Exploring 'South-South' Technology Transfer Perspective for Regional Development and Stability: The Case of China Pakistan Economic Corridor

NUST Journal of International Peace & Stability
2019, Vol. II (2) Pages 67-77
njips.nust.edu.pk

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Abstract
Historically, there was a traditional North-South paradigm of technology transfer under which the developed part of the world had the capability and authority of technology transfer to the relatively less developed and developing states. However, this was challenged by China which rose as an economic power and reversed the technology transfer paradigm (South-North technology cooperation). Chinese innovative policies have made it a world power and the source of technology transfer to the developing part of the world thus forming the South-South technology transfer network. China has earned the status of world lender and project financier through its One Belt One Road project and through CPEC Pakistan has become the recipient of more than $46 billion of Chinese FDI. This provides Pakistan with ample of opportunities of technology transfer and boosting its economy. However, only the implementation of balanced economic and technological policies can lead to fruitful results for the donor as well as recipient state.

Keywords
Technology transfer, CPEC, China, Pakistan

Introduction
China is gaining the status of the centre of the world stage by becoming the second largest economy along with taking the lead in science and technological innovation (Petras, 2012). With this continued progression, China has not been reluctant to share its technological achievements with other states and the technological transfer from China to the South is the result of Chinese openness to share its technological achievements.

In its pursuit of development and technological innovation, China has adopted emerging fields such as renewable energy, advanced nuclear energy, space technology and new generation telecommunication technologies, along with the innovations in the conventional fields such as automobile, electronics, etc (Liu, Simon, Sun, & Cao, 2011). China's technological capabilities are increasing over time and the state is keen to reach the top level expertise, and achieve the financial firepower which could realign the power structure making China the center of the global technology industry. Chinese firms have been a long way from being fast followers in terms of technology and have transformed into true innovators (Brewer, 2007). The state has transformed its market-oriented economic approach to an innovative approach which focuses more on science

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and technological innovation which emphasize on the policies which encourage progressive fiscal measures. This transformation is evident in the evolution of economic policies of China and most importantly from the Medium and Long-term Plan for the Development of Science and Technology (2006-2020) policy of the state (Lam, 2017). Now there has been a shift from the traditional pattern of innovation strategy where only one government agency was responsible for the formation of innovation policies to a more promising innovation trajectory in which a number of government and local agencies are involved in the process. The consumer appetite and the government support have made the technological dominance of the Chinese firms possible. Along with this, Chinese research in disaster prevention, rice breeding technology, meteorology, etc. has assisted many partner states to increase their income. Among other Asian and African states, Pakistan, through CPEC and related deals, has benefited a lot from Chinese research in these fields (Dudley, 2019).

Whilst China is continuing its quest for technological innovation, it is also becoming a source of technology transfer for the South and the developing countries. Most of these states which look up to China, for Technology Transfer (TT) aim to benefit from China's technological innovations. Such states including Pakistan have been engaged in projects with the Chinese government under the Chinese One Belt One Road Initiative. Pakistan, being part of the Chinese OBOR project and a close friend of China can most certainly benefit from the technological innovations of China and engage in successful technology transfer (Abid & Ashfaq, 2010). Under its Belt and Road Initiative, the Chinese Academy of Sciences has provided more than 1.8 billion yuan for the science and technology projects in the African and Asian countries which are partners of China under the OBOR project (Ille, 2009). Such initiatives on part of China depict that the state is keen to invest in technological development along with showcasing its strengths in manufacturing, infrastructure development and financial power. This would serve both the donor and the recipient but most importantly it would change the political and economic landscape of Asia; the most economically vibrant region of the twenty-first century.

The paper discusses the traditional technology transfer paradigm and the drastic shift that China has managed to ascertain in the technology transfer regime. It further discusses the Foreign Direct Investment that Pakistan is receiving from China and the spillover effects of such investments. Whilst discussing the Chinese drive for innovative technology, the article explores how Pakistan can benefit from Chinese quest.

Technology Transfer Paradigm

Most of the under developed and developing countries have lesser capabilities to create original innovation, mainly in the energy sector. This places them at a strategic disadvantage, because now a days energy innovation has become crucial for lessening energy poverty, along with increasing energy security in order to build an energy sector. Such an energy sector has become necessary for state survival as it reduces greenhouse emissions and proves to be resilient to climatic distress as well. Many scholars (Brewer & Mani, 2008; Osano & Koine, 2016; Brewer, 2007; Urban, 2018) have tried to highlight the importance of technological innovation and the diffusion of technology through international means of technological transfer. Such scholars have highly emphasized on the 'technology transfer paradigm' as the main means of technology diffusion to developing states.

As far as the definition of technology transfer is concerned, the same term is also understood as technology cooperation between and within states. However, the International Panel on Climate Change describes the term as an extensive set of

processes which encompass the understanding, operating and reproducing the technology. The technology could further be adapted to the local environment and with indigenous technological developments (Jaffe, 2018).

In the past, the traditional understanding of term 'technological transfer' was limited to the transfer of hardware technology (Yanning, 2018). The software technology transfer and the issues related to it were completely ignored. The software technology includes processes which are obligatory for creating, operating and maintain the technologies and are related to the knowledge, skills and expertise to comprehend the technological innovations (Vishwasrao, 1997).

The process of technological transfer was initially limited only to the traditional North-South model, in which the North being the technological innovator transferred the modern technological trends to the South, which was either under developed or developing. However, now a days, due to the rise of emerging economies like India, South Africa, Brazil and China, the technology transfer and technology cooperation has become a broader approach (Corvaglia, 2014).

Due to such shift in the world dynamics and new emerging technological centers, the technology transfer is divided into four geographic courses, 1. From North to South (e.g. European states to China), 2. From North to North (e.g. US to European states and vice versa), 3. From South to North (e.g. China to European states) and 4. From South to South (e.g. China to Asian and African states) (Mason, 2019).

Technology transfer and technology cooperation related to China predominantly include collaborative approaches between China and the receiving state. Such collaborations include overseas development assistance, joint ventures, foreign direct investment, etc. These technology cooperations also include exchange of skilled labor, joint publications and formation of new networks. Apart from the specifics of technological innovations, the flow of technology transfer varies from states to state, for example, the duration of technology transfer varies across states and the direction of flow can either be vertical or horizontal in states depending on the circumstances and the capabilities of the receiving states (Brautigam, 1993). Technology transfer can be of skills and expertise on operating and maintaining technology, the modern equipment and most importantly the knowledge for technological innovation.

Although the debate on technology transfer has been going on since 1980s (Sampath & Roffe, 2012), the South-North technology transfer and the South-South technology transfer has not been given much value. Contrary to which, North-South technology transfer has been the centre of the debate (Roffe & Tesfachew, 2014; Yanning, 2018; Urban, 2018;). Most of the literature and scholarly research has been restricted to North-South technology transfer where the high income states transfer modern technology to low and average income countries (Vishwasrao, 1997; Series, 2001). Yet the sole reason for this is not the ignorance of South-North and South-South by the scholarly community but also lack of understanding in the South regarding the socio-technical transformations of technology. Roffe & Tesfachew (2014) argue that it is due to the economic rise of states like China that such bias notion is challenged. This has led to rebalance the shift towards the South-South technology transfer. The only issue with this is that this topic is that the South-North technology transfer is not very well researched, which is why substantial evidence of this process remains an issue.

Chinese Role in Worldwide Technology Transfer

Over the past decade, China has developed a framework for exemplifying South-North and South-South model of technology cooperation and transfer. China has been the chief investor in hydropower, solar energy and wind energy. A report by the Institute of Energy Economic and Financial Analysis identified that China has been investing

heavily in clean-energy projects and takeovers which account for more than $44 billion in 2017 (Series, 2001). The state has been increasingly investing in foreign territories and is strengthening its role in the global economy. Over the past few years, China has gained the status of overseas investor in the solar and wind industries (Timperley, 2018). The state has been able to increase its investments due to the favorable financial conditions, and certain push and pull factors resulting from the domestic environment and the conditions of the overseas markets. Initially the Chinese investments had been directed towards developed countries like Germany, Italy, Australia and United States but the trend is shifting towards and more South-South technology transfer model. Now China is keen in investing in Pakistan, Ethiopia and other South African states (Tan, Zhao, Polycarp, & Bai, 2013). China is becoming an unstoppable force in the global framework of technology transfer, and its approach to introducing innovation capabilities in the South-South and South-North technology transfer is defined by acknowledging the direction of capital flow to markets and the direction of technology leadership that the state has achieved.

FDI as a Source of Technology Transfer

Foreign direct investment has gained a major role in enhancing the economic development in the less developed states. FDI has been a source of upgrading the economy of a state due to its benefits in the form of transfers of technologies related to production of modern products and their distribution, their general knowledge, skilled labor force along with establishment of new networks. FDI have been the source of foreign technology diffusion and skilled human capital across borders (Djulius, 2017).

Among the early researches conducted on the topic, MacDoughall (1960) thoroughly argued about the possibility of the external spillovers accompanying foreign direct investment. However, after analyzing the recent literature on technology transfer and foreign direct investment, FDI is considered a prevailing source of technology transfer across states. It is argued to be the most comprehensive form of technology transfer from developed states to less developed or developing states (Perez, 1998). Along with provision of the technological equipment and information, it also provides with the necessary know-how to maintain, upgrade and employ the acquired technology. The technology transferred through foreign direct investment has significant impact on the domestic firms. There has been strong theoretical backing of the fact that technology transferred through the foreign direct investment has beneficial outcomes for the receiving states as their domestic firms adopt better methods of production (Aitken & Harrison, 1999).

Chinese Innovation in Renewable Electricity Generation Technology

Even though Chinese firms depend on coal as the source of their electricity generation, still the country aims to have 15% share of non-fossil fuels in its energy mix by 2020 (Caughill, 2018), which is why China is home to growing wind power industries. In 2010, China became the chief installer of wind power capacity in the world and its wind power technology industry is developing ever since (Matthews & Tan, 2014).

Chinese drive to renewable energy innovation has made it the world's largest producer, installer and exporter of solar panels, electric vehicles, batteries and wind turbines (Liu & Goldstein, 2013). This has led to the renewables revolution which has boosted China's global leadership and has brought energy independence to states (Dudley, 2012).

Chinese Foreign Direct Investment and South-South Technology Transfer

Chinese innovation policy coupled with the Go Far policy has led to many expeditions abroad. China is involved in 330 overseas dam projects with 38% in Southeast Asia and 26% in Africa (Aitken & Harrison, 1999). Such projects started in the 2000s, and have continued ever since, with more states willing to attain foreign Direct Investment from China. Chinese firms have become the lead actors in South-South Low-carbon energy technology transfer, mainly in the field of hydropower (Gebrehiwot & Demissie, 2018).

Poor Southeast Asian countries such as Cambodia which lack in power sector, Chinese investments are eagerly welcomed as they are seen as opportunities to attain modern technology and resultantly reducing energy deficiency. Under such underprivileged circumstances, Chinese built dams are considered as a sign of modernity and a prospect for better future (Brautigam & Xiaoyang, 2012). The OECD investors do not see Cambodia as a target state for FDI and technology transfer, however, Chinese investment in the state has offered opportunities which were rarely possible for Cambodia. However, the Kamchay Dam, which is Cambodia's first large dam, demonstrates that Cambodia has relatively little capacity to absorb the new large-scale technology and to sustainably manage its environmental and social implications (O'Neill, 2014). While the absorptive capacity for hydropower innovation is low, both production capabilities and innovation capabilities are largely absent. In the specific case of the Kamchay Dam, technology transfer of hardware has occurred successfully; nevertheless, the transfer of the 'software', such as the knowledge, skills, expertise and experience of how to plan for, build, manage and operate the dam sustainably, is lagging behind (ibid.). This is also partly due to the limited sustainability of the practices of the technology-transferring country. Learning from the case of Cambodia, Pakistan should enhance its absorption capacity in terms of technology transfer from China.

Pakistan-China relations started in 1950 (Miller, 2017) when Pakistan was among the first states which recognized the People's Republic of China and also assisted the new state in attaining the membership of United Nations. Since then, the close friendship of the two states has been exemplary. The trade relations have also been very pivotal and the Chinese exports to Pakistan have been extensively spread in terms of technological classification (Bhattacharjee, 2015). The composition of the Chinese exports to Pakistan are capital or intermediary goods which serve as improving the production capabilities of the state along with developing the technological infrastructure of Pakistan (Yusuf, 2013).

Foreign direct investment provides with better opportunities to developing countries which struggle through their way to economic growth and stable trade and investment relations (Kayani, Ahmed, Shah, & Kayani, 2013). In the case of Pakistan, China Pakistan Economic Corridor (CPEC) is considered as an important spur for economic development.

The economic history of Pakistan has not been very stable and the state has continuously faced a lot of economic hurdles related to the inflow of FDI. Inadequate domestic resources, outdated technology, unskilled labor has caused the downfall of Pakistani economy. In such circumstances, FDI becomes a valuable feature which has the ability to transform the status of our economy as it brings with it modern technology, market-access and skilled human capital, which increases production rate and government revenue (Huang, Fischer, & Xu, 2017). In the case of Pakistan, FDI could assist in improving employment rate, whilst upgrading the infrastructure of the state resulting in macroeconomic stability.

In 2019, Pakistan GDP growth rate is expected to hover around 5% (Rizvi, 2019) however, IMF has predicted that it will slow down to 2.9% (Ahmed, 2019) at the end of the fiscal year, which would be the lowest GDP growth rate in South Asia. This situation is politically and economically worrisome as well as unacceptable. The technological backwardness of Pakistan, unskilled human capital, and the increasing number of unemployed youth are indicating towards the weak status of the state's economy. Such circumstances make it a dire need for Pakistan to establish links with the foreign markets and engage them in technology transfer and cooperation. As far as China's FDI in Pakistan are concerned, the numbers have been modest in history.

However, due to shift in Chinese international policy and the greater OBOR plan, investments in Pakistan have increased, as a result of which Pakistan's industries have become more stable and the technology transfer has assisted the state to counter the energy constraints (The News, 2017). Such conditions are good for Pakistan as the state could improve and promote the technological sophistication of its tradable sectors through the inflow of FDI from China. It is proved by the successful East Asian experience that inflow of FDI secures local resources and further enhances the state's economic capacity by forming international value chains, thus resulting in economic stability of the state.

CPEC and the Technology Transfer to Pakistan

CPEC is the milestone of Pakistan-China friendship and cooperation. The project is expected to be the biggest investment in infrastructure in Pakistan. According to the project plan, by 2030 Chinese investment in energy, fiber optic and transport at the Gwadar port would reach a total of $46 billion (Bhattacharjee, 2015). The project has incited excitement in Pakistan as people are hopeful that the CPEC project would benefit the state. The CPEC contract includes four pillars of development, which are industrial development, infrastructural development, communications sector, and energy sector. The lease of Gwadar port along with a Free Trade agreement with China includes regional level gas and oil pipelines, which would also develop trade and economic activities for Pakistan. The agreement under the One Belt One Road project brings into limelight China's tangible interests in international investment regime which is now becoming more influential in the region (Brautigam & Xiaoyang, 2012). OBOR would work as a massive integration network for the Chinese economy with the world market, and Pakistan being the artery for this corridor can extract huge benefits for its economy as well. Pakistan's port city Gwadar provides the economic, maritime energy and land routes for the Chinese Silk Route which are considered the most crucial part of the project. This puts Pakistan in a better position to learn from the Chinese innovation policies and through CPEC it can form a network for technology transfer as well (Mirza & Kanwal, 2017) In the series of MOU's signed between Pakistan and China and project agreements focused on infrastructure and energy, Pakistan has been able to secure $35 billion (Abid & Ashfaq, 2010) for energy sector. This can very effectively tackle the energy deficit that Pakistan is facing. The FDI which would is coming from China under CPEC is critical in nature as it would be a major source of capital and it brings with it up-to-date technology which will result in enhancing the economic capabilities of Pakistan. Currently, the inflow of FDI through CPEC is more than any foreign direct investment that Pakistan has received in its history.

Pakistan can accelerate its GDP growth through further collaborations with the Chinese firms. Through this, it could also be able to achieve considerably higher level of GDP than the average of 5 percent of the last sixty years (Rizvi, 2019). There is no doubt in the fact that achieving such a target in the current domestic headwinds would be a major challenge for Pakistan, but the most adequate step in this regard would

be to strengthen the trade relations with the most important political ally and friend in the neighborhood, China.

China is the only state which has achieved a per capita GDP growth rate of more than 7% (World Bank, 2019). China currently embarks a process of economic rebalancing which require a lesser dependence on the exports as a source of growth, which increases the share of the domestic consumption. This generally results in an increase of import demand. In such circumstances, Pakistan could benefit from the trade with China and the Chinese FDI. In addition to escalating its present mix of exports and expand its control over the value chain for Chinese products, China is resolute to broaden its horizons into high tech products and to technologically improve its exports (Dudley, 2019). For this purpose, China is rapidly developing its domestic technological capabilities so as to increase the technology incorporation from international states and to generate its own innovation capacity. China is actively indulged in getting hold of new and up to date technologies and is keen to make the most of the technology transfer through foreign direct investment by Multi-National Companies (MNCs) (Liu et al., 2011). This approach has led to many fruitful outcomes for China. The technological catch-up has proved to be phenomenal for the state and its brands are now making strong holds in the international market. Lenovo, Haier and many other Chinese brands are improving their technology impressively (Caughill, 2018). In its quest for better technology and trade market, China has employed an extensive effort to get hold on the most advanced yet unmodified technologies and has invested in foreign firms having valuable intellectual property, expertise in designing and manufacturing of sophisticated products. Chinese firms have also procured several American and European firms which have top notch technologies (Djulius, 2017). Pakistan can make arrangements with Chinese firms to collaborate with the Pakistani counterparts in exchange of sophisticated technologies and skilled labor.

The analysis of Chinese trade expeditions and its pursuit of getting latest technologies along with the Go out Strategy resulting in OBOR depicts that China is desperate to invest in states that can provide it with technology transfer and trade linkages (Miller, 2017). Pakistan, due to its strategic geographical positions holds a special position in this regard. China will continue to follow its technological interests; however, in attaining its objectives it is likely that it will serve Pakistan. The Chinese FDI could jump start the economic growth in Pakistan through its complementary infrastructure development.

Chinese investments and the extent of collaboration with Pakistan directs towards China as an influential international lender and project financier. This is not only due to the Chinese technological exploration; rather Pakistan and China have a pleasant history of diplomatic, military and economic relations which started in 1950s (Yusuf, 2013). The relations however, intensified in recent decades when both states realized their strategic and political importance against their common contenders. Xi Jinping's first visit to Pakistan was in 2015 when the President of People's Republic of China compared visiting Pakistan to visiting the home of a brother (The News, 2017). Chinese investments in Pakistan seem to be an extreme case depicting a perfect case of Chinese collaborations with its allies, CPEC being the centre piece of Chinese friendship. CPEC is hard to ignore as a poster child for China-Pakistan bilateralism in the 21st century due to both scale and extent of projects.

While what CPEC means for China is a gripping puzzle in itself, but more important are the innumerable repercussions for Pakistan. The recipient state in this association is a heavily populated nuclear power which is as one of the key developing states of the 21st century (ibid.). Its population is comparatively young, and it has an important geostrategic position at an intersection of South, Southwest and Central Asia,

and the state currently faces a colossal energy and infrastructure development shortage (Ahmed, 2019).

Furthering the Chinese collaborations with Pakistan, Chinese International Technology Transfer Centre (CITTC) signed an MoU with National University of Sciences and Technology in order to establish the China Pakistan Technology Transfer Centre (CPTTC) (The Express Tribune, 2018). CPTTC will facilitate the technology transfer between China and Pakistan whilst providing soft-landing to the firms of both the states to facilitate the entry in each other trade markets. CITTC is a joint project of the Beijing Municipal Science and Technology Commission and the Chinese Ministry of Science and Technology which provides professional international technology transfer platform between China and other states across the globe (ibid.).

Conclusion

The China-Pakistan Economic Corridor has provided Pakistan with a much needed opportunity to boost its developing economy and get hold of the up to date sophisticated technology. Pakistan has a huge potential with young people dominating half of its population. CPEC has provided Pakistan with a pathway to progress towards the Newly Industrialized Economies (NIEs). Chinese innovative technological expertise has benefited its economy making it capable of competing with the world economic powers, thereby; the Chinese firms can open up new trading routes, energy corridors and industrial zones for Pakistan to meet its rapidly growing needs.

Although, the CPEC is not limited to renewable energy, as coal power plants are a major part of the project, there are still major prospects to promote the renewable energy market through a range of corresponding policy initiatives. Therefore, there is still much to learn from China's endeavor in the renewable energy sector. The potential spillovers of CPEC that Pakistan will experience can be catalyst in leading Pakistan in the direction of the current global discourse in sustainable and low carbon development.

The transfer of knowledge and expertise can be attained from this collaboration with China in the renewable energy field, can be effectively utilized if the state forms adequate policies which eases the flow of knowledge to the domestic industry. For this purpose, direct training programmes must be setup with China's cooperation. Win-win scenarios can be fashioned, when economical local workforce will be provided with the required skills and knowledge to work in the Chinese administered ventures in Pakistan. Furthermore, domestic production of renewable energy equipments should to be propped up through fixing market malfunctions and persuading domestic manufactures.

Currently CPEC is justified as the necessary boost up for the Pakistani economy, but government should not rely completely on one market and should explore more markets for trade and technology transfer. Pakistan's government has to be careful while dealing with projects under CPEC as when economic opportunities arise from the inflow of foreign FDI then there must be necessary steps taken to ensure the equal distribution of resources to all parts of the state. The conflict over the unequal distribution of resources is a much heated issue in Pakistan so projects under CPEC need to be secured from being affected by it. Policies like imposition of windfall profit tax on Chinese firms which extract minerals can direct the collected money to developmental projects in Pakistan. This can amplify the likelihood of equitable distribution and lessen the grievances of the people from deprived areas.

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