
Log recurring fund	0.543***	1.721***	0.603***	1.827***	0.568***	1.765***	0.618***	1.855***
	(0.0732)	(0.126)	(0.0765)	(0.140)	(0.0730)	(0.129)	(0.0768)	(0.143)
ORICs (1=yes, 0=no)	0.0647	1.067	0.0511	1.052	0.0460	1.047	0.0352	1.036
	(0.0861)	(0.0918)	(0.0854)	(0.0899)	(0.0870)	(0.0911)	(0.0858)	(0.0889)
BIC (1=yes, 0=no)	-0.120	0.887	-0.119	0.888	-0.0874	0.916	-0.0880	0.916
	(0.143)	(0.127)	(0.146)	(0.129)	(0.140)	(0.129)	(0.141)	(0.129)
QEC (1=yes, 0=no)	-0.192**	0.826**	-0.170*	0.844*	-0.182*	0.834*	-0.161*	0.851*
	(0.0959)	(0.0792)	(0.0963)	(0.0813)	(0.0950)	(0.0792)	(0.0951)	(0.0810)
Old university (1=yes, 0=no)	-2.002***	0.135***	-2.217***	0.109***	-2.304***	0.0998***	-2.486***	0.0833***
	(0.282)	(0.0381)	(0.277)	(0.0301)	(0.297)	(0.0296)	(0.288)	(0.0240)
Punjab	1.141***	3.130***	1.024***	2.786***	1.109***	3.030***	0.989***	2.689***
	(0.234)	(0.732)	(0.226)	(0.629)	(0.249)	(0.755)	(0.239)	(0.643)
KPK	1.900***	6.686***	2.121***	8.339***	2.165***	8.718***	2.370***	10.69***
	(0.258)	(1.726)	(0.257)	(2.146)	(0.274)	(2.389)	(0.271)	(2.901)
Sindh	1.031***	2.804***	1.064***	2.899***	1.091***	2.979***	1.110***	3.035***

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Research Paper	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
VARIABLES	**Negative Binomial**	**IRR**	**Negative Binomial**	**IRR**	**Negative Binomial**	**IRR**	**Negative Binomial**	**IRR**
	(0.241)	(0.675)	(0.243)	(0.704)	(0.254)	(0.756)	(0.256)	(0.776)
Constant	-4.453***	0.0116***	-4.712***	0.00898***	-4.328***	0.0132***	-4.562***	0.0104***
Observations	465	465	465	465	440	440	440	440
Number of universities	71	71	71	71	58	58	58	58
University RE	YES	YES	YES	YES	NO	NO	NO	NO
University FE	NO	NO	NO	NO	YES	YES	YES	YES

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

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Table 5.10: Appendix H: Impact of TTS Policy on Number of Citation—

Citation VARIABLES	(1) NB	(2) IRR	(3) NB	(4) IRR	(5) NB	(6) IRR	(7) NB	(8) IRR
TTS Faculty (1=yes, 0=no)			0.618***	1.856***			0.454***	1.575***
			(0.0747)	(0.139)			(0.0866)	(0.136)
Log TTS fac. ratio	0.222***	1.248***			0.157***	1.170***		
	(0.0313)	(0.0390)			(0.0369)	(0.0432)		
Log age	0.618***	1.855***	0.669***	1.952***	0.222	1.248	0.330**	1.390**
	(0.123)	(0.228)	(0.120)	(0.235)	(0.154)	(0.192)	(0.157)	(0.218)
Log enrollment	0.0802	1.084	0.0763	1.079	0.0776	1.081	0.104*	1.110*
	(0.0567)	(0.0614)	(0.0549)	(0.0593)	(0.0606)	(0.0655)	(0.0604)	(0.0670)
Log research fund	0.141***	1.151***	0.141***	1.152***	0.0872*	1.091*	0.101**	1.106**
	(0.0513)	(0.0591)	(0.0495)	(0.0570)	(0.0464)	(0.0506)	(0.0461)	(0.0510)
Log recurring fund	0.324***	1.383***	0.321***	1.379***	0.578***	1.782***	0.511***	1.667***
	(0.0509)	(0.0704)	(0.0506)	(0.0697)	(0.0876)	(0.156)	(0.0886)	(0.148)
ORICs (1=yes)	0.122	1.130	0.107	1.113	0.0956	1.100	0.0935	1.098
	(0.117)	(0.132)	(0.108)	(0.121)	(0.117)	(0.128)	(0.111)	(0.122)
BIC (1=yes)	0.117	1.124	0.126	1.134	0.0924	1.097	0.0784	1.082
	(0.173)	(0.194)	(0.168)	(0.190)	(0.169)	(0.185)	(0.166)	(0.180)
QEC (1=yes)	-0.0855	0.918	-0.0448	0.956	-0.138	0.871	-0.0988	0.906
	(0.109)	(0.0999)	(0.106)	(0.101)	(0.108)	(0.0940)	(0.106)	(0.0963)
Old university(1=yes)	-0.361	0.697	-0.255	0.775	-0.806***	0.447***	-0.780***	0.458***
	(0.244)	(0.170)	(0.225)	(0.174)	(0.217)	(0.0971)	(0.218)	(0.100)
Punjab	0.265	1.304	0.451***	1.570***	0.282	1.326	0.391*	1.478*
	(0.174)	(0.227)	(0.174)	(0.274)	(0.197)	(0.261)	(0.202)	(0.298)
KPK	0.233	1.263	0.210	1.234	0.580**	1.785**	0.513**	1.670**
	(0.207)	(0.261)	(0.199)	(0.245)	(0.234)	(0.417)	(0.232)	(0.388)

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Citation VARIABLES	**(1) NB**	**(2) IRR**	**(3) NB**	**(4) IRR**	**(5) NB**	**(6) IRR**	**(7) NB**	**(8) IRR**
Sindh	-0.732***	0.481***	-0.763***	0.466***	-0.586***	0.557***	-0.667***	0.513***
	(0.204)	(0.0981)	(0.201)	(0.0940)	(0.222)	(0.124)	(0.221)	(0.113)
Constant	-4.332***	0.0131***	-4.641***	0.00965***	-3.806***	0.0222***	-4.164***	0.0155***
Observations	465	465	465	465	453	453	453	453
Number of universities	71	71	71	71	60	60	60	60
University RE	YES	YES	YES	YES	NO	NO	NO	NO
University FE	NO	NO	NO	NO	YES	YES	YES	YES

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

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Table 5.11: Appendix I: Impact of TTS Policy on Number of PhD Produced

PhD produced VARIABLES	(1) NBR	(2) IRR	(3) NBR	(4) IRR	(5) NBR	(6) IRR	(7) NBR	(8) IRR
TTS faculty (1=yes, 0=no)			0.418***	1.519***			0.422***	1.524***
			(0.0898)	(0.136)			(0.0928)	(0.141)
Log TTS fac, ratio	0.239***	1.270***			0.251***	1.285***		
	(0.0407)	(0.0516)			(0.0421)	(0.0541)		
Log age	2.077***	7.981***	2.016***	7.509***	2.241***	9.406***	2.193***	8.958***
	(0.228)	(1.824)	(0.236)	(1.775)	(0.236)	(2.222)	(0.251)	(2.249)
Log enrollment	-0.151	0.860	-0.152*	0.859*	-0.242**	0.785**	-0.247***	0.781***
	(0.0918)	(0.0790)	(0.0914)	(0.0785)	(0.0947)	(0.0744)	(0.0956)	(0.0746)
Log research fund	0.149***	1.160***	0.170***	1.185***	0.130***	1.139***	0.149***	1.161***
	(0.0488)	(0.0566)	(0.0517)	(0.0612)	(0.0473)	(0.0539)	(0.0510)	(0.0593)
Log recurring fund	0.0672	1.069	0.169*	1.184*	0.0618	1.064	0.174*	1.190*
	(0.0945)	(0.101)	(0.0935)	(0.111)	(0.0991)	(0.105)	(0.101)	(0.120)
ORICs (1=yes, 0=no)	0.0974	1.102	0.101	1.106	0.109	1.115	0.116	1.123
	(0.108)	(0.119)	(0.109)	(0.121)	(0.109)	(0.122)	(0.112)	(0.126)
BIC (1=yes, 0=no)	-0.102	0.903	-0.0898	0.914	-0.120	0.887	-0.107	0.898
	(0.187)	(0.169)	(0.191)	(0.175)	(0.190)	(0.169)	(0.193)	(0.174)
QEC (1=yes, 0=no)	-0.112	0.894	-0.127	0.880	-0.110	0.896	-0.133	0.876
	(0.128)	(0.115)	(0.131)	(0.115)	(0.130)	(0.116)	(0.132)	(0.116)
Old university (1=yes, 0=no)	-1.351***	0.259***	-1.164***	0.312***	-2.157***	0.116***	-1.933***	0.145***
	(0.422)	(0.109)	(0.416)	(0.130)	(0.490)	(0.0566)	(0.493)	(0.0713)

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PhD produced VARIABLES	(1) NBR	(2) IRR	(3) NBR	(4) IRR	(5) NBR	(6) IRR	(7) NBR	(8) IRR
Punjab	-0.0463	0.955	-0.133	0.876	-0.209	0.811	-0.373	0.689
KPK	-0.260	0.771	-0.617*	0.539*	-0.412	0.662	-0.931**	0.394**
Sindh	-0.166	0.847	-0.597	0.550	0.0897	1.094	-0.515	0.598
Constant	-4.297***	0.0136***	-4.819***	0.00807***	-3.137***	0.0434***	-3.654***	0.0259***
Observations	465	465	465	465	379	379	379	379
Number of universities	71	71	71	71	45	45	45	45
University RE	YES	YES	YES	YES	NO	NO	NO	NO
University FE	NO	NO	NO	NO	YES	YES	YES	YES

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

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QUESTIONNAIRE

Dear Faculty Member,

Assalam-o-Alaikum

I am a PhD student of Economics at School of Economics, Quaid e Azam University Islamabad. I am doing research to evaluate Tenure Track System (TTS), which has been introduced for quite some time in public sector Higher Education Institutions (HEIs). In this regard, I have developed a questionnaire and would be grateful if you spare some time to fill it out. This questionnaire needs to be filled in by Both TTS and BPS PhD faculty. I assure you that the collected data will be used for the purpose of research only. For more information feel free to contact me.

Name Bashir Khan cell no. 0333-5348463 email. stateconomics007@gmail.com

PART-1

1. Name ……..…….
2. Age (in years)…….....
3. Gender i. Male ii. Female
4. Province/Region……
5. Name of the University/Institution of your current employment…….. ……...
6. Department/Centre/School……
7. Subject……...
8. Current Designation……
9. Name of PhD Awarding University/Institute ……Country…….
10. Teaching Experience (Years)……

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11. Total Number of Research Papers Published……...……...

12. Total Citation……...H-Index……

13. M.Phil. Produced (supervised)……...PhD Produced (supervised)……..

14. Number of Patents (Registered)……Number of Patents (Commercialized)…...

15. Number of Books published as author or co-author ……

16. Number of conferences organized: ……

17. Number of research papers presented in international conferences in foreign countries……

18. Number of research papers presented in conferences in Pakistan ……...

19. Number of National Research Projects earned...……total Amount in Rs……

20. Number of International Research Projects earned……total Amount in Rs……

21. Number of University Industrial Linkages programs through (ORICs) in which you have actively participated.

    .....

    .....

22. Number of International Collaboration /exchange programs (outbound at least for 15days) in which you have Participated

    …….....

23. Number of National Award Received e.g. Research Productivity Award etc …….

24. Number of International Award Received (UN, US, UK etc)…….

25. In how many committees you are a member at university…. and at National Level (Except University).....

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26. In how many committees/Societies etc you are a member at International Level …….

27. Have you been a member of Policy Board/Group/Task Force etc?

    i. Yes ii. No

If yes, then it is: i. Govt ii. Non-Government iii. International iv. Any other (please) Specify)…….

28. Are you publishing quality research papers in the Top 50 journals of the World?

    i. Yes ii. No

29. Are you publishing quality research papers in the Top 100 journals of the World?

    i. Yes ii. No

30. Do you feel that your research is contributing to solving the current problems of Pakistan?

    i. Yes ii. No

31. Does your research work compromise your quality of teaching?

    i. Yes ii No

32. Your teaching quality is as per required quality/standard.

    i. Yes ii. No

33. M.Phil. Program is being offered in the department/subject where you teach.

    i. Yes ii. No

34. PhD Program is being offered in the department/subject where you teach.

    i. Yes ii. No

35. Currently you teach to: i. BS ii. MS/M.Phil. iii. PhD iv. Any other (specify)……

36. Do you have the following facilities in your university/institution at required level to help you in your research?

Please tick the appropriate choice:

a. Internet

i. Not available ii. Below required level iii. At required Level

b. Library

i. Not available ii. Below required level iii. At required Level

c. Digital Library

i. Not available ii. Below required level iii. At required Level

d. Funding (for Conference paper presentation)

i. Not available ii. Below required level iii. At required Level

e. Funding (For research paper publishing fee)

i. Not available ii. Below required level iii. At required Level

f. Funding (For research project)

i. Not available ii. Below required level iii. At required Level

g. Research Laboratory

i. Not available ii. Below required level iii. At required Level

h. Relevant Books

i. Not available ii. Below required level iii. At required Level

i. Access to Quality Journals

i. Not available ii. Below required level iii. At required Level

j. Laptop

i. Not available ii. Below required level iii. At required Level

k. Facilitation in Registration

i. Not available ii. Below required level iii. At required Level

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Part II

(For TTS Faculty)

The following questions are to be answered by the TTS faculty only:

1. What was the first mode of your appointment?

   i. TTS ii. BPS

   If BPS, then Date of Joining as Faculty Member in BPS.....Experience in BPS (Years)…..

2. Date of Joining/conversion as/to Faculty Member in TTS……Experience in TTS (Years)……...

3. Number of Papers Published during BPS (if your first Mode of appointment was BPS) …….Papers Published during TTS……

4. The current promotion criteria in TTS is appropriate.
   i. Strongly disagree ii. Disagree iii. Neutral iv. Agree v. Strongly Agree

5. If given an option, I will switch to BPS mode of appointment from TTS.
   i. Strongly disagree ii. Disagree iii. Neutral iv. Agree v. Strongly Agree

6. The current salary package of TTS is according to the market rate.
   i. Strongly disagree ii. Disagree iii. Neutral iv. Agree v. Strongly Agree

7. My decision was right for selecting TTS mode of appointment:
   i. Strongly disagree ii. Disagree iii. Neutral iv. Agree v. Strongly Agree

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Part-III

(For BPS Faculty)

The following questions are to be answered by the BPS faculty only:

1. Date of Joining as Faculty Member in BPS ……Experience in BPS (Years)…….

2. The current promotion criteria in BPS is appropriate
   i. Strongly disagree ii. Disagree iii. Neutral iv. Agree v. Strongly Agree

3. If given the option, I will switch to TTS mode of appointment from BPS.
   i. Strongly disagree ii. Disagree iii. Neutral iv. Agree v. Strongly Agree

4. The current salary package of BPS is according to the market rate.

   i. Strongly disagree ii. Disagree iii Neutral iv Agree v. Strongly Agree

5. My decision was right for selecting BPS mode of appointment:

   i. Strongly disagree ii. Disagree iii. Neutral iv. Agree v. Strongly Agree

- Recommendations/suggestions for improvement of TTS **OR** any other comments

……
……
……