BILATERAL INNOVATION COOPERATION BETWEEN PAKISTAN AND TAIWAN

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Abstract - With the rapidly growth of emerging markets and huge investment of China's One Belt One Road (OBOR) and China-Pakistan Economic Corridors (CPEC) influences, we can expect that Pakistan will have dramatically growth in GDP in the near future. This paper provides a descriptive analysis of current innovation development in Taiwan and Pakistan, following the textile industry used as an example of innovation cooperation. Based on secondary data analysis, our findings suggested that academic partnership/co-authorship is positive to improve the low submission rate in Pakistan, alternative outlet of PhD programs in partner universities are beneficial for insufficient higher talents in Pakistan, and alternative oversea production sites are important for Taiwan textile/apparel industry. In sum, from the innovation point of view, Pakistan and Taiwan can enjoy a complementary benefit starting from academic and R&D cooperation in textile and related industries.

Keywords - Taiwan, Pakistan, Innovation, Textile Industry

I. INTRODUCTION

1.1 Pakistan

Pakistan is located at the crossroads of South Asia, Central Asia, China and the Middle East and is thus at the fulcrum of a regional market with a vast population, large and diverse resources, and untapped potential for trade. Pakistan's offer of access to the Indian Ocean could reduce China's reliance on the chokepoint of the Malacca Strait in Southeast Asia for oil imports from the Mideast and help spur development in China's land-locked far west. The economic growth rate is 4.2%, 4.5% inflation rate, and 6.5% unemployment rate (World Bank, 2016). Pakistan has a fast growing population with 208 million people in 2017(Statistics, Pakistan), 1998-2017 average population growth rate is 2.4%, the increasing proportion of Pakistan's youth, with 35% of the total population aged 15 years old or under, provides the country with a potential demographic dividend(UNICEF).

According to Pakistan Vision 2025 and the ninth Sustainable Development Goal (SDG) from the 2030 Agenda, 1.5 million new jobs have to be created annually until 2040 to keep unemployment steady at current rates (Afraz, 2016). The main challenge facing the Pakistan economic policy makers is to provide adequate services and employment. Poverty and lack of a modern education curriculum are two of the many underlying factors for youth in developing countries to prove their worth in a highly globalized market (Naeem, 2014). Innovation and entrepreneurship have emerged as viable means of dealing with the problems that Pakistan faces.

1.2 Taiwan

In compare with the fast-growing population in Pakistan, Taiwan's small size, a population of 23 million, grew economically in the 1960s to 1990s and was dubbed as one of the four Asian Tigers with strong economic growth. Today, in the midst of China's manufacturing capabilities outshining its own, Taiwan has faced economic challenges. It has been gearing to become the epicenter of innovation in Asia Pacific for a multitude of reasons. It ranks 15th in global competitiveness, 10th in innovation and has one of the largest populations of software and hardware engineers in the world. Along with this, Taiwan also ranks first in global expat rankings and continues attracting foreign talent in all sectors. This strong workforce is responsible for parts of original design as well as the production of flagship products by global electronic leaders like Apple, Microsoft, Sony, and Tesla.

The country has also dominated the semiconductor industry for over decades. Science and Technological Parks and innovation clusters are also growing organically throughout major cities such as Hsinchu, Taichung, Tainan, and Kaohsiung. Taiwan is taking active measures to cultivate an environment for innovation. In 2016 the government allocated over USD310 million to construct a new technological center, which dubbed Asian Silicon Valley. As the effort continues, it will likely become one of the major tech center in Asia Pacific. Thus, the goals of this paper are(1) to summarize the development of technology systems in Pakistan and Taiwan,and (2) to explore potential opportunities in textile industry based on economic and non-economic challengesin Pakistan and Taiwan.

II. TECHNOLOGYDEVELOPMENT

In the wake of growth-oriented initiatives and prudent economic policies introduced by the PML-N government, the country's FDP recorded ten-year

highest growth of 5.3% in 2016.The initiatives included National Power Policy, Kissan Package, Automotive Policy, Textile Policy, Strategic Trade Policy Framework 2015-18, Domestic Resource Mobilization Strategy, Public Sector Entity Reforms Strategy, China-Pakistan Economical Corridor (CPEC) and National Financial inclusion strategy. The government has also special focus on education, health and nutrition and a number of programs have been implemented. Pakistan has achieved progressive and significant improvement in country's overall security due to successful counter terrorism efforts of the government under framework of comprehensive National Action Plan (NAP), backed by an extensive and highly effective counter terrorism operation Zarb-e-Azb by armed forces, and actions by other security and law enforcement agencies and intelligence-based operations across the country (Rehman, 2017).

CPEC connecting South Xinjiang with Pakistan, spans Xinjiang Uygur Autonomous Region and whole Pakistan in spatial range. It will include a full system of monitoring and surveillance in cities from Peshawar to Karachi, with 24-hour video recordings on roads and busy marketplaces for law and order. A national fiber-optic backbone will be built for Pakistan not only for Internet traffic, but also for terrestrial distribution of broadcast TV, which will cooperate with Chinese media. CPEC seeks to create a "safe city", an electronic monitoring and control system for the border in Khunjerab. In addition, thousands of acres of agricultural land in Pakistan will be leased out to Chinese enterprises to set up demonstration projects in areas ranging from seed varieties to irrigation technology.Chinese private investors are planning investment in energy generation and transmission projects. Chinese loans also will fund in roads, rail and facilities at a deep sea port. Gwadar port will be built into a base of heavy and chemical industries, such as iron and steel/petrochemical.

Pakistan is a major Asian player in the garments export market and the garments sector is one of the largest sources of low-cost employment creation (Memon, 2010). The promotion of industries has been a major agenda in Pakistan, specifically, labor-intensive industries, such as knitwear, woven products, footwear, toys, and plastic parts, create substantial employment opportunities and play a pivotal role in reducing poverty. The international and local challenges have forced enterprises to cut their costs through innovations such as improved production organization and enhanced production efficiency, and aggressive marketing strategies in search of higher product prices(Khan & Khan, 2010).
The Asian Development Bank (ADB) reported that Taiwan outperforms Hong Kong, Japan, Singapore and South Korea in 2014. Taiwan's strength in technology innovation and adoption is best illustrated by its rapid emergence and dominance in the global IT manufacturing supply chain. The island has shown keen interest in embracing new technology as a means of upgrading industry/economy and improving the standard of living.

The Global Information Technology Report (GITR), Taiwan's overall performance in terms of networked readiness has lagged behind that of Singapore, Hong Kong and South Korea. Taiwan is particularly weak in terms of the regulatory environment (law making, settling disputes, etc.), affordability (tariffs) and usage (virtual networks, etc.). This shows there is further room for improvement in terms of technology adoption to help enhance domestic economic and social welfare. The challenge for the government will be on how to reassure the general public given rising concerns over cyber-security, protection of consumer rights, enforcement of rules of law, etc. This suggests that both market players and regulators will have to ensure security features are adequate in handling new-age financial crimes, fraud prevention, information/data leakage, etc. It also indicates the need for less complex rules to ensure legal rights and claims involving disputes arising from on-line, e-commerce transactions, especially cross-border activity.

Taiwan's transformation to a world-class IT manufacturing powerhouse is not accidental; the government has played an active role. During 2011-12 the government introduced the 'Outline for Industrial Development' program, which was the blueprint for upgrading Taiwan's industrial structure into a high-tech, specialty, services-oriented manufacturing economy.In 2016, the Tsai administration launched the '5+2 Major Innovative Industries policy' to spur innovation, create well-paid job opportunities, and bring more balanced regional development to Taiwan. The initial five 'pillar industries' are the Internet of Things, Biomedical, Green Energy, Smart Machinery, and Defense. Added later are high-value agriculture and the circular economy. The 5+2 plan calls for huge investments in building research facilities and other infrastructure in regions where industry clusters already exist(Ferry, 2017).

The Tsai government is seeking to amend the Company Law, the Basic Law on Technology, and several other laws along with a host of regulations.The government expects a significant rise in e-commerce activity, owing mainly to widespread acceptance and use of on-line, wireless services and rapidly increasing digital content and applications ranging from shopping, entertainment, health care and financial services. As a result, Taiwan has earmarked the use of digital content, wireless broadband applications, cloud computing, e-commerce and intelligent automation as the next

wave of technology to help promote and upgrade the domestic services sector with hi-tech, high value-added content. To enable the local-banking sector to fully explore the new market potential, Taiwan's government has embarked on a 'FinTech' reform program that aims to provide the infrastructure to further streamline banking operations and improve overall efficiency and productivity by leveraging the latest mobile gear and bio-technology.

III. THEORETICAL BACKGROUND

Audretsch and Thurik (2001a) established the framework of two broad concepts of organizing economies: the managed economy and the knowledge economy. The managed economy as characterized by Chandler (1977, 1990) thrived for nearly three-quarters of a century when the environment was relatively certain, in outputs, manufactured products and in inputs land, labor and capital. The knowledge economy emerged beginning in the 1990's as a response to the global events of that period. The main drivers were globalization / ICT revolution shortening economic distance, routinized tasks shifting from high-cost zones to low cost zones, and high-cost zones re-aligning to leverage comparative advantage in high-value knowledge industries and services.

At the country level, the World Bank has developed an assessment method for measuring what it terms as the "readiness" of nation states to develop knowledge economies. Knowledge economies are founded on four key pillars, the first of which is the "economic and institutional regime for providing incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship" WBI (2008). Other elements of the knowledge assessment method (KAM), includes variables on human development, ICT and the innovation system.

CATEGORY	KNOWLEDGE	MANAGED
Underlying forces	Localization	Globalization
	Change	Continuity
	Jobs with high wages	Jobs with low wages
Environmental	Turbulence	Stability
	Diversity	Specialization
	Heterogeneity	Homogeneity
How firms function	Motivation	Control
	Market exchange	Firm Transaction
	Competition and cooperation	Competition or cooperation
	Flexibility	Scale
Government Policy	Enabling	Constraining
	Input targeting	Output targeting
	Local locus	National locus
	Entrepreneurial	Incumbent
Economic Factor	Knowledge	Land, Labor, Capital

Table 1 New Economy versus Old Economy
Source: Adapted from Audretsch and Thurik(2001a)

IV. METHODOLOGY

This exploratory study is mainly conducted by secondary data analysis to provide a deeper understanding of sci-tech innovation in Pakistan and Taiwan. This method provides number and facts listed above sections which describe the profile for further comparison based on two countries. Secondary data that have already collected and recorded by governments, WTO and World Data Bank are readily available and trustworthy.

4.1 Economic snapshots

As shown in Table 1, the median age is 22.7 years old in Pakistan, 40.3 years old in Taiwan; fertility rate is 3.65 to 1.06 (Worldometers, 2017). Clearly, Taiwan is an aging society with a large proportion of retirees; Pakistan has a huge population of youth-working population. Secondly, Pakistan has 167 research and development persons per million people compared to Taiwan's 3,500 and China's 1,090. Pakistan ranks 147 out of 188 countries in the 2015 Human Development Index (HDI) with most indicators lower than most countries in South Asia. In compare with Taiwan top 10th innovation ranking, the great potential of mutual scientific cooperation should be explored.

Table 2 Population of Asia, China, Pakistan, and Taiwan

	Median age	Fertility rate	Urban Pop %	Share of World Pop
Asia	30.7	2.19	49.3%	59.59%
Pakistan	22.7	3.65	39.2	2.69%
Taiwan	40.3	1.06	78%	0.31%
China	37.3	1.56	59.1%	18.47%

Source: Worldometers (2017)



Fig. 1a Number of higher education, Fig. 1b student enrolments
Source: Economic Survey, Pakistan (2014-2015), MOE Taiwan (2016)

4.2 Talents, PhDs, Scientists

To analyze the potential bilateral cooperation opportunities, we collect data on the number of higher education institutions, and total student enrollment in HEIs. As shown in Fig. 1, the growth of HEI student enrollments in Pakistan outnumbers in compare with Taiwan HEIs. But the number of PhDs (Fig. 2) produced in Pakistan is significantly lower than HEIs in Taiwan. We suggest Pakistani who consider pursue PhD should select high-ranked alternatives HEIs in other Asia countries. The number of scientists in disciplines is diverse in Pakistan, most of scientists are working in agriculture, biology, chemistry, physics, engineering, and mathematics. In Taiwan, most of scientists are working in biology,

chemistry, physics, pharmacy, and computer fields, as shown in Fig. 3.

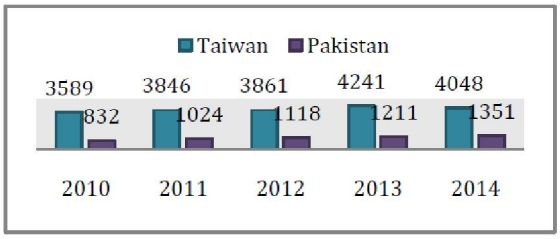


Fig. 2 PhD produced in Taiwan and Pakistan HEIs
Source: HEC-PHD produced by Pakistan universities, MOE Taiwan

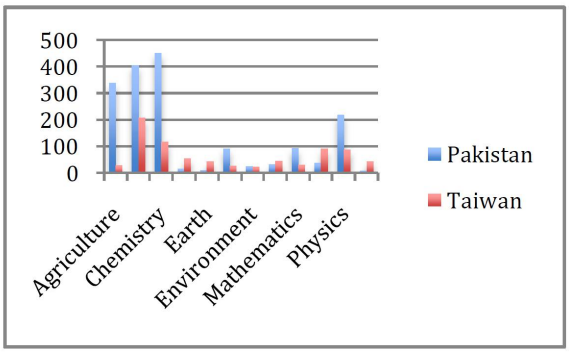


Fig 3. Scientist number by sector
Source: Pakistan Council for Science and Technology, MOST Taiwan

Khattak, Baseer&Bajwa (2011) classified technological status of Pakistan into Low Technology category, as shown in Fig. 4. Pakistan has a greater human resource potential, the problem is how to utilize her existing research facilities and acquire educational and technological competence from partner countries.

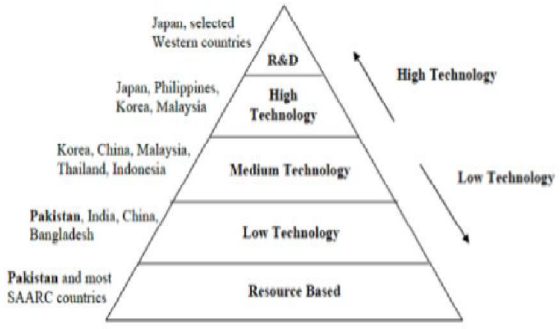


Fig. 4 World Technological Status Pyramid
Source: Adapted from Khattak, Baseer&Bajwa (2011)

Thomas Reuters survey of global publishing (2012) shows the total Taiwanese submission is 19,340, Pakistani submission is 3,316 as well. According to the survey conducted by ESI (2016), in the past 10 years, the academic contribution made by Taiwan academic institutions: 1,649 papers are classified as Highly Cited Papers and 67 papers are Hot Papers. Those Top Papers cover 22 disciplines, as depicted in Table 2, 303 papers in Clinical Medicine, 277 papers in Physics, and 234 papers in Engineering.From the international publication point of view, we suggest a strategy to increase the exposure of Pakistani research outcome to top international journals is co-authorship with partner institutions.

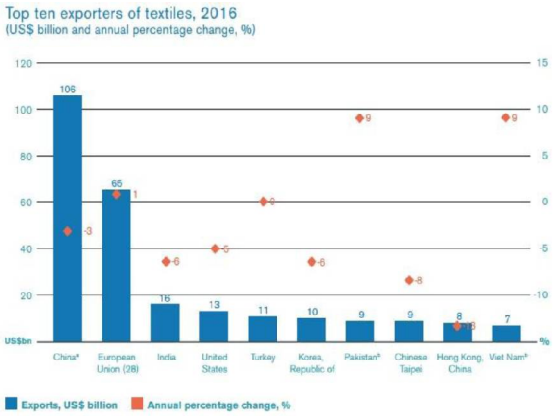


Fig. 5 The leading textile exporting countries in 2016

V. BILATERAL INNOVATION COOPERATION OPPORTUNITIES-THE EXAMPLE OF TEXTILE INDUSTRY

After the textile trade was liberalized in 2005, the production was shifted to emerging economies such as China, India, Pakistan, Bangladesh, and Vietnam. The WTO data reveals the growth rate for textile and apparel between 2005 and 2015 was 4.4% and 5.6%. In 2016,the global trade of textile industry amounted to USD 2,905 billion, apparel USD 4,539 billion. China was the largest textile exporting, both Taiwan and Pakistan are ranked 7th. The textile industry of Taiwan/Pakistan is highly exported-oriented, the 4th largest foreign exchange earner segment in Taiwan, the largest one in Pakistan.

The economic forces include Brexit, China alignments, slow-moving trends in demographics and productivity growth, as well as non-economic factors such as geopolitical uncertainties, sharp the global economy, energy saving and carbon reduction, human right, environmental protection, sustainability and corporate social responsibility. More than that, the textile industry is faced with fierce competition in an oversupply condition since emerging countries have joined the development of textile industry. More than that, these days textiles is no longer the trade of exporting fibers or bales of cotton, it is an arena of marvelous fibrous materials and productions that may bear many times higher values return. The global trends in demanding the eco-friendly products, processes, and work conditions are undoubtedly justified for healthier life standard. Poisoning or polluting air, land, or water brings drastic hazards for men and animals (Uddin, 2017). Over 200 institutions in more than 40 countries are associated with the cotton production research. The subjects of cotton breeding, genetics, entomology and agronomy all have received research interest. Being an agricultural

crop, land labor/farmers, water, chemicals, fertilizers, and pesticides are the important players in achieving the quantity and quality of cotton yield. In terms of revenue generation to national economy, the chain of value-addition in cotton fibers and cotton textiles provides an effective alternative to cotton crop expansion. A long term strategy in the development of textile sector must appreciate in reality the significance of value-addition from fiber length to smart textiles that are emerging as engineering materials.

In Pakistan, the textile industry faces several challenges including the regional competitors (China, India, Bangladesh, etc.) but from the global level competitors from US and EU players with the support of much advanced infrastructure and improved systematic operations (Kazmi and Takala, 2014). The Government of Pakistan has formulated 'Textile Vision 2007' and 'The Textile Policy 2014-19" in order to boost exports to USD26bn by 2019 and attain fifth position as a leading Asian textile exporter. The package carries special duty-drawback rates, duty exemption on plants and machinery, subsidy on long-term loans and development subsidies (Khan, 2015). Even though energy production and inefficiencies in the power network are terrible challenges to be solved. Energy supply to huge printing, cutting and sewing departments is rotated according to need (Dawn, 2017). The local industry desperately requires more modern machinery and techniques to compete in an increasing competitive industry.

Textile industry in Taiwan has different difficulties in labor cost, losing main markets' shares (North America Free Trade Area, EU) year by year (Taiwan Textile Federation, 2016). The Taiwan apparel industry has relocated production bases to overseas for many years and manages their headquarters and logistic offices in Taiwan.

Taiwan textile industry has been transformed from labor-intensive to technical-intensive, and eventually becoming capital-intensive. Gradually, the industry became vertically integrated, eventually joining all the links in the supply chain, including the manufacture of man-made fibers, yarn spinning, weaving and knitting, dyeing and finishing, and apparel and accessories industries. Taiwan's goal has always been to be a world leader of technical textiles. Taiwan now has a fully integrated supply chain and has continued to innovate and cultivate R&D capabilities. To meet the global market demand, Taiwan textile industry has come up four useful strategies, product differentiation, design and creativity, combine function with Eco-conscious, and branding, which could be cooperated with Pakistan textile industry. We encourage textile industry put emphasis on R&D and leading edge technology to create high value-added materials and products to enhance product differentiation. Both of Taiwan and Pakistan have unique extraordinary cultural images, gradually shifted their foci to innovation, R&D, and design-oriented sectors will be beneficial to setting up a common goal for collaborative development on products with emphasis on innovation, uniqueness, refinement and design. Textile industry should also consider incorporating environmental factors in its development of functional textile. Therefore, a global R&D and production base of functional and industrial textile product and to transform down-stream from 'Made in Taiwan/Pakistan' to 'Design in Taiwan/Pakistan' and 'Brand in Taiwan/Pakistan' is the final goal.To achieve the final goal, we should invite not only government officials to join the advanced knowledge and strategy training in textile industry, but also scientists and scholars to working on joint programs based on the above proposed strategies.

In 2013, China 's "One-Belt, One Road" policy (OBOR) and the subsequent establishment of the Asian Infrastructure Investment Bank (AIIB), are two of the most important international political economy issues. In short, OBOR is composed of two routes: (1) Silk Road Economic Belt, which connects the countries in Central Asia, West Asia, the Middle East, and Europe, and (2) Maritime Silk Road, which links the countries in Southeast Asia, Oceania, and North Africa. Pakistan and Taiwan are linked in this oceangoing route. The textile industry should be ready for the coming opportunities generated by OBOR and CPEC impacts.

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