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IMPACT OF RESEARCH AND DEVELOPMENT ON THE VALUE ADDITION OF SERVICES: STRUCTURAL TRANSFORMATION OF PAKISTAN AND INDIA

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Abstract

The structural transformation requires that in the long run, the changes in sectoral shares are associated to the economic growth. With developed as well as developing countries transforming themselves into services-oriented economies, innovation and research and development in information communication technology has become inevitable to achieve sustained economic growth and value addition in services sector. Unit root testing, cointegration bound testing, correlation matrices and autoregressive distributive lag model is being implemented in our analysis of impact of research and development on the value addition of services showcasing the long-run impact vis a vis short-run impact on our time series data set. The time series dataset comprises of two South Asian economies (Pakistan and India). Time period taken into consideration is from 1996 to 2020. The unit root testing for all the variables showed us that they are not stationary at level and are integrated of either order I(1) or I(2). Similarly, covariance-correlation showed us a close relationship among explanatory variables. Cointegration bound testing made us aware of the fact that there certainly exists a long-run causal relationship between our outcome variables and explanatory variables. Auto Regressive Distributive Lag model showcased that relationship between research and development and value addition of services is positive and significant and does have long run positive implications on economic output and growth. Similarly, labor force with advanced education and expenditure on education are also taken as proxies for research and development. Both these variables showcased somewhat ambiguous results on value addition of services for both Pakistan and India.with TensorFlow or PyTorch if required. In order to test hypotheses, and inference regarding interrelationships between variables, regression and structural equation modeling (SEM) are suggested as statistical tools. The implications of the study are both

Keywords: Research and development, labor force, education, value-added services, GDP per capita, economic growth

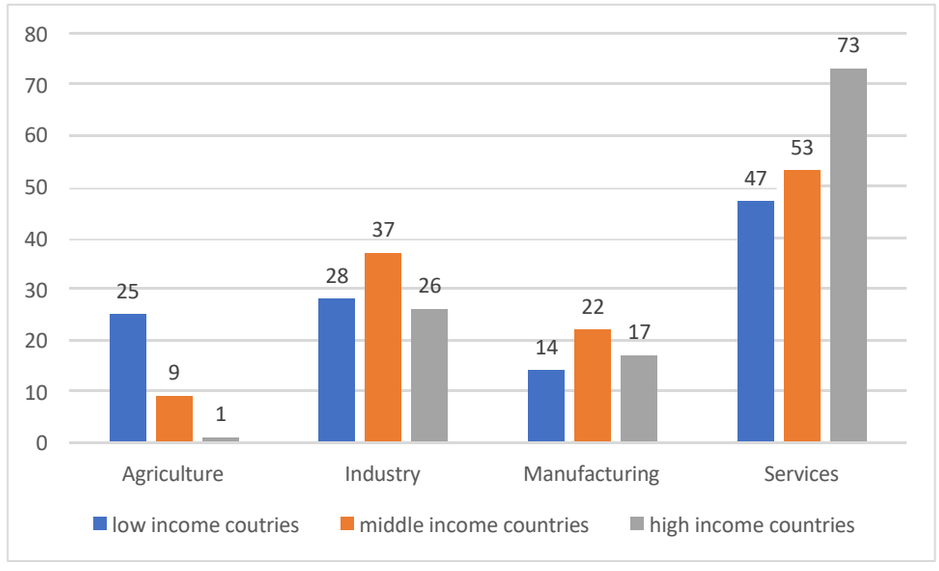
Introduction

1.1. Background of the study

Services lie at the epicentre of any social economic activity of the society. The services industry has the significance of contributing for almost 2/3 of the whole world's total output as published by (World Bank, 2002). In addition to basic livelihoods, where individual families can be self-sufficient, the services activities also have a significant emphasis in keeping the whole country's economy aloft while also improving quality of life. The services industry accounts for 47% of total Gross Domestic Product in low-income countries, 53% of GDP in middle-income countries, and almost has a contribution of around 73% of Gross Domestic Product in developed countries. In the early 1900s, only 3 out of every 5 workers were employed in the service industry. Now, this number has risen upto 8 out of 10 workers.

The first misunderstanding about services is that in the "scale of human needs" (A. H. Maslow, 1954), they are not as important or significant as 'products' to some extent. Many theorists and scholars mistakenly regard the services industry as "baking cakes" or "shining boots" or "cleaning toilets". These over-elucidations suppress the sophistication, scope, technical sophistication, and the potential for sustained growth of services in the modern economic framework. Anyhow, there does not exist a unified understanding on the defining characteristics of the service industry, it is basically considered to blanket all of the categories in the unified industry classification, in which (1) primary outputs are not products or a constructed output, (2) addition of final value is mainly through different faucets (such as comfortability, recreation, feelings of happiness, enhanced knowledge, security, health, comfort, location availability, or flexibility) are added, which cannot be constructed on one's
own self, and (3) final products are necessarily consumed up right after production (Francis, 2004).

This structural transformation is best described in the Clark Fisher hypothesis; which states that as the country industrializes, the employment will inevitably shift from one economic sector to another (Kaynak, 2006). Clark (1941) Kuznets (1957) and Fuchs (1980) observed that the structural changes in the course of transformation from agri-based economy to manufacturing-based economy, and then from manufacturing-based economy to services-oriented economy occurred in the process of economic advancement.



Source: World Development Indicators (WDI)

Figure 1: Sectoral share in GDP of world's economies 2018

In high-income countries, the service industry accounts for 73% of GDP. The increased interest in the service industry in developed countries has triggered active investment, which has led to major development activities in this sector. Preliminary analysis shows that the value added measured by the service sector is almost the same in the highest level as that of the manufacturing sector. Services sector also seem to be less cyclical than manufacturing sector.

In the past 20 years, employment in the service industry has grown by an average of 2.1% during the economic contraction and 4.8% during the expansion. Another misunderstanding about the service industry is as that compared with the manufacturing industry, the service industry is more labour-oriented and lacks significantly in technological innovations. Stephen Roach of Morgan Stanley and Company Inc. states; since the mid-1960s, the capital stock of each service worker has increased and now exceeds the capital stock of manufacturing workers (Sterlacchini, R&D, higher education and regional growth, 2008)

All of the aforementioned structural variations tend to provide us with useful insights about the potential reasons of wealth and wage differentials. Kuznets (1971) listed structural transformation to be 1 of the 6 basic causative agents of economic development. Kuznets made the discovery that all of the developed economies tend to follow the same pathway of structural transformation. Kuznets distinguished 2 major steps in the series of structural transformation. During early stages of the development procedure, a naive economy redistributes majority of its wealth and resources to the agricultural domain. By and large economy develops further, resources and wealth are again redistributed from agricultural to industrial and services domain. This is attributed as the first stage of structural transformation. During the upcoming stage, resources are eventually redistributed from both agriculture and industry to services sector.

Structural transformation is considered to be one of the topics recently discussed by literary gurus and academicians vis a vis researchers. The association among structural transformation and economic development cannot be ignored. A common phenomenon has come into light that during last few decades, a majority of countries have been able to achieve sustained and long-lasting economic growth. Research and analysis of the link between economic development and structural transformation is traced back to the classical era (Lucas, 1988).

Clark (1940) and Fisher (1935) have begun to study structural transformation, suggesting that the economy be divided into three subsectors mainly; primary, secondary and tertiary sub-sectors.

In recent decades, a huge number of poor countries have attained quite fast economic development. However, very small number of countries are able to escape the "middle income trap" because they had very bad implementation in total factor productivity (TFP), which is mainly based on innovation and is attributed to research and development. Not enough investment in basic innovation capabilities is the major cause of middle-income trap (Paus, 2017). Investing in R&D is seen as an important and valid strategy to realize high-level technological abilities to promote creation/invention and sustain economic development. Nevertheless, in spite of the huge potential rewards of innovating, developing and poor economies invest much less in the factors that promote innovation and value creation, which some economists label as the "Innovation Paradox" (Maloney, 2017).

1.2. The curious case of Developing Countries

In the past few decades, the service industry has enjoyed extravagant, and I must say, exponential growth in industrialized and developed countries, but little or no attention has been paid to developing countries in the same way. This lack of interest can be attributed to negligent government policies and misunderstandings about service marketing. Although almost all developing countries are agricultural in nature, due to the acceleration of urbanization, the partake of employment in the agricultural division is declining, and natives are turning to other economic ventures for more rewarding jobs. The service industry provides people with very diverse jobs, such as highly skilled, skilled, semi-skilled and unskilled.

But the most frustrating and noteworthy aspect in developing countries is that their service industries account for a much larger proportion of unskilled and semi-skilled labour, such as barbers, janitors, waiters, taxi drivers, food delivery Staff and so on. The lack of qualified and high-quality services is a key problem in developing countries. The most urgent need is to expand services in these countries and increase productivity and efficiency. All these services shares are included in the total GDP of the country, which makes people mistakenly believe that the country is developing day by day and is advancing on the right path. But in fact, the situation is just the opposite. In most developing countries, an enormous number of businesses are owned by a family or a small group of family members. Take Saudi Arabia as an example, where large merchant families and their companies control the main service industries that have families' members at key positions and many acquaintances at many secondary positions. In these countries, the most important policy decisions on marketing and other management issues are made by the owners and executed by professional managers.

1.3. Technological inputs and the services sector

Productive knowledge plays a critical role in the growth of a country. It includes technical knowledge (research and development (R&D), design and process engineering) as well as knowledge of management, organisation, inter-firm and international relationships, much of which are tacit in nature (UNCTAD 1999). Many research oriented studies confirm that research and development (R&D) plays a significant role in economic development. Research and development costs can increase because they have an increasing impact on innovation and total factor productivity (TFP) (M I Roemer, 1990) (Lucas, 1988). Grossman and Helpmann (1994) point out, long-term technological progress through industrial innovation is a driving force for improving living standards in developed countries. As companies invest in research

and development, they are expected to develop new ideas, semi-finished products, cost-saving opportunities and consumables that can create more productive and wealth creating businesses. Addendum the specific perks of R&D, good results can be achieved across companies, industries and sectors. Knowledge developed through research and

development is not competitive and allows companies to benefit from other companies; research and development investments in other industries and sectors (Howitt, 1990) (Arrow, 1962)

Recent estimates suggest that R&D efficiencies in developed countries are around 40-60% per year (Rachel Griffith, 2004) .Over time, many developing countries have become increasingly dominant in manufacturing and service sectors that are relatively inferior to agriculture. This dilemma is revealed in Baumol's "Cost disease of services" analysis. It is argued that developed countries have a negative impact on productivity growth, especially among less productive service workers (William J. Baumol, 2012). Local innovation and untapped R&D capabilities are at the heart of middle-income trap.

Anyhow, the progress and development in information and communications technology (ICT) with ultimate focus on research and development (R&D) could change the overall picture that services sector are much less capable and low in efficiency criteria. Burgeoning influence of research and development in the services sector is mobilizing services and smoothening up across the border trade in various categories of services. Advent of the user-friendly Internet, big data, and advanced analytics has brought about service innovation (Tony D'Emidio, 2015).

As Cohen and Levinthal (2000) said, "Research and development are important knowledge sources that shape a company's capacity to determine, analyze & use new information about transportability and the environment. Current research shows that companies that invest heavily in knowledge and R&D tend to be innovative (Luisa Blanco, 2013). There is a virtuous cycle of mutual reinforcement of investments in R&D, innovation and productivity to support long-term growth and development (Robert E. Hall, 1999) (Tekin, 2012)

There are huge differences and disbandment in research and development activity and economic development throughout the world. There does not exist any common trend in research and development spending worldwide; where seventeen countries performed more research and development in 2005-2009 than in 2000-2004, twenty thee performed less. Five countries with the highest level of research and development spending as a share of GDP in 2009 are: Israel (4.46 %), Finland (3.93 %), Sweden (3.60 %), South Korea (3.56 %), and Japan (3.36 %). We realize that all these countries are highly developed while some countries achieved robust growth during this period, Japan lagged behind. United States of America, standing at the eighth place, had research and development spending in 2009 that composed 2.90% of GDP, but had modest economic growth at best—and two recessionary years—during the 2000's. Many countries including Spain, Italy, Brazil, Russia, and China, spent less than half as much as the United States of America on research and development. Countries not investing much on research and development are usually much less advanced than those that spend the most, even though some of the lower research and development investing bodies had considerably high growth rates during the bygone decade. Therefore, we can hypothesize that, the relationship between these synchronous research and development spending and economic development appears to be highly volatile.

Research and Development (R&D) had emanated out as another very important mechanism, or should I say tool, for modern economic development. The influence of research and development in today's economic development has also been emphasized in the Growth. Theory of Development. The results of research and development lead to innovations that improve the value addition of the finalized product and smoothens out the process of production. Research carrying out firms take out essence from certain research and developments benefits of each innovation, but these benefits tend to disappear with subsequent innovations (Howitt, 1990). Engelbrecht (1997) proposes the multipronged role of human resource and research & development in national innovation and international dissemination of information. This expansion will lead to long lasting economic development. Blackburn (2000) combines R&D & human capital cumulation with an endogenous growth model, based on the ideas of Lucas (1988), Ozawa (1965), Grossman, Hillman (1989), and Romer (1990).

The aforementioned research analyses encourage the cumulation of crafts and information for economic development. The gathering of human capital not only gives major boost to economic growth, but also promotes research & innovation and highly benefits production and value addition. Ballots et al. (2001, Zeng (2001), Chow (2002), Jones (2002), Li (2005), Kwak and Yang (2006), et al.) & several noteworthy researchers and academicians contributed to the importance of research and development and educational attainment in economic development and growth. Additionally, even though considering the extreme importance of research and development for economic growth, sadly, the research and development sector has not been able to attract proper attention of policy makers in Pakistan. This article examines the importance of research and development in Pakistan and Indian economy between 1996 and 2020.

1.4. Research Question

All of the previous studies carried out in this regard had been focused on industrial sector and the performances of selected firms in the context of research and

development. Current research showcases that companies that invest heavily in knowledge and R&D tend to be innovative. Furthermore, almost 95% of research is carried out for developed nations and countries who have already established enough insight into their future planning and are already working on it. But very less research has been put forward in case of developing economies who are in dire need of knowing the root cause of their lagging behind in global arena and addressing that notion. So, naturally, my research came out to be that;

How does investment in research and development impacts the value addition of services and also the overall economy of the country for developing economies i.e. Pakistan & India.

1.5. Hypothesis

Hypothesis (H1); Developing economies' investment in R&D translates into innovation and there is a significant and long-term impact of investment in research and development on the value addition of services.

The estimates based on H1 could provide and important insight as to how R&D impacts value addition and such results could provide a strong basis for a policy framework pertaining to long term economic growth of an economy. Similarly, one should also expect some interdependency among variables used in our analysis.

Hypothesis (H0); H1 is not true.

1.6. Objective of the study

This study aims to analyze the relationship between research and development (R&D) on the value addition of services and how much it influences the growth of an economy. For that particular purpose, we will analyze the time series of two south Asian developing countries; Pakistan and India while covering the analytics from year 1996 to 2020. The reason for taking Pakistan & India together in this study is to showcase a comparative analysis of the two developing economies in the context of research and development. And how Pakistan has lagged behind its South Asian counterpart in the context of investment in modern research and technology.

1.7. Organization of the study

The dissertation in question carries in itself 7 chapters. Chapter 1 presents the introduction and background of the study. In Chapter 2, literature review has been presented which throws light upon the past empirical studies related to this research. Chapter 3 cadres to the brief overview of the structural framework of the developing economies. In Chapter 4, Data & Variables involved in this study have been discussed. Methodology of our dissertation has been presented in Chapter 5. Chapter 6 cadres to the results and discussion of our empirical work while Chapter 7 concludes our dissertation and provides us with policy recommendations. Finally, References are provided at the end of the thesis.

LITERATURE REVIEW

In the current economic environment, there is a broad consensus on the fundamental role of the services sector in the economy. In recent decades, value addition has shifted from physical production to knowledge-based, intangible and product-based economies, resulting in a radical structural change in most of the world's economies. The rapid growth of developed countries, mainly centered on service economies, received little attention from research and development in the early 1960s (Ackhurst 2008; Mackie2011). Currently, the process of producing goods and the process of producing services cannot be separated (Sundbo, 2008). Sundbo (1996) argues that innovation activities can be governed by R&D or "balanced empowerment systems". The latter is a common system that brings together most of the company's employees.

In recent years, especially in the United States, structural and technological changes in the manufacturing industry have received particular attention. However, technology has brought major changes in the service sector. Today, the services sector accounts for about 68% of US GDP and 71% of US employment. Services diversity has been considered as a long-term ritual in the United States of America as well as in all advance developed countries.

Extensive literature forms the link between knowledge contributions and innovative products. However, what is known is limited to production. However, many companies and groups today face new threats to their business and service companies. Criminals are a member of the new digital novices who are creating innovative and user-friendly alternatives to traditional and older services through research and development, advances in information technology, customer behavior and data availability.

In fact, a variety of digital developments that began 20 years ago including Amazon and AliExpress retail are rapidly moving into nearby industries. Further examples include Uber, SWVL, Careem in transportation, Airbnb in hotels and hospitality, FoodPanda in restaurant & cuisine, CastLight Health and HealthGrades in health & fitness training. These start-ups and attackers may be small right now, but they pose greater challenges than ever to traditional businesses. These R&D-related startups and digital transformations can drive GDP growth by adding value to downstream services in general.

The nature and pace of change in the service sector has changed quite dramatically in recent years, and it is not enough to remain at the forefront in traditional aspects of service delivery. To capitalize on the opportunity to become more competitive and marketable, companies must learn to harness the innovative potential of their services through research and development.

Extensive literature confirms that company size is an important factor in investment decisions in R&D and subsequent innovation (D. Czarnitzki, 2011) (H. B. Hall, 2009) (Baumann and Kritios; 2016). Current research examining the impact of research and development expenditure on business concoction outcomes and value-added services, and ultimately business productivity, focuses primarily on manufacturing, which cannot be differentiated by sector and region. Empirical studies of firms' innovative activities in the service sector have recently begun (Luff and Heshmat; 2006).

Services companies engage in research and development in order to improve product quality, add value, give a boost to their sales, cut down their productive costs, and eventually increase productive outcomes. Probably the most notable approach to analyze firm-level innovation in theoretical economics is that of Grerich (1979), who introduced the Cobb-Douglas global production function, which explicitly embeds knowledge in the form of capital and labor. It describes the process of investing in productivity-enhancing research and development to estimate the level of technical knowledge and its impact on productivity, using past and present research and development costs along with a productivity framework. Extensive empirical literary works follow this conceptual framework, examining the performance of knowledge creation and showcasing that investment in research and devlopment has a positive effect on business productivity (Mares and Sassenau 1991; Grylich 1998; Griffith, et al., 2004, Hall, et al. 2010).

Research and development play an important role in national economic development through technological procession and well-being. R&D costs can be more rewarding if they are included in the high-tech sector (M. I. Nadiri, 1993). Universities are considered as places of research and study, and advance education costs tend to play an important role in research and development. Furthermore, there also exist specialized and fully concentrated research and development institutions in Pakistan and India. National R&D spending reflects interest in science, technological fronts and various other sectors driving economic growth. This thing has come into consideration that many of the world's wealthiest countries having vast resources spend vast sums of their investment and money on research and development. Between 1999 and 2000, global research and development spending had increased from 410 billion dollars to 755 billion dollars, 80% of which was funded by OECD countries (R. Reinikka, 2004).

Some service industries have reported new economies of scale that the latest technology has introduced new economic aspects. This first-order effect was new and considered to be having a competitive structural framework, characterized in most cases through greater concentration and greater fragmentation (overlapping or fragmentation). In order to have large economies of scale, quite a few numbers of large services companies got merged with giant companies (R. W. Zmud, 1984). The event offers many exciting opportunities for cross-border trade policy. As we know that quite a few services are considered to be cheaper to travel abroad, countries or companies that are rapidly realizing economies of scale should have few barriers to gaining a core business advantage abroad and entering domestic markets. Countries whose economic policies allow for this scale will benefit from this.

The introduction of new technologies often enhances economies of scope and has a secondary effect; the second-order effect. The services network has the potential to offer entirely new service products. This was especially true of electronic communication technologies and information processing. With the proper installation of these technologies, users can assign equipment, development and even software applications to perform a variety of low-cost business, data or customer service. In addition, new technologies often offer better strategic capabilities due to the advantages of when to launch new products and when to react quickly to the moves of competitors. This strategic flexibility may be the most important advantage for service companies.

(B. Crépon, 1998) established a structural equation model (the "CDM model") that creates a linkage between the approach of (Z. Griliches, 1979) with a knowledge production function which is quite similar to that of Pakes and Griliches (1984). Quite a few literary works have taken the advantage of the CDM model, or the fabricated versions of it, to analyze the relationships at the firm level (Mohnen and Hall 2013). The CDM framework describes a structural model that accounts for innovation through productivity in investment in research and innovation outcomes, and provides an opportunity to fine-tune the selectivity and diversity inherent in the model. The "service-oriented" approach emphasizes the distinction between innovations by emphasizing the nature of the different services that production results in (L. Galloway, 2002) (Howells 2010).

In a quite dissimilarity to the neoclassical regulatory framework, the endogenous growth model states that long-term, economic development is very much affected by the conscious cumulation of information/knowledge or Research & Development (Romer, 1990) and human resource (Lucas, 1988), in spite of by exogenous alterations in technology. The field of technology gives endogenous scientists the knowhow that knowledge is a very common commodity, and thus hypothesizes that economies tend to come together in quite a unique balance. Inherent growth theorists totally dump the concept that knowledge is a pure public commodity, and eventually also reject the hypothesis that economies will converge to a unique steady-state equilibrium. Anyhow, they still tend to make a claim that there is a convergence of different steady states at different initial conditions.

Given the availability of data, a large number of these researches are cross-sectional studies and are have a basis on the common assumption that there exists a synergistic effect between innovation input and output and innovation efficiency. They typically use R&D costs to approach innovation inputs and find that the potential of innovation outcomes increases with R&D intensity, although the estimated flexibility varies (Kanks and Siliverstov, 2016). At the same time, there are companies that have invested in R&D but have not reported innovation success, as well as companies that have reported innovative products without formal R&D
funding. Panel data set are frequently used (Hall, Lottie and Myerse 2013; Sidschlag and Zhang 2015; Czernitzky and Delanot 2017; Hall and Senna 2017) and few research works have investigated the effect of dynamic feedback (Hurgo and Joumandreu 2004,). Raymond, et al. 2015.) Bohm, et al. 2017). Quite a few research works have investigated if there exists a causal relationship between innovation and productivity using the CDM model and its modifications.

Peters, Roberts, Wong & Freges (2017) had analyzed the relationship among R&D, innovative creation, and development productivity using a robust structural model of an organization's or firm's decision to engage in research and development as a function of future compensation costs. He believes that while research and development mostly end at the expense of industry, potential payments could be avoided and delayed and fraught with uncertainty. Peters, Roberts, and Fong (2017) extend this approach to explore the impact of a firm's financial position on the relationship among research and development, innovation, and productivity and profitability. Hall, Lottie and Marese (2009) and Bowman and Kritos (2016) clearly explore the relationship among research and development, innovative creation and productivity in small and medium-sized producers. The latter are small businesses. Both studies show that SMEs are producing significant creative outcomes, and few can achieve them without formal investment in research and development.

A factor common to all current research on research and development, innovation and productivity in the manufacturing industry is the important influence of size of the firm (ACS & Audresh 1987). When it comes to research and development expenditure investment decisions, there are quite a few reasons to believe that firm size is positively correlated with research and development expenditure. As R&D is an important part of achieving knowledge outcomes, small and medium-sized enterprises (SMEs) inherently suffer from the lack of innovation. However, it is important to point out that the theory also applies most of the evidence to industrialization (Galloway & Weinstein 1997). Little is known about R&D outsourcing companies, the relationship between innovation and productivity, and how this relationship affects company size.

Another subject is formal investment in R&D in the service sector that creates advance knowledge throughout services and manufacturing industries. First of all, we note that most R&D spending on knowledge-based services (75 per-cent) goes to funding research and development labor and workers, making a point that research and development investment is mainly vested towards highly skilled and educated "brains" and very few into machinery or technological equipment. There also does exist consensus on the level of innovation outcomes that can be created in the absence of proper ceremonious investment in research and development. Analytical research works have shown that even in the manufacturing industry, some types of companies create new and advance products without any ceremonious research and development funding. People who generate knowledge on a daily basis can quickly recognize opportunities for innovation, so they are better able to have a breakthrough in the creation of new information in the normal course of business, even if there is no formal cost to research and development in the classical sense (De Jong and Marchelli 2006). Technology makes services complex. Engineers, molecular biologists, and epidemiologists can use computer models and networks of databases to analyze and solve more complex problems than ever before. The impact was so great that Rockefeller University President Joshua Lederberg suggested that technology is "having a move on from information retrieval to education and knowledge". In other words, latest technological instruments and computers are now able to correlate relationships and create new hypotheses as well as merely analyse and put on a test on them.
In the modern world, the added value of a product largely depends on the performance of its services, such as improved design, utility, packaging, sales, marketing, customer service and so on. Many of the most valuable (and expensive) activities are architecture such as arts, health, entertainment, travel, banking, investment, personal safety or education. Preliminary analysis shows that added value in the service sector is at least as important as the industry. Many service industries today are at the forefront of technology. We mainly deal with municipal services, airline, health, information, and telecommunications. However, delivery services, education, car rental, entertainment,

financial services, banking, and retail are also very technical sectors (Assessment, 1984). Some service industries report that the latest technology has introduced new economic aspects.

Advances in technology through services are rapidly evolving in the modern economy, providing totally modern challenges as well as opportunities for businesses and national policy makers. The latest estimates estimate that R&D production in developed countries is around 40-60% per year (Islam, 2020). Technology has created a service industry with scope, complexity, sophistication and value-added features suitable for any industry. Current research shows that companies that invest heavily in knowledge, research and development tend to be innovative (Bruno Crepon, 1998). There is a virtuous cycle of mutual reinforcement of investments in R&D, innovation and productivity to support long-term growth and development (Blanco, Prieger, & and Gu, 2013).

Previous studies and literature including (Islam, 2020) had studied the impact of research and development on the innovation on the services sector of the developing ASEAN countries. Services sector being central to the economic growth has been under the radar of many
researchers and academicians. Therefore, I had opted to carry out the analytical research of the impact of research and development on the value addition of services of the selected South Asian developing economies i.e., India and Pakistan which I have considered to be the research gap between previous studies and this one.

Value addition can be defined as the difference between the price of an end product or service and the cost of production. There are several ways to add this value. The service share is the sum of the added value of the service sector. This is the relationship between the service sector and the total output of the economy. The Services segment includes value-added services in the areas of personal and professional services such as wholesale and retail, transportation, government, finance, real estate services, healthcare and education. Discrepancies due to payables, bank fees, import taxes, and statistical discrepancies and revaluations known to domestic collectors are also incorporated. Value-added services data are based on 2010 constant US dollars prices.

Value-added services start with a product or service and then add value to it. In recent years, the nature of the service sector, the services currently offered and the pace of change have changed dramatically, so having a stronghold of the traditional aspects of service delivery is no longer considered to be sufficient enough. To have a grasp at the right opportunities, Pakistan and India will have to learn to harness the potential of service innovation through research and development. Services, which currently account for around 65% of global GDP, are projected to account for nearly three-quarters of global growth over the next decade. Fast-growing companies are very likely to benefit from this growth, and companies that stick to traditional models face pressure from digital attackers.

STRUCTURE OF THE ECONOMIES

2.1. Structural Transformation

In modern economic literature, the term structure refers to different levels of productivity and different distributions of factors of production in many economic sectors. In a controlled structure, these network economic activities are carried out by three main components; Agriculture, Industry and Services. Long-term structural changes in the economy involve dynamic relationships between the three main sectors (agriculture, industry and services) and economic development.

Kuznets (1971) found two stages of structural transformation. At the first stage, the economy of a country tends to allocate the largest share of resources to the agricultural domain. With the passage of time, as the economy grows, resources are redistributed from agriculture to industries and services domain. This is considered as the first step in structural transformation. During the second stage, agricultural and industrial resources are again redistributed to services domain. This is a trend that all developed countries and economies follow. However, many developing countries are following a slightly asymmetrical path of structural change, clearly lagging behind in the early stages of change and moving directly from agriculture to the services sector, missing out on industrialization. Developing countries are also affected by significant structural changes during periods of economic stagnation and recessions. Kuznets (1971) turned these concerns into the enigma of structural transformation.

2.2. Indo-Pak’s economic skeletal framework

Both India and Pakistan comprise the sub-continental region of Asia. They make the major chunk of South Asia with other economies being Bangladesh, Sri Lanka, Nepal, Maldives and Bhutan. Both Pakistan and India are considered among the developing nations striving to have economic growth and a better standard of living for their natives. The developing countries, while their process of growth, are facing a number of problems including dense population, unemployment, lack of capital, lack of infrastructure, and these problems are more or less associated with the lower productivity among the sectors and unemployment of a sector (Bhowmik, 2002). A country having much more diversified economic structure can easily cope up with shocks, fluctuations and interruptions put forward to it. This means that a more diversified structure will have high ratio in the GDP (Barry Eichengreen, 2011).

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2.2.1. Structural Transformation: Indian Experience

Indian economy when it embarked on the development process after Independence in 1950, with about 60 per cent of GDP accounted for by agriculture, industry contributing about 13 and services about 27 per cent, it was structurally comparable to the economy of the Great Britain in late eighteenth century, and of Germany at the beginning of the nineteenth century, of the United States and Italy of mid-nineteenth century and of Japan in 1900. What India has achieved in terms of structural transformation in income in a span of sixty years is much quicker than what developed countries have taken in the historical course. The share of agriculture in GDP in India has declined from around 60 per cent in 1950-51 to 36.38 per cent in 1983 and further declined to 14 per cent in 2010-11. That of industry increased from 13 to 24 and reaches to 28 per cent and of services from 28 to 40 and further rises to 58 per cent. The difference is while most developed countries entered the phase of predominance of services in their economies after going through a phase of industrialisation, India's industry failed to show similar growth and it arrived into service sector dominance straight away.

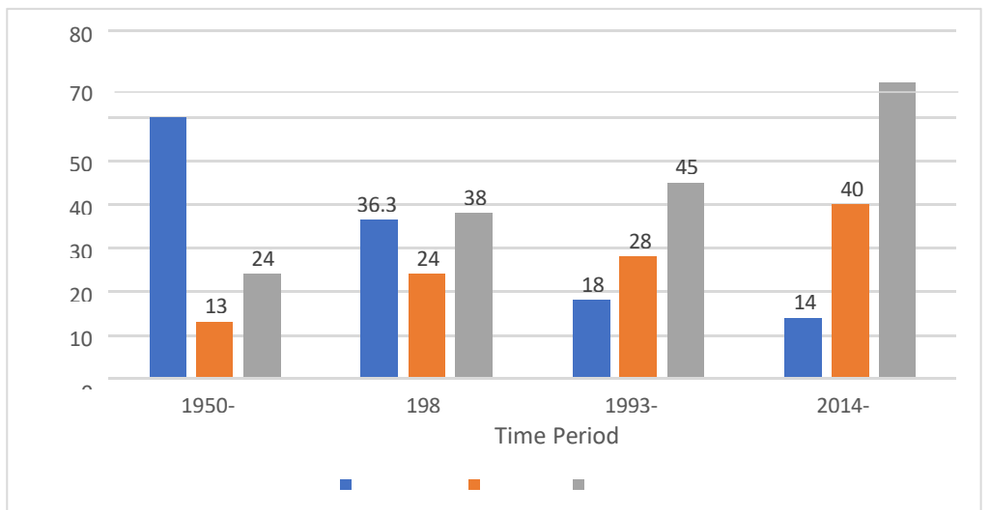

Figure 2: %age Shares of sectoral incomes in India

Source: National Account Statistics

2.1.1. India's R&D framework

India continues to be by far the most preferred destination in the world for Information Technology (IT), Information Technology enabled Services (ITeS), engineering and research & development (R&D) services delivery. In 2018, of the 307 new centres that were set up for such services, India accounted for 23 per cent of them, Singapore followed at about 8 per cent whereas Ireland, China and Mexico accounted for 5 per cent each (Everest Group's Global Locations Annual Report 2019.). Many Multi-National Corporations (MNCs) are now increasingly outsourcing their corporate R&D efforts by investing in India's local start-up ecosystem – to create breakthroughs in innovations that could help the parent companies. Global giants such as Google, Microsoft, SAP, and IBM have come forward with strategies to invest as well as incubate start-ups, or collaborate with small early-stage service providers in the form of venture funds, evangelism programs, and partnerships with a focus on solving problems faster for customers. According to industry reports, the number of start-ups in India has gone up from 7,000 in 2008 to 50,000 in 2018. More than 150 international companies are doing R&D in India including Netflix, Amazon, AliBaba, Hulu, Hotstar, Spotify etc etc and these all are service-providers.

There have been a few studies, which have looked into the inflow of FDI in R&D (RDFDI) to Indian services economy. The study by National Institute of Science, Technology and Development Studies (NISTADS 2011) estimates the R&DFDI inflows to India and the impact of such inflows. During the period between 2003 and 2009 the R&DFDI inflows was $29.2 Bn, which constituted 8.3 per cent of the FDI inflows into India during the same period. Sandhya et.al. (2014) found that R&DFDI tend to be concentrated in certain clusters. Bangalore, Hyderabad, Chennai, Mumbai/Pune and Delhi/National Capital Region (NCR) accounted for 92 per cent of the amount of inflows in the three sectors—software and IT, pharmaceuticals/biotech and automotive.

Year	***FDI (Rs. Mn.)***	***R&DFDI (Rs. Mn.)***	***Share of R&DFDI (%)***
Sept.-Dec. 2004	112805.2	185.0	0.2

2005	192706.0	1047.1	0.5
2006	503572.1	1304.8	0.3
2007	654950.4	4844.0	0.7
2008	1351452.2	3986.8	0.3
2009	1309797.7	1922.6	0.1
2010	960149.4	3764.4	0.4
2011	1202384.9	4146.8	0.3
2012	1215914.4	2665.6	0.2
2013	1294825.1	7512.8	0.6
2014	1753133.7	7852.8	0.4
2015	2525614.7	14063.5	0.6
Jan.-March 2016	513112.2	1566.3	0.3
All the years above	13590418.0	54862.6	0.4

Figure 3: FDI and RDFDI Inflows to India

Source: FDI Newsletter

Similarly, RDFDI was concentrated in four sectors—ICT and software services, natural sciences and engineering (NSE), pharmaceuticals and clinical research, which accounted for more than 80 per cent of total RDFDI.

	R&DFDI Inflows		**No. of R&DFDI Firms**	
Sector	Amount (Rs. Mn.)	Share (%)	No. of Firms	Share (%)
ICT & Software IT Services	15604.6	28.4	42	14.1
Natural Sciences and Engineering	10642.2	19.4	76	25.5
Pharmaceuticals	9462.9	17.2	49	16.4
Clinical research	9022.5	16.5	55	18.5
Chemicals	4436.8	8.1	10	3.4
Agriculture	1900.5	3.5	16	5.4
Defense	1133.8	2.1	1	0.3
Automobiles	762.1	1.4	6	2.0
Machinery	724.0	1.3	8	2.7
Petroleum and Oil	578.9	1.1	1	0.3
Medical Devices	340.9	0.6	4	1.3
Social Sector	111.0	0.2	14	4.7
Renewable Energy	101.0	0.2	14	4.7
Design	41.5	0.1	2	0.7
	54862.6	100.0	298	100.0

Figure 4:Sector-wise Distribution of R&DFDI

Source: Compiled by Authors from FDI Newsletter

The Gross Expenditure on Research & Development in absolute terms has increased over the years from Rs. 74.8 Bn in 1995-96 to Rs. 1048.6 Bn in 2016-17.

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2.2.3. Structural Transformation: Pakistan Experience

On the other hand, Pakistan had also been agriculture dependent economy ever since its inception in 1947. Employment percentage of population in agricultural sector in the early decades was 43.5% and it contributed to 20% of GDP while 68% population was still living in villages. Pakistan has pursued different development strategies since 1947. In the 1950s and 60s, it pursued a policy of industrialization through import substitution. Public enterprises in the manufacturing sector were set up but subsequently sold to the private sector and as such this period is characterized by private-led growth strategy. In the 1970s, there was shift from private-led growth strategy to state-led heavy industry-based industrialization strategy. In the 1980s, there was again reversal to private-sector led growth strategy as the industries

nationalized during the 1970s were gradually denationalized. Pakistan has, however, not been able to put itself on the trajectory of sustainable economic development despite experimentation with several strategies of economic development.

Structural transformation in Pakistan has remained slow compared to countries like South Korea, Malaysia, and China. The service sector has always supported Pakistan's economic development. Their share of GDP is now over 50%. For Pakistan, the share of services in all sectors of the economy are increasing with the passage of time. As a matter of fact, the services sector is growing faster than the agricultural and industrial sectors. The services sector contributes around 54% of the gross domestic product and more than a 1/3rd of total employment. The service sector is closely linked to other economic sectors. It provides essential inputs for agriculture and production.

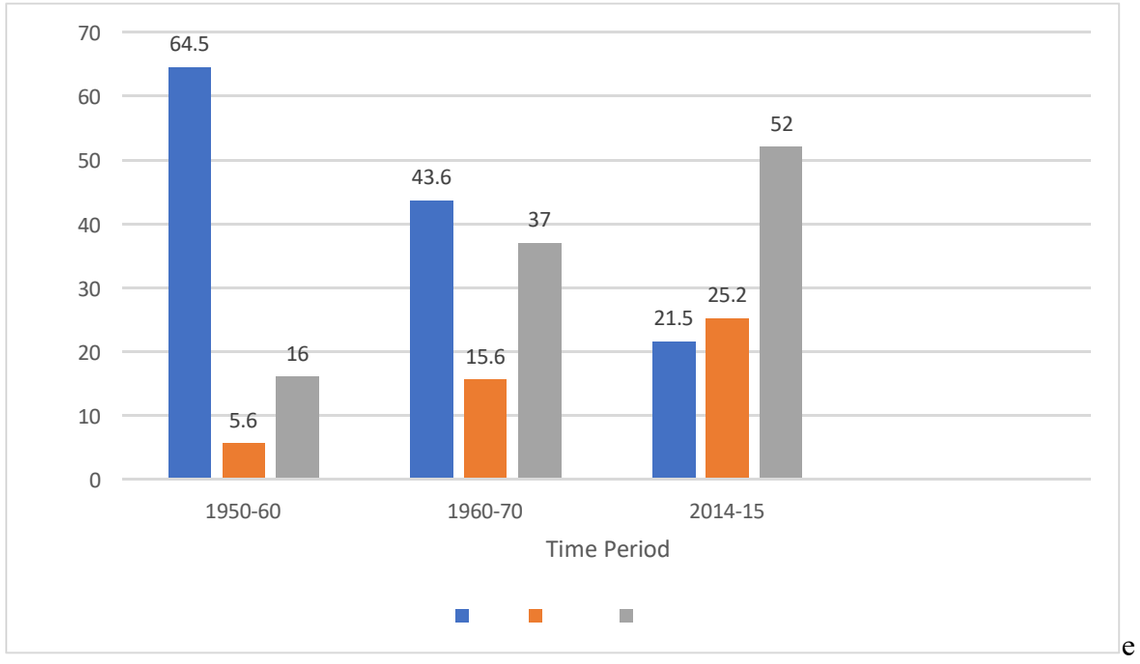

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Figure 5:Percentage Shares in GDP

Source: State Bank of Pakistan 2005

The services sector makes a huge contribution towards a huge chunk in the economic activity of Pakistan. During the past few decades, the structural cobweb of Pakistan economy has experienced substantial altercations. The research output of Pakistan economy showcases that share of agriculture had been on a decline slowly and gradually over time from 43.6 percent in 1960-61 to 21.5 percent of GDP in 2014-15, while industrial share had increased from 15.6 percent in 1960-61 to 25.2 percent of GDP in 2014-15.

Table 1: Sectorial Contribution to GDP Source: Economic Survey 2020

Sector	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Agriculture	21.7	21.6	21.4	21.10	20.7	19.9	19.5
Manufacturing	21.2	21.0	20.3	20.5	20.7	20.9	20.9
Services	57.1	57.4	58.2	58.4	58.6	59.2	59.6

2.2.4 Pakistan's R&D Framework

The services sector can be very innovative and it is widely recognized worldwide that service innovation that exists across the economy is a key source of economic growth. Investing in research and development (R&D) is considered as a highly impactful strategy for unlocking high-tech potential to stimulate innovation and support economic growth (Sterlacchini, R&D, higher education and regional growth, 2008). The services sector can be very innovative and it is widely recognized worldwide that service innovation that exists across the economy is a key source of economic growth.

The expenditures in Research and Development (R&D) by a country show its interest in science and technology and other sectors which lead to economic development. It has been observed that rich countries of the world with huge pool of resources spend huge amounts of money on R&D. During the year 1999-2000 the world expenditures on R&D increased from 410 billion USD to 755 billion USD and out of this 80% was made by OECD countries (UNESCO, 2004).

In Pakistan, expenditure on R&D is mostly made by the government of Pakistan through investment in higher education. Universities are considered home for research and expenditure made on higher education does play an important role in R&D. There are also few specialized organizations concerned with R&D in Pakistan. The research expenditure and quality has improved in recent decades after the formation of Higher Education Commission (HEC) of Pakistan in 2001.Before the formation of HEC, in 1976 the number of publication in Pakistan were 271 per annum only (ISI, 2010). This number almost doubled in 1984-85 when the number of publications reached 512. The 2000s is a decade of research for Pakistan because the number of publications, number of research organizations and expenditures on research all increased with acceptable pace. The publications increased from 1305 in 2000-01 to 7661 in 2008-09. Due to lack of availability of data on R&D the expenditures of higher education were taken as expenditure on R&D because in Pakistan most research is conducted in higher education institution. Another justification for the use of this expenditure as expenditure on R&D is that high correlation has been noted in higher education expenditure and number of scientific publications.

DATA AND VARIABLES

While making use of time series dataset obtained from World Development Indicators (WDI) of the opted South Asian Economies i.e., Pakistan and India over the time period of 1996 to 2020, this research work puts into limelight the impact of research and development expenditure on the value addition of services. First, we make an analysis of the influence of research and development on the growth of the economy at an aggregate level. Then, we systematically move onto disaggregate services level and analyze the impact of research and development on the value addition of services. In order to make an examination of the impact of research and development on the value addition of services, it is pre-requisite to decide the appropriate and suitable variables to measure the required output. We could use the research and development expenditure (%age of total GDP), labour force with advanced education (%age of total labour force), expenditure on education, total and GDP per capita can be used in this case.

4.1. Research and development expenditure

Research and development (R&D) can be the result of a company or the activities a company undertakes to bring a new product or service to market. Research and development play an important role in giving companies an edge over their competitors. The services sector can be very innovative and it is widely recognized worldwide that service innovation that exists across the economy is a key source of economic growth. Investing in research and development
(R&D) is considered as an highly impactful strategy for unlocking high-tech potential to stimulate innovation and support economic growth (Sterlacchini, R&D, higher education and regional growth, 2008). Research and development data is based on a percentage of total GDP and is used from 1996 to 2020. Time series data of the selected South Asian economies i.e Pakistan and India, taken from World Development Indicators (WDI), has been utilized. Research and development and technological sector have been so far a neglected sector in Pakistan but much emphasis had been put on R&D investment in India. It is dedicating just a meagre percentage of its gross domestic product on research and development as shown in the table given below.

Table 2: R&D Expenditure as a %age of GDP

Years	Pakistan	India
1996	0.14	0.64
1997	0.16	0.69
1998	0.11	0.70
1999	0.12	0.72

2000	0.13	0.76
2001	0.17	0.74
2002	0.22	0.73
2003	0.15	0.72
2004	0.16	0.76
2005	0.44	0.82
2006	0.23	0.80
2007	0.68	0.81
2008	0.32	0.86
2009	0.45	0.83
2010	0.41	0.79
2011	0.33	0.76
2012	0.43	0.74
2013	0.29	0.71
2014	0.38	0.70
2015	0.25	0.69
2016	0.34	0.67
2017	0.24	0.67
2018	0.30	0.65
2019	0.30	0.67
2020	0.28	0.66
Source: (World Development Indicators, (WDI))		

Data shows that Pakistan had spent 0.16% of its GDP on research and development in 1997. This existing expenditure on research works suffered a downfall during the upcoming four years but had a substantial increase in the year 2002. Similarly, the research and expenditure expenditure showcased a visible expansion during the year 2005 (0.44%of GDP). The ruling elites of Pakistan and Pakistan government had realized the importance of research and development, and henceforth increased investment on research and development to 0.68% of GDP in the year 2007. 2001 was the year of development in which Pakistan had established the Higher Education Commission (HEC). The establishment of Higher Education Commission (HEC) of Pakistan in the year 2001 is considered to be the major boost to the development of R&D sector in Pakistan. Similarly in India, government had put a major emphasis on R&D expenditure in the decade of 1990s with 0.64% expenditure on R&D as a %age of GDP in 1996. The decade 2000 saw very high increase in R&D expenditure in India with R&D exp. mounting upto 0.86% of GDP in 2008. This major difference depicted quite clearly the major areas of interests in two subcontinent neighbouring countries.

The graphical comparison of two South Asian countries is shown below.

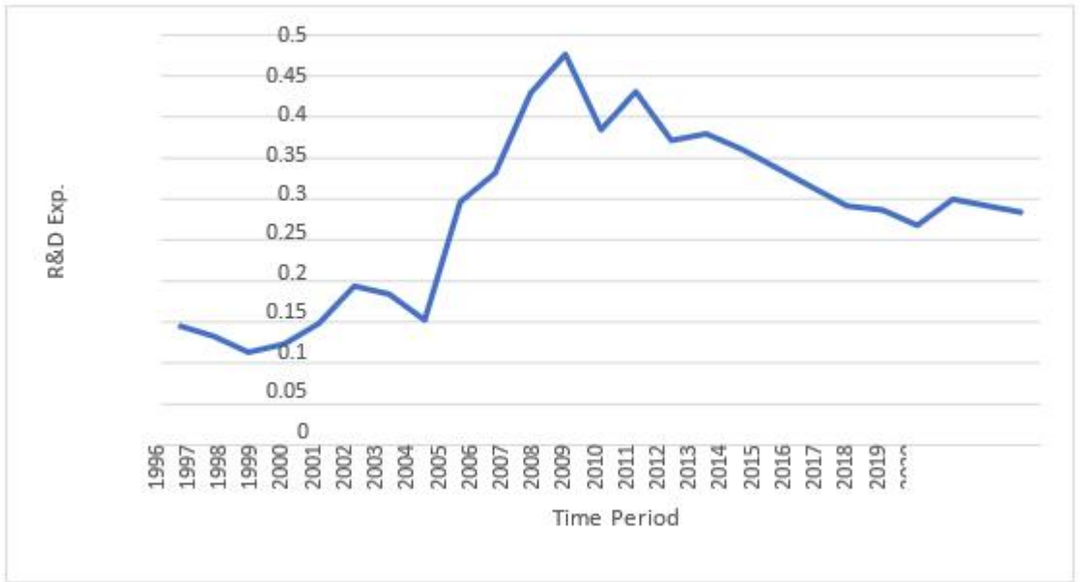


Figure 6: R&D exp. (%age of GDP) Pakistan

Source: World Development Indicators (WDI)

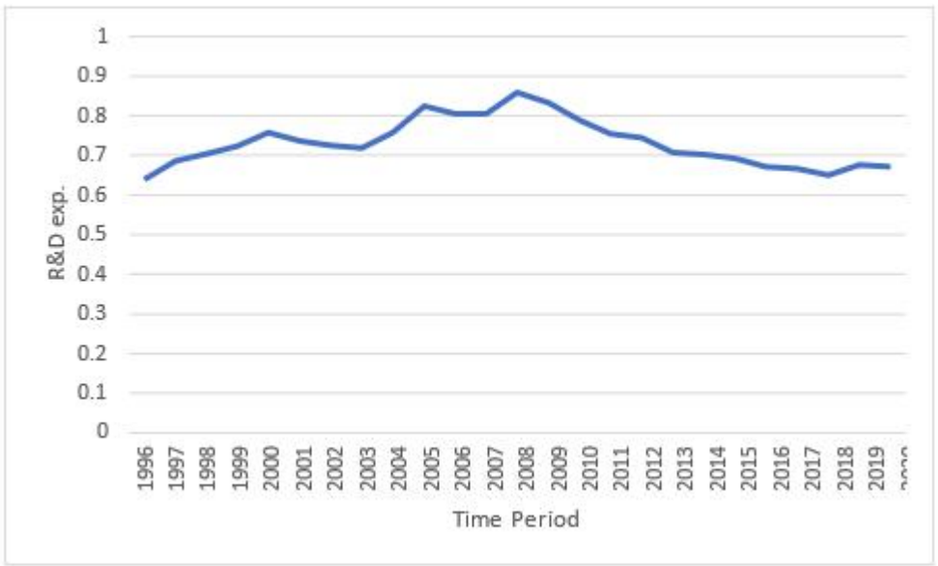
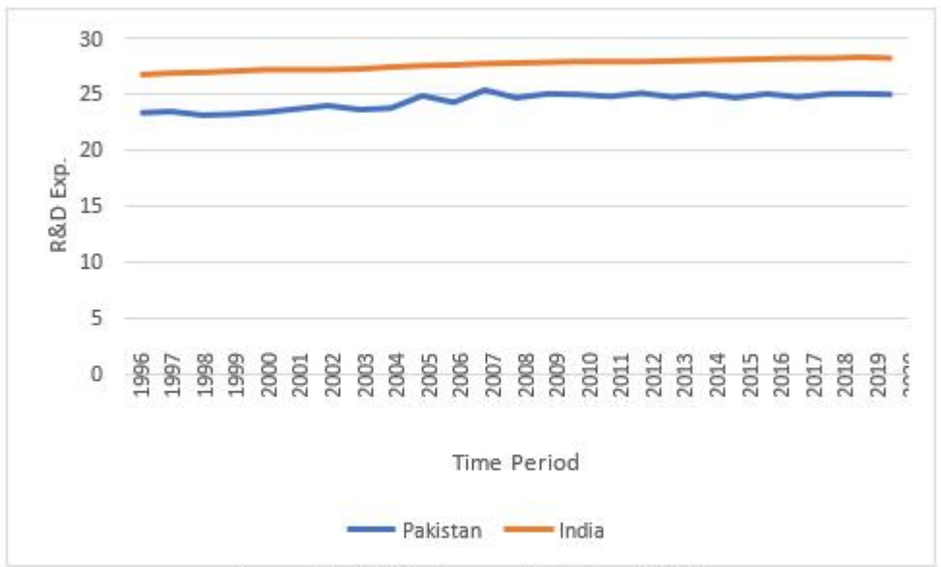


Figure 7: R&D exp. (%age of GDP) India

source: World Development Indicators (WDI)

Above mentioned figures showcase the patterns of research and development expenditures as a %age of GDP in both Pakistan and India from 1996 till 2020. Year-wise analysis of R&D exp. is presented in these figures which tells us that in terms of research and development expenditure, Pakistan had been lagging behind its neighbouring country India since the data was starting to get accumulated. In 1996, R&D exp. for Pakistan was languishing at 0.15% of total GDP while its counterpart India enjoyed around 0.61% of R&D exp. as a % of GDP. This extraordinary attentiveness can be attributed to macroeconomic stability and financial sector development. Comparative analysis of two South Asian countries is shown in the figure below. Side by side analysis of the two arch-rivals reveals that Pakistan had always been lagging behind in terms of investment in research and development and other governmental expenditures and thus not achieving the desired economic output.



Source: World Development Indicators (WDI)

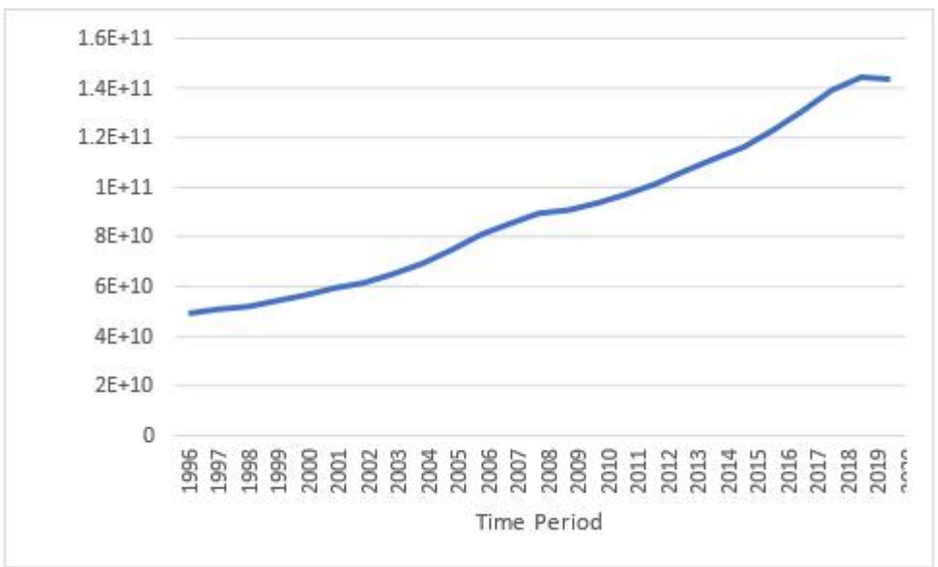
Figure 8: Comparative analysis of R&D exp. (Pakistan & India)

4.1. Value-Added Services

Value addition can be defined as the difference between the price of an end product or service and the cost of production. There are several ways to add this value. The service share is the sum of the added value of the service sector. This is the relationship between the service sector and the total output of the economy. The

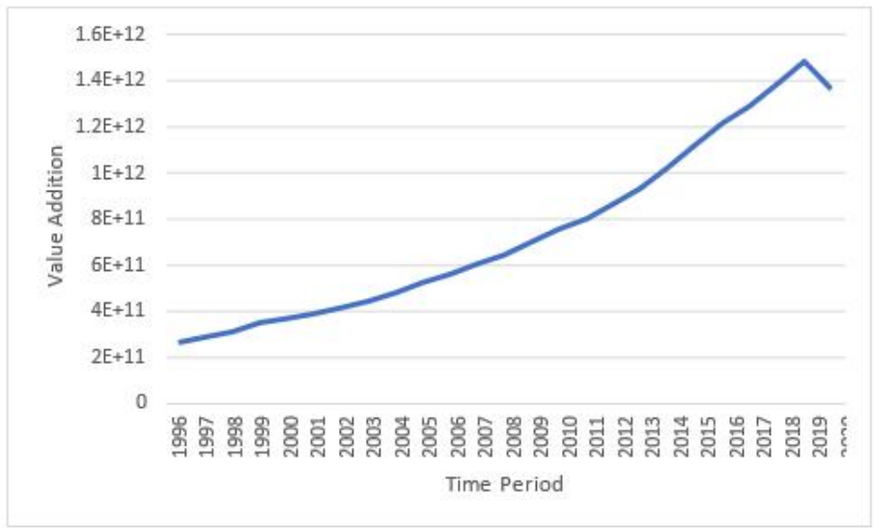
Services segment includes value-added services in the areas of personal and professional services such as wholesale and retail, transportation, government, finance, real estate services, healthcare and education. Discrepancies due to payables, bank fees, import taxes, and statistical discrepancies and revaluations known to domestic collectors are also incorporated. Value-added services data are based on 2010 constant US dollars prices.

Value-added services start with a product or service and then add value to it. In recent years, the nature of the service sector, the services currently offered and the pace of change have changed dramatically, so having a stronghold of the traditional aspects of service delivery is no longer considered to be sufficient enough. To have a grasp at the right opportunities, Pakistan and India will have to learn to harness the potential of service innovation through research and development. Services, which currently account for around 65% of global GDP, are projected to account for nearly three-quarters of global growth over the next decade. Fast-growing companies are very likely to benefit from this growth, and companies that stick to traditional models face pressure from digital attackers.



Source: World Development Indicators (WDI)

Figure 9: Services, Value Added (constant 2010 US$) Pakistan



source: World Development Indicators (WDI)

Figure 10: Services Value Added (constant 2010 US$) India

The aforementioned figures give a visual representation of the graphs of the services share in Gross Domestic Product. Upward and positive trend is depicted in both the countries of the analysis i.e., Pakistan and India. Services sector is now considered to be the most dominant sector in all of the developing economies as well as South Asian countries. Huge leaps of growth have been reported in this sector, while its contribution to the gross domestic product has spiked up from 41.3 percent to 54.7 percent during the previous three decades (Ul Haq, 2015).

Within Indian services sector, the sub-sector of hoteling, trade, transport and communications have contributed a major chunk to the GDP of the country. As a matter of fact, the contribution of these sub-sectors towards the overall services domain have remained quite steady ever since the 1980s. Communications sector has been considered to be the fastest growing factor within the services sector in the post-liberalization era. This matchup is subsequently followed by banking and insurance, mainly due to the rise of private players in the financial market during the reformation era.

In the services sector of Pakistan, the sub-sectors of storage, and communications wholesale and retail trade as well as transport have the biggest shares and have performed quite impressively during the last three decades. The share of these two sub-sectors in the total value-added by the services sector increased from fifty one percent to fifty seven percent between analysis period. While growth occurred in the sub-sectors of wholesale and retail trade, transport and communications, and banking, insurance and real estate in the services sector of Pakistan (Ayaz Ahmed, 2011).

Comparative analysis of two South Asian countries is shown in the figure below.

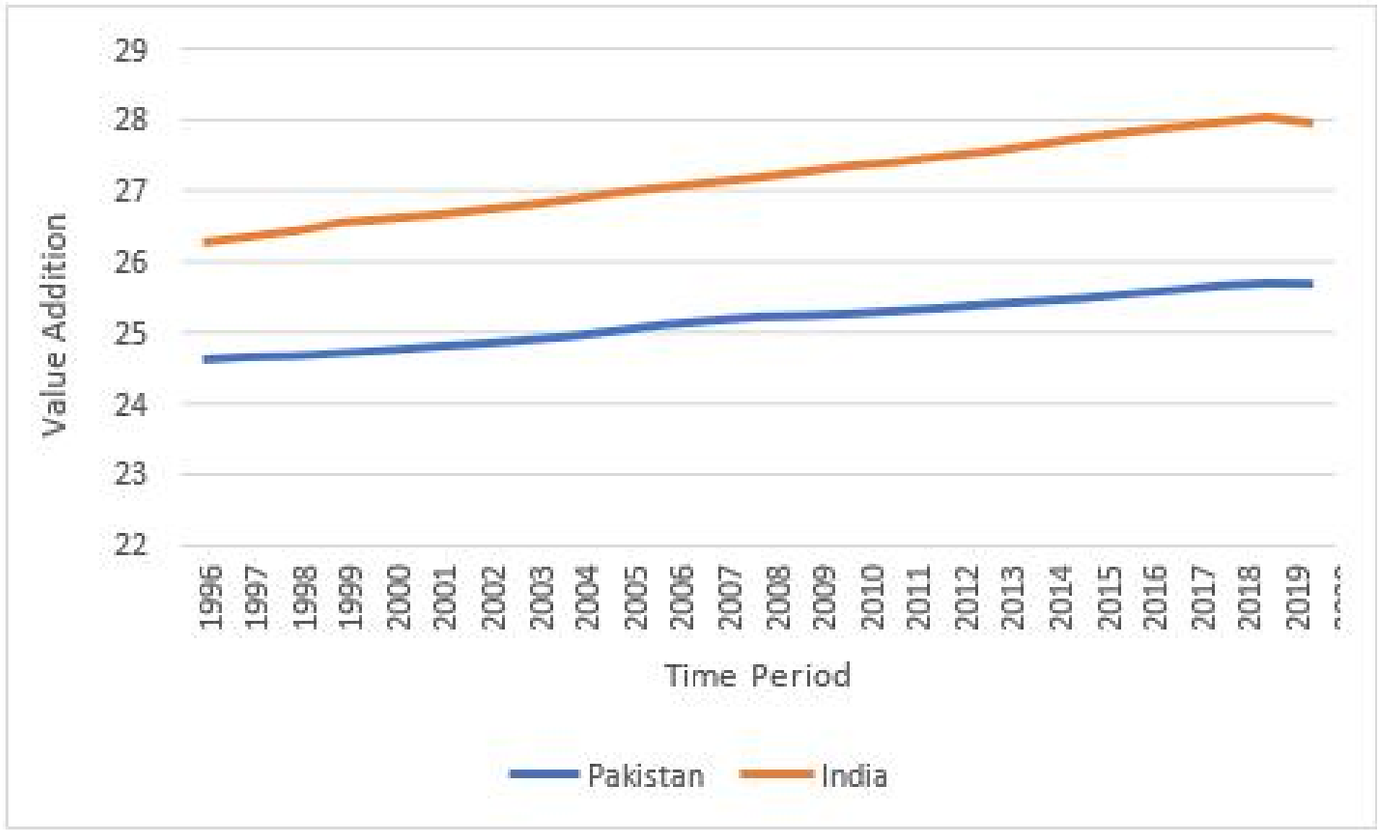
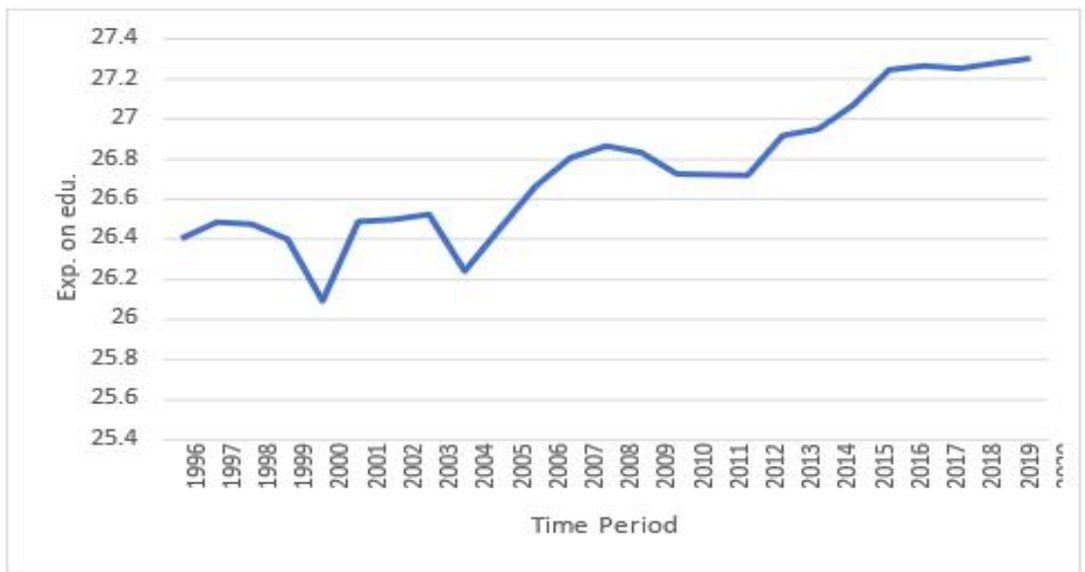


Figure 11: Services, Value Added (Pakistan & India)

4.2. Expenditure On Education

Education is widely recognized as an important tool to promote economic growth. It plays an important role in building human capabilities and accelerating economic development through social knowledge, skills and creativity. The benefits of education are not only limited to individuals and but to the whole economy. Education is especially important to Pakistan. Development is essential to break down the vicious cycle of poverty in Pakistan. The relationship between education and economic development has been under the discussion since the ancient Greek Era. Adam Smith and numerous classical economists have put much emphasis on the importance of investing in human skills and skill building. Over the past two decades, higher education has focused on national development, economic revitalization and strengthening development as an important direction to address the world's new challenges (Harvey, 2000).



Source: World Development Indicators (WDI)

Figure 12: Expenditure on Education (Pakistan)

The relationship between higher education and employment was considered for both political and research purposes (C. Pagés-Serra, 2007). In the world of work and employment in Pakistan, there is a conflicting situation when it comes to education. Unfortunately, poor education causes several problems (A. M. Husain, 2005). Encouragingly, the unemployment rate for skilled workers fell slightly from 6.3% to 6% (PBS, 2015). Sheikh Abdul Wahid Sandel, former regional director of FPCCI, confidently states that there are no unemployed graduates with higher education in major cities (S. Abduhu, 2014). He even said that most of the other economic sectors like, textile, engineering, services etc. are facing a shortage of skillful and qualified personnels. In pertinence to the lack of availability of data on research and development, the expenditures on education were considered as a proxy for expenditure on research and development. This is because, in Pakistan most research is conducted in higher education institutions. Another justification for the use of this expenditure as a proxy for R&D is that high correlation has been noted in education expenditure and number of scientific publications.

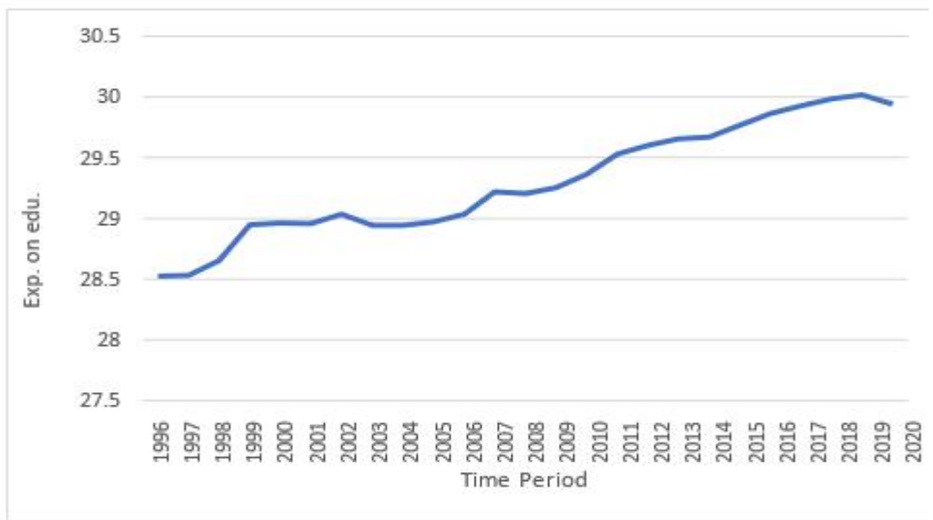


Figure 13: Expenditure on Education (India)

Source: World Development Indicators (WDI)

Comparative analysis of two South Asian economies is shown in the figure below.

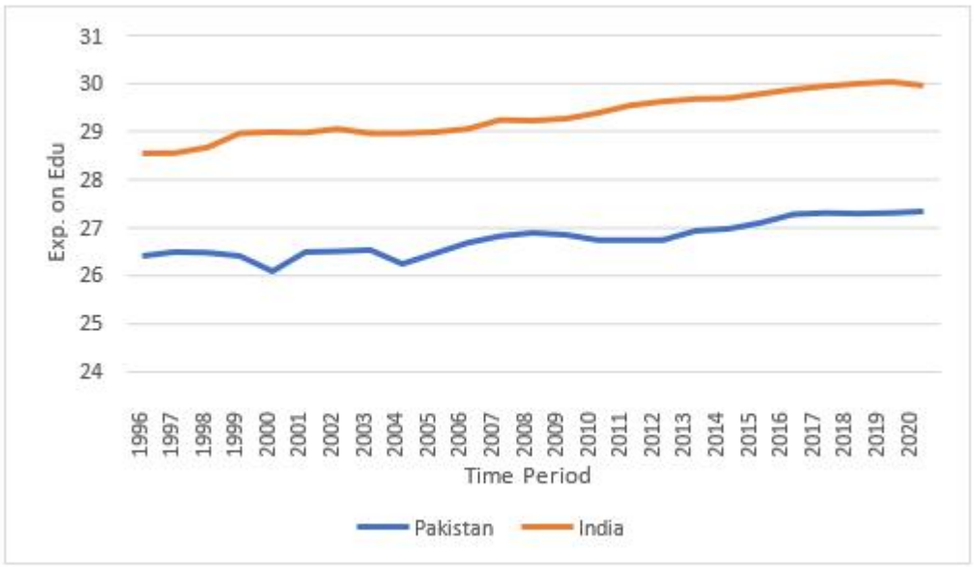


Figure 14: Comparative analysis of educational expenditures

Source: World Development Indicators (WDI)

4.3 Labor Force with Advance Education

The last decade has seen an articulated change in labor demand towards high-skilled laborers. The alternating patterns in labor demand are not basically determined by shifts in economic activity between industry towards additional skill-intensive exercises, rather they have ascended inside most enterprises, both manufacturing and non-manufacturing enterprises.

The expanded interest for skilled labor at the business level corresponds with the spread of information and communication technology. Complementarity between human resources and data/communication technology or other new advances might be one of the elements clarifying the quick within-industry demand moves from semi-skilled or unskilled labor work and towards skilled labor work. It stays indistinct, in any case, the amount of the change sought after shift towards skilled labor can be clarified by the accumulation of information technology.

Some authors, such as (M. Manacorda, 1997) and (Biichel and WeiBhuhn, 1997), however, claim that the rapid rise in the employment of high-skilled workers solely reflects the rapid growth in educational levels and attainment of the high-skilled work force. The link between information/communication capital and the skill structure of the labour force has been empirically analysed by a large of researchers (for a survey of the literature, see (L. Chennells, 1999).

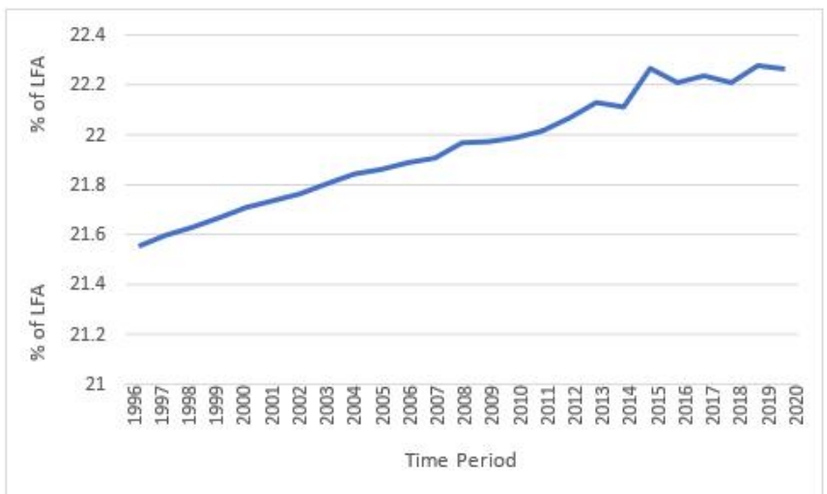


Figure 15: Labor Force with Advanced Education (Pakistan)

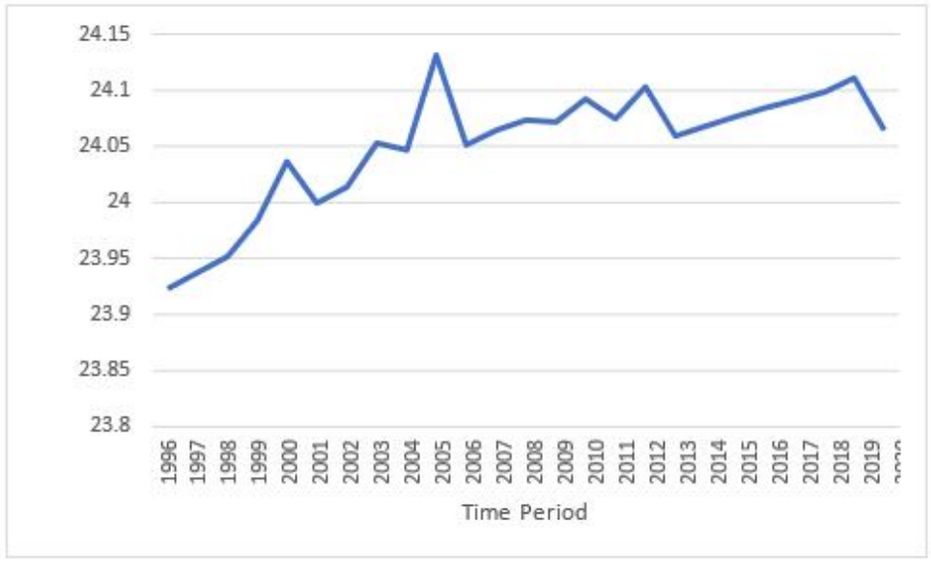


Figure 16: Labor Force with Advanced Education (India)

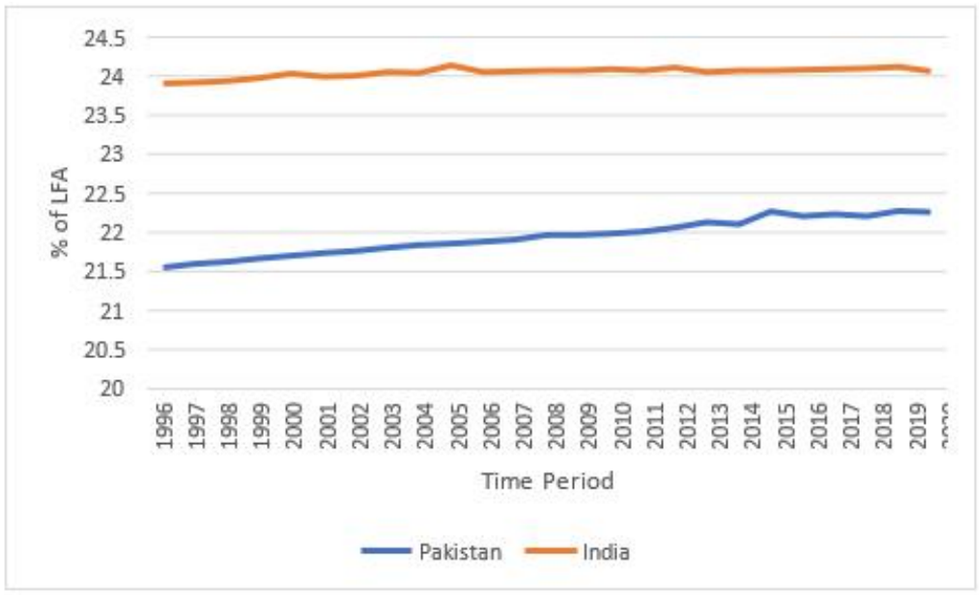


Figure 17: Labor Force with Advanced Education (Combined)

4.3. GDP Growth

In order to symbolize the growth of the economy in the country, GDP per capita is utilized for the purpose of analysis. Gross Domestic Product or (GDP) can be defined as the market value of goods and services value-added produced inside a country's geographical limits over a specific period of time, normally considered to be one year. Taxes levied on finished products are added in gross domestic product whereas subsidies provided do not make the cut in the final value of products. Briefly put, GDP or Gross Domestic Product is the considered as a measuring scale of the state's overall progress and economic activity. Our data for GDP growth is based on constant 2010 US$ prices. Time series dataset of selected South Asian economies i.e., Pakistan and India for the time period 1996-2020, taken from World Development Indicators (WDI), has been utilized.

The figures showcased below show the patterns of natural logs of economic growth in the time series of selected South Asian Countries. The decade of 1990s had observed progress in India in the shape of eliminating industrial licensing practices and allowing foreign direct investment (FDI). Huge structural reforms were put into place through the curtailing of import licenses and reducing the number of non-tariff barriers, financial sector being opened up, and making amends and ease in the investment regulatory frameworks in important services such as advance telecommunication. Aforementioned reforms of the 80s and 90s had a huge impact and that led to a sharp upsurge in the growth of the Indian economy. Upward trend in the growth of the Indian economy continued into the early 2000s. Even so, the Indian economy was witness to an outstanding GDP growth of 8.8 percent in between the years 2004 and 2008. This period of upsurge was mainly credited to

huge capital injections and accorded with a huge booming phase of the global economy. But the ever-growing growth process had to suffer an obstacle due to the arrival of global financial crisis of 2008.

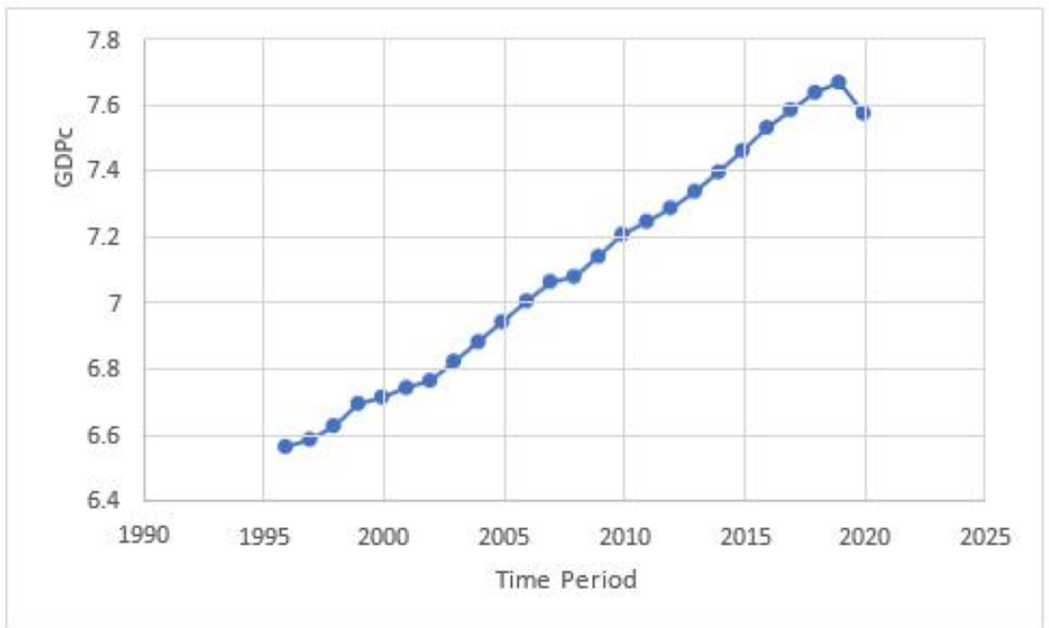


Figure 18: GDP per capita (constant 2010 US$) India

The economy of Pakistan had also done quite remarkably well owing to the upward positive trends in investment, savings, trade and consumption. During the early 1980s, GDP per capita of Pakistan had increased at an annual rate of 6.3 percent. This upward trend was mainly attributed due to the very successful implementation of the 6th Five Year Plan (1983-88). This upcoming plan inculcated huge tax reformations, deregulation of the economic fronts, and a high emphasis on achieving necessary education, healthcare and poverty alleviation. Anyhow, over the time period of the 1990s, the growth rates of gross domestic product faced a downward surge. In this time span, gross domestic product increased at 4.5 percent per annum, and also showcased a slight betterment in the 2000s, rising to 4.6 percent. During the succeeding years, growth recovery in the gross domestic product had been noticed. The ruling government had taken quite a few numbers of steps to tackle terrorist activities and energy crisis while aiming to achieve high economic growth (Ul Haq, 2015).

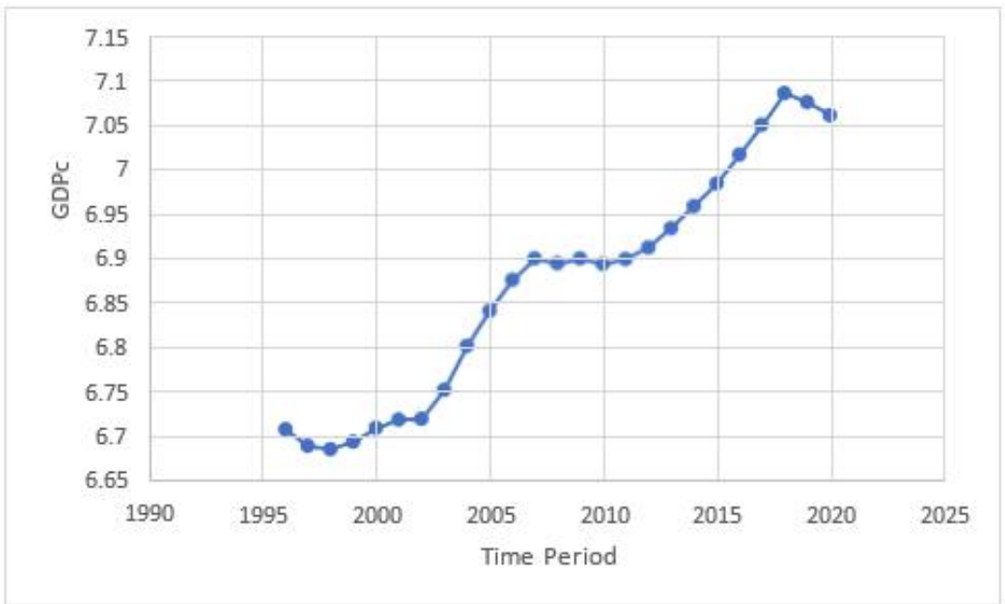


Figure 19: GDP per capita (constant 2010 US$) Pakistan

Comparative analysis of two South Asian economies is shown below.

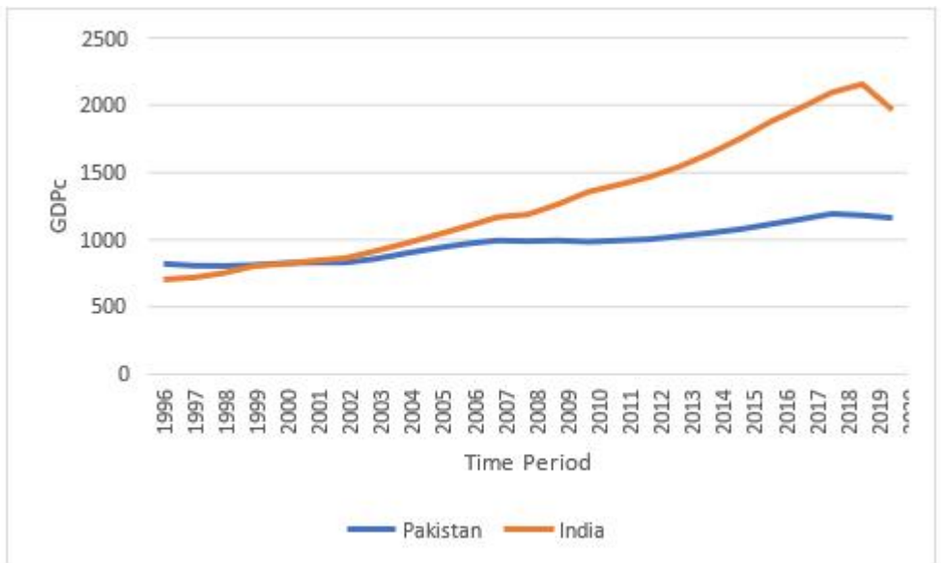


Figure 20: GDPc (constant 2010 US$) Combined

5 METHODOLOGY

The upcoming chapter cadres to the theoretical and analytical assistance on the relationship between research and development and value addition of services first at the aggregate level pertaining to GDP per capita and afterwards at a disaggregate level. The forthcoming sections of this chapter further tend to explain the economic as well as econometric techniques and methods used for the estimation.

5.1. Analytical Framework

The production function, being implemented in the economic and econometric models to examine various input-output effects for hundreds of years, is also considered to be a haughty aspect of the economic growth model. The production function tries to identify the relationship among the production factors and the output produced by the group of related inputs, that is, it attaches great importance to the efficiency of the different input configurations used in the production process. As we are working hard to build an analysis of the relationship between our R&D and the added-value of services, we will try to construct our model in the production framework in order to achieve our eventual goal.

The theoretical basis of the production function can be traced back to (P. H. Wicksteed, 1894). However, this pioneering contribution was the neoclassical production function in the work of (J. R. Hicks, 1939). But this is mainly from the perspective of microeconomics. When working from the point of view of macroeconomics, the aggregate production function has to be used to examine the efficiency and influence of various inputs on outputs. The production function theory involves very important inputs or production factors that are unavoidable in the production process. Regarding this research, we tried to study the relationship between R&D and services' added value and its impact on overall economic growth. For this specific purpose, R&D expenditure (as a percentage of total GDP) and services' added value is used to analyze this relationship between selected South Asian economies (i.e Pakistan and India).

Continuing our discussion of incorporating the main inputs or production factors into the framework of the production function, human capital is considered to be one of the most important production factors in product production. Growth theory also regards physical capital as the basic determinant of economic growth. But in our case, we look at it from the perspective of research and development. Therefore, the first important investment that appears to have a significant influence on the added value of services will be research and development expenditure (as a percentage of GDP). Some studies have shown that, compared with manufacturing, R&D in the service industry has a "greater" impact on innovation (D. M. Morris, 2018). This might be attributed to the fact that research and development may not be a typical type of investment in innovation for service companies (P. Mohnen, 2013).

In addition, if the labour force is not included, that is, the labour force of the economy, the production function is incomplete. Like research and development, in the form of simplest and most complex production frameworks and growth theories, such as (R. M. Solow, 1956)and its extension (N. G. Mankiw, 1995), labour is also listed as a basic and inevitable input or production factor. In this particular study, the labor force with advance education (the percentage of the total labor force with advance education) was used as a proxy for identifying the high-impact labour force. Recent empirical studies have shown us that the recently achieved economic boom of the European Union has been positively and significantly influenced by its investment and strengthening the knowledge base and educational accolades and achievements, as well as due to the intensity by which research and development expenditure took place and the increasing proportion of adults having advance education. In contrast, in terms of human capital investment, both the developed and developing economies can seek benefit from the people with higher education and better skillsets.

Likewise, the expenditure on education (as a percentage of total in GDP) can be another important or productive factor that can be included in production function. Education is widely accepted and considered as an important tool or instrument to promote economic development. Overall, it plays an important role in accelerating economic development by building human skills and capabilities and adding knowledge, skills and values to society. The relationship between education, economic development and value creation had been under the course of discussion since the times of ancient Greeks. Adam Smith and several other classical economists strongly highlighted the importance of investing in human skills. Quite a few studies have tried to investigate the mutual relationship between economic development and educational achievements (Saharupoulas, 1988) (de Melmeister et al., 1995) (Jorgensen and Fraumeni, 1998). For this reason, we believe it is very important to integrate these traditional inputs into production function when analysing the relationship between R&D and services' value added.

5.2. Economic Model

Trying to construct upon the theoretical basis explained quite extensively in the analytical framework in the previous section, we would like to start with the simplest form of production function. The production function specified by the neo-classicals specifies output as the function of labor, capital and technology utilized in each sector.

$$Y = F(K, L, T) \quad \text{.....Eq 1}$$

In the world of today, services account for almost 2/3rd of world's whole production output (World Bank, 2002). Cross-border trade involving services is gaining momentum with each passing day than any other sector and accounts for one-fifth of global trade (Stoss & Mang, 1999). Total world trade in services in 2001 exceeded $1.48 trillion (OECD, 2003). In particular, the development of information technology has greatly widened the range of services which could be traded internationally (Braga, 1995). In the US alone, the services sector accounts for 75% of GDP and 80% of employment, and exportable services account for the majority of world trade in US services (M. Czinkota, 2002).

Over the past 90 years, we have undergone a significant shift from manufacturing to services. Subsequent alterations and advances occurring in modern information and communication technology (ICT) have the potential to alter this ancient situation of low service innovation and low productivity. Innovation, research and development are essential to ensure that services are highly efficient and effective in production. Therefore, we will incorporate research and development in our production function which will give us the required output of value-added services. So, our production function will look like;

$$Y_s = f(K_s, L_s, T_s) \quad \text{..... Eq 2}$$

In order to derive our empirical model, we will first make an estimation of the impact of research and development on output and productivity at an aggregate level for Pakistan and India. We will try to follow much of the empirical growth literature provided by (D. T. Coe, 1995) (R. Bronzini, 2016) and make an assumption about the production function with Hicks-neutral Total Factor Productivity:

$$Y_t = TFP_t L_t^{\alpha} K_t^{\beta} \quad \text{..... Eq 3}$$

where 't' is the year index. Here, Y represents GDP per capita, L is the services sector labour, K represents services sector physical capital stock; and TFP is the abbreviation of Total Factor Productivity. Capital stock in services sector is being obtained by making the use of investment in the services sector and the rate of capital depreciation. Assemblage of capital stock of each region is being obtained through perpetual investment method (Ahmad, 2013)

$$K_{t+1} = INV_t + (1-\delta) K_t$$

Total Factor Productivity is even further being influenced through technological change, which is further being impacted by research and development expenditure, expenditure on education, and labour force with advanced education. Therefore, we will have;

$$TFP = A_t RD^{\gamma} EED^{\delta} LFA^{\theta} \cdots\cdots\cdots\cdots \text{ Eq 4}$$

Where 'A_t' represents "unexplained" technological alterations, 'RD' represents expenditure on research and development, 'EED' represents expenditure on education while 'LFA' represents labor force with advanced education. Substituting, equation for TFP into equation 03, we get

$$Y_t = A_t RD^{\gamma} EED^{\delta} LFA^{\theta} L_t^{\alpha} K_t^{\beta} \cdots\cdots\cdots\cdots \text{ Eq 5}$$

This equation tells us the impact of R&D on an aggregate level of GDP per capita. Gross Domestic Product or GDP can be defined as the market or gross value of final goods and services produced inside a country's geographical boundary within a specific period of time, which formally leads up to one year. Now, we move on to a disaggregate level and analyze the influence of research and development on the services sector and its value addition. So, our economic model will transform into,

$$Y_s = A_t RD^{\gamma} EED^{\delta} LFA^{\theta} L_t^{\alpha} K_t^{\beta} \cdots\cdots\cdots\cdots \text{ Eq 6}$$

Here, 'Y_s' represents the value addition of services. Share of value-added services (VAS) can be accounted as the total value-addition in the final product by the services sector. It is calculated or measured as the devotion or influx/contribution of the services sector in the overall produce of the nation's economy. The sector of services domain consists of value added in financial, transportation, wholesale and retail trade, personal, government, professional and services like real estate services, healthcare and education.

Quite an extensive literature has put light on the long-run relationship between innovation in services sector and research and development (Audretsch, 2018) (Rask, 1994) (I. Miles, 2007) (Islam, 2020). Henceforth, the current research analysis includes the indicators for services innovation in our model as the explanatory variables. So, in the aforementioned economic model, value addition of services is the function of research and development, labour force with advance education and expenditure on education. Above mentioned model used the following abbreviations for the variables;

Y_s: Value added Services

RD: Research & Development

LFA: Labour force with advanced education EED: Expenditure on education

Now we know that as a result of structural transformation around the globe, both developed and developing countries are very much services-oriented and the major driving force in boosting the services sector is considered to be research and development. So, services output heavily depends upon R&D.

5.2. Econometric Model

In order to find the impact of independent variables (i.e., Research and Development expenditure (RD), Labour force with advanced education (LFA), and Expenditure on education (EED) on the Value-Addition of services of the selected South Asian economies (Pakistan & India), we try to transform our economic model into time series Econometric Model which is as follows:

$$\ln Y_t = \alpha_0 + \alpha_1 \ln L_t + \alpha_2 \ln A_t + \beta \ln K_t + \gamma \ln RD + \delta \ln EED + \theta \ln LFA + \varepsilon_t \ldots\ldots \text{ Eq7}$$

The above econometric equation represents aggregate level output as a natural logarithm of GDP per capita and natural logarithm of all the explanatory variables influencing GDP per capita. We will make a similar econometric equation for disaggregate level showing impact of R&D on value addition of services sector. That will come out to be as;

$$\ln Y_s = \alpha_0 + \alpha_1 \ln L_t + \alpha_2 \ln A_t + \beta \ln K_t + \gamma \ln RD + \delta \ln EED + \theta \ln LFA + \varepsilon_t \ldots\ldots \text{ Eq 8}$$

Here, ln L_t represents the natural logarithm of labor supply in the services domain at time period t, lnA_t represents the natural logarithm of technological input in the services domain, lnK_t represents natural logarithm of capital stock in services domain, ln RD represents natural log of research and development expenditure which is being implemented as a proxy for technological input, ln EED represents the natural log of expenditure on education which being used a substitute or proxy for research and development and ln LFA is the natural log of labor force having acquired advanced education which is being used as a substitute or proxy for research

and development. At the aggregate level, ln Y_t represents the natural logarithm of Gross Domestic Product per capita which is being utilized as the proxy to have a clear interpretation of the optimum living standard or economic growth. At a disaggregate level, ln Y_s represents value addition of services. Afterwards, we make a practical application of the Auto Regressive Distributive Lag (ARDL) model, which is, in most of the cases generally used to analyse the long-run relationship among the variables, despite having differing orders of their integration (M. H. Pesaran, 2001).

$$\Delta \ln Y_t = \alpha_0 + \Sigma^p \varphi_{t-1} \Delta \ln Y_{t-j} + \Sigma^p \beta_{t-1} \Delta \ln L_{t-j} + \Sigma^p \gamma_{t-1} \Delta \ln K_{t-j} + \Sigma^p \theta \Delta \ln RD_{t-j} + \varphi_1 \ln L_{t-1} + \varphi_2 \ln K_{t-1} + \varphi_3 \ln RD_{t-1} + \varepsilon_t \quad \text{Eq 9}$$

Where $\Delta \ln Y_t$ represents rate of growth of GDP per capita at time period t, ln Yt represents the rate of growth of labor in services sector, lnKt represents the rate of growth of capital in services sector and ln RDt represents the rate of growth of research and development expenditure. Similarly, for value-addition of services sector;

$$\Delta \ln Y_s = \alpha_0 + \Sigma^p \varphi_{t-1} \Delta \ln Y_{t-j} + \Sigma^p \beta_{t-1} \Delta \ln L_{t-j} + \Sigma^p \gamma \Delta \ln K_{t-j} + \Sigma^p_{j=1} \theta \Delta \ln RD_{t-j} + \varphi 1 \ln Lt\text{-}1 + \varphi 2 \ln Kt\text{-}1 + \varphi 3 \ln RDt\text{-}1 + \varepsilon t \quad \text{Eq 10}$$

Here, $\Delta \ln Y_s$ represents value-addition of services. In the aforementioned equation, the right side of the expression from φ_1 to φ_3 portrays the long-run relationship among variables. Hypothesis of no co-integration in the above equation is the alternative hypothesis H_0 $\varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4$. If cointegration exists, we estimate conditional ARDL long-run model (Muhammad Tayyab Ayaz, 2017).

$$\Delta \ln Y_s = \alpha_0 + \Sigma^p_{j=1} \alpha_1 \Delta \ln Y_{t-j} + \Sigma^p \beta_{t-1} \Delta \ln L_{t-j} + \Sigma^p_{j=1} \gamma \Delta \ln K_{t-j} + \Sigma^p \theta \Delta \ln RD_{t-j} + \theta \acute{\varepsilon}_{t-1} + u_t \quad \text{Eq 11}$$

The coefficients bearing summation symbols showcase the short-run dynamics. Whereas, 'α_0' represents drift constant in the equation. Similarly, θ reveals Gaussian white noise constant. Long-run, as well as, short-run coefficient, are going to be estimated utilizing the aforementioned model.

6 RESULTS AND DISCUSSION

This study aims to target analyzing the relationship between R&D and the value addition of services by using time series data of two South Asian countries (named as Pakistan and India). We have taken into consideration the time series data from 1996 to 2020 to get a hold of our goal. Following chapter showcases the discussion of empirical estimation and results. Empirical analysis gets initiated by having the analysis of the stationarity of the variables before the estimation of ARDL model. First of all, we will analyze the descriptive statistics of data under our consideration.

6.1. Descriptive statistics

Our research analyses the impact of R&D on the value addition of services for both Pakistan and India. Following tables showcase the descriptive statistics for the data used for Pakistan in which value-added services are taken as dependent variable while all other variables as independent variables. The descriptive analysis shows different aspects of data including mean, median, max., min. etc. which helps us better grasp the outlook of our data.

Table 3: Descriptive statistics of Pakistan

Sample 1996 - 2020						
	LN_YS	**LN_LS**	**LNKS**	**LN_RD**	**LN_LFA**	**LN_EED**
Mean	25.16291	21.37293	27.9414	24.43601	21.94454	26.74901
Median	25.21764	21.35587	27.97303	24.76067	21.96487	26.72576
Maximum	25.69724	21.75862	29.33023	25.38154	22.27613	27.30607
Minimum	24.61441	20.95156	25.94244	23.19100	21.54941	26.09191
Std. Dev.	0.352515	0.227280	1.021450	0.714801	0.229147	0.348800
Skewness	-0.054604	-0.101763	-0.380755	-0.517632	-0.065029	0.162955
Kurtosis	1.740940	2.114322	2.155731	1.673676	1.808535	2.060263

Source: EViews 10

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Table 4: Descriptive statistics of India

Sample 1996 - 2020						
	LN_YS	**LN_LS**	**LNRD**	**LN_LFA**	**LN_EED**	**LN_KS**
Mean	27.19771	23.19478	27.68566	24.05042	29.30002	30.27949
Median	27.19080	23.20193	27.83770	24.06426	29.21683	30.38606
Maximum	28.02580	23.49398	28.30925	24.13159	30.02408	31.65335
Minimum	26.29239	22.84150	26.82568	23.92266	28.51673	28.43483
Std. Dev.	0.540115	0.196365	0.451547	0.054157	0.470572	1.004508
Skewness	-0.030900	-0.218025	-0.399320	-0.992827	0.056471	-0.348310
Kurtosis	1.768712	1.907535	1.866842	3.186562	1.818667	1.965235

Source: EViews 10

6.2. Unit Root Test

This thing is deemed quite necessary to measure the stationarity of the variables even before carrying out an estimation of the ARDL model. Before estimating our time series data, this practice is considered very important to determine the order of integration of all of the variables. In the first step, the unit root test is applied at level. After analyzing the results, we come to find that null-hypothesis of non-stationarity is accepted. This essentially means that variables tend to be non-stationary at level. For this particular purpose, we make use of Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests.

Table 5: Unit Root Test (Pakistan)

	ADF-test		**PP-test**	
Variables	***p-value***	***t-value***	***p-value***	***t-value***
lnY_t	0.03	-3.40	0.27	-2.62
lnY_s	0.31	-2.52	0.68	-1.98
lnK_t	0.05	-2.43	0.05	-2.24
lnL_t	0.04	-2.86	0.41	-2.31
$lnRD_t$	0.01	-1.07	0.01	-3.18
$lnEED_t$	0.02	-1.79	0.05	-2.92
$lnLFA_t$	0.05	-3.62	0.01	-4.27

Note: *, ** and *** are 1%, 5% and 10% level of significances

Anyhow, After the application of above-mentioned tests at variables' level, it rejected the null hypothesis of non-stationarity for all the variables. So, the variables involved in our analysis have come out to be stationary at either base or first difference as the p-values of the targeted variables are either significant at 1% or 5% or 10% significance level. This necessarily means that our series are either integrated of order I(0) or I(1).

Table 6: Unit Root Test (India)

	ADF-test		**PP-test**	
Variables	***p-value***	***t-value***	***p-value***	***t-value***
lnY_t	0.06	-1.80	0.04	-1.69
lnY_s	0.05	-0.98	0.08	-0.98

lnK_t	0.10	0.54	0.10	-2.40
lnL_t	0.06	-0.04	0.05	-0.04
$lnRD_t$	0.05	-0.65	0.01	-0.65
$lnEED_t$	0.07	-2.03	0.04	-2.03
$lnLFA_t$	0.09	-2.78	0.10	-2.78

Note: *, ** and *** are 1%, 5% and 10% level of significances

Similarly, in case of India, when we applied stationarity tests at variables' level, the tests rejected the null hypothesis of non-stationarity for all our variables. So, all the variables involved in our analysis were stationary at either base or first difference as the p-values of the concerned variables are either significant at 1% or 5% or 10% significance level. This means that our series are either integrated of order I(0) or I(1).

6.3 Covariance-Correlation Matrix

In the next step of our analysis, we will look into covariance correlation matrix of our variables. This step will tell us about the closeness or interconnectedness of the variables involved in our analysis and the subsequent route to move forward.

Covariance can be defined as a statistical tool that helps us to measure the directional relationship among the returns between two variables. The positive-covariance stat showcases that the variables' returns reposition together. Similarly, a negative covariance showcases that they move inversely. The sign of the covariance therefore tells us about the tendency in the linear relationship between the variables.

On the other hand, Correlation or dependence can be defined as a statistical tool, be it causal or not, between two or more random variables which can be interpreted as a statistical association commonly referring to the degree to which a pair of variables are linearly related to each other. Positive correlation would be assigned the digit 1. The meaning of this particular stat is that the two variables moved either up or down in the same direction together. The negative correlation would be -1. This necessarily means that the concerned variables would rather move in opposite directions. Zero correlation would mean that no particular relationship exists between the two variables. Simply put, as one variable moves in one way, the other would necessarily tend to move in another unrelated direction.

Table 7: Covariance Correlation Matrix-Aggregate (Pakistan)

Covariance Correlation	LN_GDPC	LN_LS	LNKS	LN_RD	LN_LFA	LN_EED
LN_GDPC	0.017171 1.000000					
LN_LS	0.028268 0.968727	0.049590 1.000000				
LNKS	0.125556 0.957379	0.220078 0.987478	1.001627 1.000000			
LN_RD	0.078745 0.858025	0.129431 0.829892	0.598169 0.853394	0.490503 1.000000		
LN_LFA	0.028479 0.967984	0.049311 0.986274	0.221257 0.984678	0.130087 0.827300	0.050408 1.000000	
LN_EED	0.041404 0.924539	0.066985 0.880170	0.295419 0.863720	0.179293 0.749081	0.068868 0.897546	0.116795 1.000000

Source: EViews 10

The aforementioned figures showcase that the independent variables included in our analysis are highly correlated to each other. We will carry out the same procedure at disaggregate level.

Table 8: Covariance-Correlation Matrix-Disaggregate (Pakistan)

Covariance Correlation	LN_YS	LN_LS	LNKS	LN_RD	LN_LFA	LN_EED
LN_YS	0.119296 1.000000					
LN_LS	0.075965 0.987651	0.049590 1.000000				
LNKS	0.339526 0.982214	0.220078 0.987478	1.001627 1.000000			
LN_RD	0.208825 0.863274	0.129431 0.829892	0.598169 0.853394	0.490503 1.000000		
LN_LFA	0.076650 0.988440	0.049311 0.986274	0.221257 0.984678	0.130087 0.827300	0.050408 1.000000	
LN_EED	0.108247 0.917040	0.066985 0.880170	0.295419 0.863720	0.179293 0.749081	0.068868 0.897546	0.116795 1.000000

Source: Eviews 10

Table 9: Covariance Correlation Matrix-Aggregate (India)

Covariance Correlation	LN_GDPC	LN_LS	LNKS	LN_RD	LN_LFA	LN_EED
LN_GDPC	0.124467 1.000000					
LN_LS	0.067211 0.990179	0.037017 1.000000				
LNKS	0.341677 0.984011	0.188178 0.993757	0.968675 1.000000			
LN_RD	0.152855 0.979299	0.084167 0.988789	0.431550 0.991068	0.195739 1.000000		
LN_LFA	0.014416 0.770086	0.008478 0.830442	0.043718 0.837109	0.020048 0.853988	0.002816 1.000000	
LN_EED	0.159678 0.981653	0.086235 0.972131	0.440604 0.970952	0.194317 0.952599	0.018173 0.742830	0.212580 1.000000

Source: Eviews 10

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Table 10: Covariance-Correlation Matrix-Disaggregate (India)

Covariance Correlation	LN_YS	LN_LS	LNKS	LN_RD	LN_LFA	LN_EED
LN YS	0.280055 1.000000					
LN LS	0.101304 0.994958	0.037017 1.000000				
LNKS	0.515588 0.989902	0.188178 0.993757	0.968675 1.000000			
LN RD	0.230628 0.985032	0.084167 0.988789	0.431550 0.991068	0.195739 1.000000		
LN LFA	0.022207 0.790840	0.008478 0.830442	0.043718 0.837109	0.020048 0.853988	0.002816 1.000000	
LN EED	0.239907 0.983238	0.086235 0.972131	0.440604 0.970952	0.194317 0.952599	0.018173 0.742830	0.212580 1.000000

Source: Eviews 10

After carrying out covariance- correlation analysis, we come to realize that the independent variables included in our analysis i.e., research and development, labor force with advance education and expenditure are highly and positively correlated to each other. So, we carry out our analysis using auto-regressive distributive lag ARDL method because it is considered to be more flexible with respect to the order of integration.

6.4 Co-integration Bound Test

We contain variables in our analysis that seem to be integrated of various differing orders. Which means that they are a amalgamation of both level, first difference and second difference stationarity. Therefore, carrying out a cointegration bound test becomes essential to construct a long-run relationship. Any usage of Johansen cointegration no longer seems to be valid enough. Appropriate cointegration test at this moment is considered to be the Bounds Test proposed by Pesaran, Shin and Smith (2001). Therefore, the hypothesis is established as $H_{o;}$ no cointegrating equation while H_1; H_0 is not true. I have utilized log-transformation of the raw variables in my analysis.

Table 11: Cointegration Bound Test-Aggregate (Pakistan)

Dependent Variable	**Lag and Length**	**F-Statistic**	***I(0) - I(1) Bound at 1%***	**I(0) - I(1) Bound at 5%**	**I(0) - I(1) Bound at 10%**
ln$GDPc_t$	02	6.208	*2.82-4.21*	2.14-3.34	1.81-2.93

Table 12: Cointegration Bound Test-Disaggregate (Pakistan)

Dependent Variable	**Lag and Length**	**F-Statistic**	**I(0) - I(1) Bound at 1%**	**I(0) - I(1) Bound at 5%**	**I(0) - I(1) Bound at 10%**
lnYs_t	02	3.367	2.82 - 4.21	2.14 - 3.34	1.81 - 2.93

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In case of disaggregate analysis, F-stat also comes out to be greater than the critical value for the upper bound I(1) at 5% level. So, we make a conclusion that there does exist cointegration. Which means that there exists a long-run relationship. Thus, null hypothesis is rejected.

Table 13: Cointegration Bound Test-Aggregate (India)

Dependent Variable	**Lag and Length**	**F-Statistic**	**I(0) - I(1) Bound at 1%**	**I(0) - I(1) Bound at 5%**	**I(0) - I(1) Bound at 10%**
ln$GDPc_t$	02	7.2783	3.06 - 4.15	2.39 - 3.38	2.08 - 3

After carrying out the Bounds test, we realize that calculated F-stat appears higher than the critical value for the upper bound I(1) at 5% level.So, we conclude that there exists cointegration. Which means that there exists a long-run relationship. Thus, null hypothesis is rejected. Similarly,

Table 14: Cointegration Bound Test Disaggregate (India)

Dependent Variable	**Lag and Length**	**F-Statistic**	**I(0) - I(1) Bound at 1%**	**I(0) - I(1) Bound at 5%**	**I(0) - I(1) Bound at 10%**
lnYs_t	02	6.3897	3.06 – 4.15	2.39 – 3.38	2.08 - 3

After carrying out the Bounds test at a disaggregate level, we come to know that calculated F-statistic is greater than the critical value for the upper bound I(1) at 5% level, we can conclude that there is cointegration. Which means that there exists a long-run relationship. Thus, null hypothesis is rejected.

6.5 Estimation Output

In the first step of our estimation procedure, we carry out long term analysis at an aggregate level for the selected South Asian economies that is Pakistan and India. Our second step would be to analyze short term impact of the variables at an aggregate level. Afterwards, we will carry out the same procedure at a disaggregate level. Dependent variable in our analysis, at an aggregate level, will be log of GDP per capita. While dependent variable at a disaggregate level will be log of Value-Added Services. We will carry out time series analysis of both the countries (Pakistan and India) side by side. We are making use of Auto regressive distributive lag ARDL model. Simple regression, Ordinary least square (OLS) method can be used only if there is no UNIT ROOT in the variables. But if variables have unit root problem, then other methods are to be used. A method, ARDL (Autoregressive Distributed Lag) was introduced by Pesaran et al. (2001) which caters the mix of variables integrated of I(0) and I (1). ARDL has certain set of rules:

1. The variables must be a mix of I (0) and I (1)
2. The dependent variable must be non-stationary I (1)
3. ARDL strategy is inapplicable in the region of I (2)

For the selection of maximum number of lags, I have opted for automatic selection and the maximum no. of lags for dependent variables and regressors is 2. Model selection criteria for our analysis is Akaike Info Criteria (AIC). In order to smoothen out heteroscedasticity in my data set and to correct it, I have made use of HAC (Newey-Test) in my analysis.

Table 15: Results for Long Run Relationship-Aggregate (Pakistan)

Dependent Variable: $LnGDPc_t$			
Variables	**Coefficient**	**t-stat**	***prob.***
$\ln Ls_t$	0.3776	2.9411	0.04
Ks_t	1.03659	6.6164	0.00
$\ln RD_t$	0.0433	6.9345	0.00
$\ln LFA_t$	- 0.2519	-1.5196	0.20
$\ln EED_t$	0.1212	2.5454	0.06
No. of Observations:	22		
R^2	0.98		

In the results obtained above, we come to know that almost all the variables involved in our analysis are positive and significant in relation to GDP per capita. Labor supply, capital in services, research and development expenditure and expenditure on education have all come out as positive and significant in relation to the dependent variable in the long run. This suggests that 1% increase in research and development expenditure will increase the GDP per capita by around 0.04%. But here we can see that Labor Force with advanced education has come out to be negative and insignificant. This might be attributed to the fact that most of the faculty/labor having advanced education does not give input into service industry but prefers to look for jobs in other sectors or prefers to move abroad. Thus, not contributing much to the overall GDP per capita.

Table 16: Results for Short Run Relationship-Aggregate (Pakistan)

Dependent Variable: $LnGDPc_t$			
Variables	**Coefficient**	**t-stat**	***prob.***
$\Delta\ln Ls_t$	0.0198	0.5463	0.61
ΔKs_t	3.89354	9.4593	0.00
$\Delta\ln RD_t$	-0.0098	-1.3982	0.23
$\Delta\ln LFA_t$	-0.1492	-3.0594	0.03
$\Delta\ln EED_t$	0.0022	0.1235	0.90
R^2	0.98		
D.W statistic	2.3522		
F-Statistic	6.208		
No. of Observations	22		

Short-run analysis at an aggregate level showcases us that research and development expenditure is negative and insignificant. These results tell us that investment in research and development does not provide immediate results in the short run but bears fruit in the long run of the economy.

Table 17: Results for Long Run Relationship-Disaggregate (Pakistan)

Dependent Variable: $LnYs_t$			
Variables	**Coefficient**	**t-stat**	***prob.***
$\ln Ls_t$	0.2379	3.7306	0.00
Ks_t	1.45197	12.4460	0.00
$\ln RD_t$	0.0185	4.9213	0.00
$\ln LFA_t$	0.0566	1.3277	0.20
$\ln EED_t$	-0.0096	-0.6315	0.53
No. of Observations:	23		
R^2	0.99		

Our main analysis of impact of research and development on the value addition of services is depicted in the table above. These results tell us that the impact of research and development on the value addition of services in case of Pakistan comes out to be positive and significant. These results necessarily suggest that a 1% increase in investment in research and development will increase the value addition of services by almost 0.01% which is consistent with the literature (Islam, 2020).

Table 18: Results for Short Run Relationship-Disaggregate (Pakistan)

Dependent Variable: $LnYs_t$			
Variables	**Coefficient**	**t-stat**	***prob.***
$\Delta \ln Ys_t(-1)$	0.4819	4.6567	0.00
$\Delta \ln RD_t$	0.0185	2.4772	0.02
$\Delta \ln LFA_t$	0.0566	0.8200	0.00
R^2	0.65		
D.W statistic	1.9488		
F-Statistic	3.3679		
No. of Observations	23		

Result for short run analysis of impact of research and development on value addition of services is showcasing that it is positive and significant. This means that a 1% increase in the investment in research and development will increase the value addition of services by around 0.01%. Similarly, another proxy for research and development i.e., labor force with advanced education has also shown its relationship to value addition of services to be positive and significant. A 1% increase in the labor force with advanced education will increase the value addition of services by around 0.05%.

Table 19: Results for Long Run Relationship-Aggregate (India)

Dependent Variable: $LnGDPc_t$			
Variables	**Coefficient**	**t-stat**	***prob.***
$\ln Ls_t$	1.0083	7.013	0.00
$\ln Ks_t$	0.1303	4.2164	0.00
$\ln RD_t$	0.2777	4.1591	0.00
$\ln LFA_t$	-0.2631	-1.6516	0.11
$\ln EED_t$	0.1994	3.2371	0.00
No. of Observations	23		
R^2	0.99		

In the results obtained above, we come to know that almost all the variables involved in our analysis are positive and significant in relation to GDP per capita. Capital in services, research and development expenditure and expenditure on education have all come out as positive and significant in relation to the dependent variable in the long run. These results showcase that 1% increase in research and development expenditure will increase the GDP per capita by around 0.27%. But here we can see that Labor Force with advanced education has come out to be negative and insignificant. This might be attributed to the fact that most of the faculty/labor having advanced education does not give input into service industry but prefers to look for jobs in other sectors or prefers to move abroad. Thus, not contributing much to the overall GDP per capita.

Table 20: Results for Short Run Relationship-Aggregate (India)

Dependent Variable: $LnGDPc_t$			
Variables	**Coefficient**	**t-stat**	***prob.***
$\Delta\ln Ls_t$	1.3688	9.3360	0.00
$\Delta\ln Ks_t$	-0.0700	-2.7567	0.07
$\Delta\ln RD_t$	0.1403	1.5005	0.23
$\Delta\ln LFA_t$	-0.0520	-0.6427	0.56
$\Delta\ln EED_t$	0.1947	3.9891	0.02
R^2	0.98		
D.W statistic	2.9714		
F-Statistic	2.9803		
No. of Observations	22		

Short-run analysis at an aggregate level showcases us that research and development expenditure is positive and insignificant. These results tell us that investment in research and development does not provide immediate results in the short run but bears fruit in the long run of the economy as was the case with Pakistan.

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Table 21: Results for Long Run Relationship-Disaggregate (India)

Dependent Variable: $LnYs_t$			
Variables	**Coefficient**	**t-stat**	***prob.***
$\ln Ls_t$	1.1320	5.5649	0.00
$\ln Ks_t$	-0.0557	-1.2196	0.23
$\ln RD_t$	0.2002	2.6722	0.01
$\ln LFA_t$	-0.3970	-1.7583	0.09
$\ln EED_t$	0.1422	2.7913	0.01
No. of Observations	24		
R^2	0.99		

Our main analysis of impact of research and development on the value addition of services is depicted in the table above. These results tell us that the impact of research and development on the value addition of services in case of India is positive and significant just like its neighboring country Pakistan. This suggests that a 1% increase in investment in research and development will increase the value addition of services by almost 0.20% which is consistent with the literature (Islam, 2020) and much higher in percentage amount than Pakistan.

Table 22: Results for Short Run Relationship-Disaggregate (India)

Dependent Variable: $LnYs_t$			
Variables	**Coefficient**	**t-stat**	***prob.***
$\Delta\ln Ls_t$	1.8180	1.9477	0.00
$\Delta\ln Ks_t$	-0.0006	-0.0761	0.94
$\Delta\ln RD_t$	0.0280	0.6653	0.5353
$\Delta\ln RD_t$ (-1)	0.1169	2.7555	0.04
$\Delta\ln LFA_t$	-0.3090	-6.7526	0.00
$\Delta\ln EED_t$	-0.0534	-3.0865	0.02
R^2	0.99		
D.W statistic	3.2908		
F-Statistic	6.3897		
No. of Observations	23		

Result for short run analysis of impact of research and development on value addition of services is showcasing that it has come out to be positive and significant, which necessarily means that a 1% increase in the investment in research and development will increase the value addition of services by around 0.01%. Similarly, another proxy for research and development i.e., labor force with advanced education has also shown its relationship to value addition of services to be positive and significant. A 1% increase in the labor force with advanced education will increase the value addition of services by around 0.05%.

4. CONCLUSION & POLICY RECOMMENDATIONS

In the current economic environment, there is a broad consensus on the fundamental role of the services sector in the economy. In recent decades, value addition has shifted

from physical production to knowledge-based, intangible and product-based economies, resulting in a radical structural change in most of the world's economies. Provided the very narrow and limited insights on the linkage between research and development and value addition in services sectors of developing countries, this study, which tries to identify the determinants of country's investment in research and development and subsequent expenditure on education and knowledge, first explored the impacts of research and development on the overall GDP per capita of an economy at an aggregate level. Then it analyzed the impact of research and development on the value addition of services in the economy at disaggregate level. For our analysis, we took into consideration two South-Asian economies i.e., Pakistan and India. The time period taken into consideration in our analysis in from 1996 – 2020.

In our analysis, we carried out unit root testing, covariance-correlation testing, cointegration bound test and autoregressive distributive lag model in the time series framework. We carried out simultaneous analysis of impact of research and development on overall GDP per capita of the economy on an aggregate level as well as impact of research and development on the value addition of services at a disaggregate level, which was the main motive of this thesis.

Research and development (R&D) tend to play a highly significant role in economic development of any country. Research and development costs can increase because they have an upward and positive impact on innovation and total factor productivity (TFP) (M I Roemer, 1990) (Lucas, 1988). Similarly, as Grossman and Helpmann (1994) point out, long-term technological progress through industrial innovation is a driving force for improving living standards in developed countries. As companies invest in research and development, they are expected to develop new ideas, semi-finished products, cost-saving opportunities and consumables that can create highly efficient and much profitable businesses. Furthermore, in addition to the specific benefits of research and development, good results are achieved across companies, industries and sectors. Knowledge developed through research and development is not competitive and allows companies to benefit from other companies' research and development investments in other industries and sectors (Howitt, 1990) (Arrow, 1962).

Our analysis for both Pakistan and India have shown that research and development had a positive and significant impact upon value addition of services. Agriculture sector had been the backbone of South Asian economies but its contributions to GDP had been declining (Ul Haq, 2015). Contribution of services sector to GDP in developing Asian countries is increasing day by day. Due to structural transformation in both Pakistan and India, services industries are being given much more attention in the overall economy. Our analysis clears out this pathway that services industries are bound to flourish if given enough consideration on research and development and information communication technology. For both Pakistan and India, results show that investment in research and development have a long-term positive impact on value addition of services and thus overall GDP of the economy.

By carrying out side by side analysis of Pakistan & India, we have come to realize that India has by far surpassed Pakistan in the race to become technological hub of the region. India has invested a heavy amount of GDP expenditure on technological innovations. India has even provided very friendly and approachable/sustainable work environment for foreign firms to come to their country and outsource their services. Hyderabad region has become the technological hub for tech giants like Google, Amazon, Netflix, Uber and many other multibillion-dollar industries. On the other, Pakistan has not yet made its mark in South Asian region as a technological hub due to political unrest, dwindling economy and many other factors. Foreign firms do not consider it a viable option to come to Pakistan and set up their camps here. Thus Pakistan has lagged far behind in the race to become digitized.

From a policy making point of view, we can infer that world is fast moving towards semiconductors, microdata chips and whatnots due to research and development. In order to catch up with the developed economies in this era of globalization, huge investments must be made in research-oriented activities and technological innovations. Labor force must be educated advanced tech, machinery handling and information communication technology.

Similarly, education expenditure must be increased in these developing economies which can act as proxy of research and development. All these developments are destined to lead to an increase in the value addition of services and thus overall GDP of the country.

Services companies should engage in research and development in order to improve product quality, add value, increase sales, reduce production costs, and ultimately increase productivity. Research and development play an important role in national economic development by providing a way forward for technological advancement and well-being.

Research and development costs are bound to be testified as more productive if they are included in the high-tech sector (M. I. Nadiri, 1993). Universities are considered as places of research and study, and investment in advance and higher education is deemed to play a significant role in research and development.

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