The Impact of China's FDI in Renewable Energy on Pakistan's Economy

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Abstract. Foreign direct investment (FDI), as a primary form of contemporary capital globalization, contributes substantially to a nation's economic growth. Specifically, in China's FDI initiative in Pakistan, channeling FDI towards renewable energy projects can alleviate Pakistan's energy deficit and generate extensive economic advantages for the country. This paper examines the effects of FDI in renewable energy on Pakistan, analyzing the country's location advantage and renewable energy potential, evaluating changes in GDP resulting from China's investment in renewable energy projects in Pakistan, and identifying economic benefits of FDI. Additionally, this paper summarizes notable renewable energy projects and their development after inflow of FDI from China. The research provides in-depth information on the fundamental components of the projects. Additionally, the paper examines the effects of FDI in renewable energy on Pakistan's immediate and long-term economic development. The results provide insights on suitable countries for receiving FDI and the impacts both inflow and outflow nations.

Keywords: FDI; renewable energy; China-Pakistan relationship.

1. Introduction

The term foreign direct investment (FDI) refers to investments made by investors who organize and operate businesses directly in foreign countries. It is widely recognized by international institutions, academics, policymakers, and researchers that FDI has a significant impact on the economic growth of developing countries. Studies have shown that FDI can have a catalytic effect on the economic development of host countries. In addition to providing direct capital financing, foreign direct investment (FDI) can benefit the host country through technological spillovers, formation of human capital, creation of a competitive business environment, development of enterprises, and promotion of international integration. As a result, many emerging economies have liberalized their FDI regimes and formulated policies that favor FDI [1].

In 2023, China's overseas foreign direct investment is expected to reach nearly $40 billion, indicating China's accelerated efforts to build a global investment network architecture. With the completion of Belt and Road Initiative (BRI) and China-Pakistan Economic Corridor (CPEC), China-Pakistan cooperation is strengthening, and China continues to play a significant role in Pakistan's economic development. China is Pakistan's primary investor among countries receiving direct investment from China. China's direct investment in renewable energy in Pakistan can address Pakistan's energy shortage, enhance the living conditions of Pakistani citizens, and eventually substitute for the use of fossil fuels, ultimately decreasing greenhouse gas emissions and enhancing the ecological environment [2].

Nowadays, global warming has drawn the attention of people worldwide. Carbon dioxide (CO_2) is regarded as a primary cause, stemming from the combustion of fossil fuels which are finite resources. In response, renewable energy and nuclear energy seem to be crucial in solving the issue of energy security and environmental degradation. Therefore, there is a fervent development of renewable resources with clean combustion that can substitute fossil energy sources, and both nuclear and renewable energy sources can lower carbon dioxide emissions, help preserve the environment, and eliminate dependence on foreign nations [3]. Prior to accepting FDI, Pakistan suffered from an acute power shortage, and the usage of renewable resources for energy was insignificant. According to multiple projections, these resources will play a substantial role in forthcoming times [4].

Renewable resources are one of the quickest ways to resolve power shortages in Pakistan. This study analyzes the beneficial effects of FDI in Pakistan by considering its geographical advantages, labor force size, and GDP. It evaluates the impact of FDI on renewable energy production before and after its acceptance in Pakistan and identifies countries that are ideal for direct investment. It also analyzes how the development of renewable energy can have a far-reaching impact on the country from a long-term perspective, taking into account examples of development in other developed countries, thus summarizing the role that FDI can play in the development and construction of the host country.

2. Case Study on Renewable Energy in Pakistan

2.1. Bakcground Description

Pakistan holds a significant geographical advantage with unique energy resources attributed to its vast mountainous terrain, frequent geological activities and obvious crustal movements. Geological Survey of Pakistan (GSP) data evidences that the country possesses oil, natural gas, coal, copper, and other mineral resources, in addition to hydroelectric power, wind energy, and solar energy. However, Pakistan's mining technology, capacity utilization, development efficiency, and other technological aspects have not been able to fully utilize its abundant energy resources, resulting in a market supply and demand imbalance [5]. Pakistan has a large pool of labor resources, with a total population of approximately 210.97 million people, ranking sixth globally, according to the Pakistan Bureau of Statistics' 2015 Pakistan Census. Pakistan has a low demand for foreign workers, and its domestic unemployment rate is consistently high. According to the 2015 World Bank database, Pakistan's total labor force population is approximately 675.88 million, which accounts for around 32.037% of the country's total population. Of this number, about 3.57% of the total labor force is unemployed. This surplus of labor force in Pakistan aids China in reducing costs for trading and investing in Pakistan.

Pakistan is situated in the northwestern region of the South Asian subcontinent and shares borders with Xinjiang, China. In 1951, Pakistan and China established diplomatic relations. Their bilateral ties have strengthened significantly since then, which has led to their crucial role in the BRI. In the early 21st century, China and Pakistan established economic relations. In 2015, the CPEC was completed, leading to even closer economic exchanges between the two countries. China's investment in renewable energy in Pakistan stems from its recognition of the country's plentiful renewable energy resources and the potential for financial gain and increased international standing. This is particularly relevant given Pakistan's insufficient advanced technology to support its development of renewable energy. Until 2015, when the CPEC project was completed, power shortages presented one of the most significant challenges for Pakistan, with summer shortfalls sometimes exceeding 5,000 megawatts. Pakistan aspires to enhance its energy mixture by tapping into its plentiful solar and wind energy, in addition to its ample coal and fossil fuel reserves [6].

In Pakistan, 85 percent of energy needs rely on oil, yet the country's indigenous petroleum sources only fulfill 20 percent of the demand. Nuclear and renewable energy sources, on the contrary, only generate 1.1 and 9.2 percent of the country's energy supply, respectively. It has been noted that approximately 99 percent of Pakistan's energy comes from conventional sources like oil and gas, with the remaining 1 percent originating from renewable sources [7]. The capacity for renewable energy production appears to be limited to 3%. Nonetheless, solar energy possesses substantial potential as an energy source in Pakistan due to its high light intensity. A 25km×25km parcel of land in Pakistan equipped with 10% efficient converters can produce 60 Million Tons Oil Equivalent of energy, demonstrating the vast potential for renewable energy in the country. Despite this, Pakistan continues to import natural gas from Central Asian nations, showing a disregard for the country's renewable energy potential [8].

Research on renewable energy indicates that solar, biogas, micro-energy, wind, and geothermal energy should be prioritized for development. Pakistan, with significant resource potential, should generate a minimum of 10% of its energy needs from renewable sources. With proper planning and

implementation to utilize available resources, the country can have a surplus in energy supply rather than addressing the current energy crisis [8].

On the other hand, China's direct investments in Pakistan, such as setting up enterprises and creating investment projects, not only provide job opportunities and facilitate the acquisition of professional and management skills, but also enhance overall employment levels and the quality of Pakistan's labor force. Furthermore, these investments create new employment opportunities for China's highly skilled personnel and open up new markets. In previous collaborations on the China-Pakistan Economic Corridor, over 85,000 job opportunities were generated, leading to some alleviation of the high unemployment rate experienced by Pakistani citizens [5]. Consequently, investing in renewable energy initiatives presents an opportunity to create additional local jobs, enhance the skillset of the regional workforce, and address issues relating to high unemployment levels.

2.2. FDI on Renewable Energy

China's direct investment in renewable energy in Pakistan is mainly in the areas of photovoltaic power generation, wind power generation, and hydroelectric power generation. The representative projects, their start-up time, scale of development, number of jobs brought to the area, and the significance of the development of each representative project are shown in Table 1.

Table 1. FDI Renewable Energy Projects in Pakistan (Data from China Energy Storage Network, Polaris Power Network, International Renewable Energy Network, Carrot Power LLC)

Renewable energy	Photovoltaic Power	Wind Power	Hydroelectricity
Project	Phase I of 900 (MW) MW photovoltaic power plant in Punjab, Pakistan (300 megawatts (MW))	Sachal Wind Farm	Kalot Hydroelectric
Partner/investor representatives	Zhongxing Energy Co.	China Electric Construction Group/ East China Academy of Sciences	China Three Gorges Group Corporation
Activation Time	June 2016	April 2017	2021
Scale of Development	Approximately 1.3 billion kWh of clean electricity annually	Estimated power generation of about 136.5 GWh annually	Planned to generate an average annual power output of 3.306 billion Kwh, with annual utilization hours of 4,452 hours
Employment	Create more than 3,000 jobs	Create more than 200 jobs	At least 3,000 jobs

As Pakistan boasts abundant renewable resources, but lacks the necessary technical know-how, capital, and expertise to fully harness them, China aims to enhance the development of renewable energy within the country by providing FDI. This, in turn, will mitigate power shortages, elevate the living standards of local inhabitants, and bolster national economic growth.

In Table 1, the Phase I project for the Punjab province photovoltaic power plant in Pakistan is the initial energy project within the CPEC to accomplish financing closure, execute grid-connected power generation, and obtain payments for electricity tariffs from Pakistan. The Jinnah Photovoltaic

Industrial Park in Bahawalpur, Punjab Province covers an area of 4,500 acres. Once completed, it will become the world's largest single power generation project. The Sachal Wind Farm project, comprised of 33 sets of 1.5 MW wind turbines produced by Goldwind Technology, has an installed capacity of 49.5 MW. This project is one of fourteen prioritized initiatives for China-Pakistan energy cooperation. This is one of China-Pakistan's 14 main energy cooperation initiatives and the first renewable energy endeavor under the "Belt and Road" program to finish loan signing. The Karot Hydropower Project, operated by China Three Gorges Corporation (Three Gorges) through a local subsidiary, has 720 MW installed capacity with four 180 MW hydroelectric generating units. Located upstream of the Karot Bridge in the Punjab Province of Pakistan, this hydropower investment project is the first to be included in the Joint Declaration of China and Pakistan. It aims to provide clean energy to support Pakistan's growing economy and address its energy crisis. The project will feature a dam, underground powerhouse, and transmission lines, and is expected to generate 720 million kWh of electricity per year once completed. Its construction is expected to contribute to the development of local infrastructure and create job opportunities for the residents of the area.

Construction projects, such as those aforementioned, create a significant amount of job opportunities for local residents, thereby addressing the issue of low employment rates within the area. Additionally, the completed projects facilitate growth in related industries, contributing to the continuous advancement of the local economy. Additionally, the completed projects facilitate growth in related industries, contributing to the continuous advancement of the local economy. Additionally, the completed projects facilitate growth in related industries, contributing to the continuous advancement of the local economy.

China's investment in renewable energy in Pakistan has bolstered the country's infrastructure, paving the way for a transition from a fossil fuel-dependent energy mix to a sustainable development-oriented approach.

2.3. Economic Impact of FDI

The China-Pakistan Corridor projects hold a total value equivalent to all foreign direct investment in Pakistan since 1970. If these projects are fully executed, they will generate over 700,000 direct employment opportunities in Pakistan from 2015 to 2030 and raise the country's annual economic growth rate by 2 to 2.5 percentage points [9].

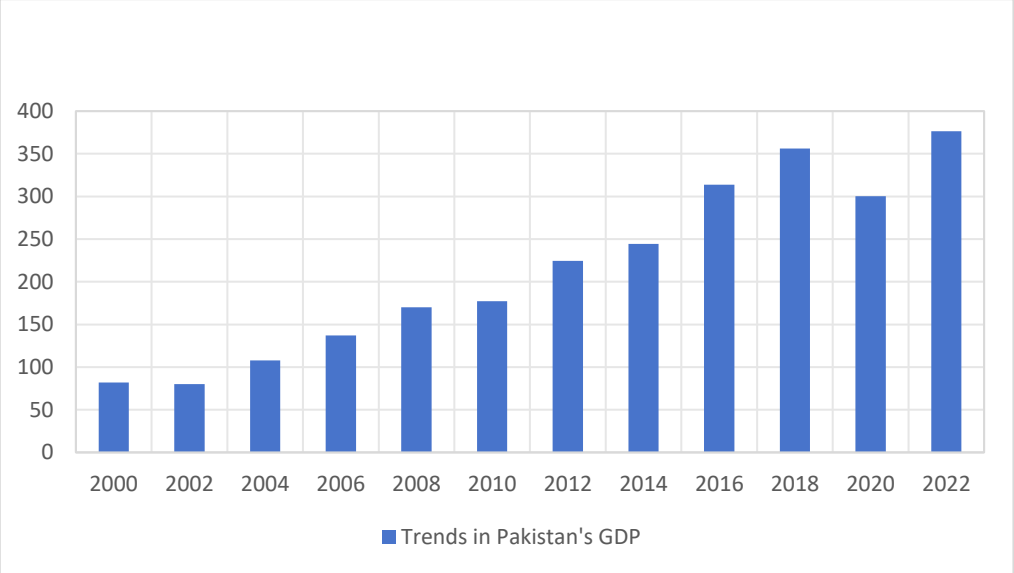


Fig. 1 Trends in Pakistan's GDP

Figure 1 represents the trend in Pakistan's GDP over the period from 2000 to 2022. The figure shows that, prior to the 21st century, Pakistan's GDP growth remained stagnant and only increased by $42.01 million between 1990-2000. However, from the start of the new century and the implementation of the China-Pakistan Economic Cooperation (CPEC), the country's GDP surged by

$91.15 million between 2000-2010, which is more than two and a half times the previous decade's growth. This demonstrates that Pakistan has derived substantial economic advantages from the China-Pakistan Economic Cooperation since its establishment. Subsequently, the GDP experienced an initial steep rise in 2021, followed by a sustained growth from 2011 to 2015.

It is evident from Pakistan's GDP since 2015 that direct investment in clean energy from China has contributed to the steady rise in the country's economic level, with a greater increase in GDP between 2015 and 2018 compared to the pre-2015 period. It is evident from Pakistan's GDP since 2015 that direct investment in clean energy from China has contributed to the steady rise in the country's economic level, with a greater increase in GDP between 2015 and 2018 compared to the pre-2015 period. Hence, it can be reasonably concluded that China's investment in clean energy has played a significant role in the economic growth of Pakistan.

Relying on the CPEC project, Pakistan can utilize China's financial and technological capabilities to establish a communication and transportation infrastructure across its territory, boosting economic growth in the regions along the route. Furthermore, it is anticipated that Gwadar Port will be transformed into a significant international free port and transportation hub, bolstering Pakistan's economic and trade development. Concurrently, the China-Pakistan Economic Corridor plan will facilitate Pakistan in enhancing citizen livelihoods, bridging regional development disparities, mitigating social and tribal conflicts, and curtailing the propagation of terrorism and extremism [9].

2.4. Discussion

In the short term, China's investment in construction projects and project construction processes in Pakistan have furnished the local population with a significant number of job opportunities and addressed the energy consumption shortfall in Pakistan. However, the expected positive impacts, including increased power generation over time and improved air quality, have yet to reveal themselves in the data. One possible reason why Chinese FDI in Pakistan has not had the intended effect is that the BRI and CPEC have primarily brought technology and capital to Pakistan for the development of energy and infrastructure, with a focus on fossil fuels such as coal, oil, and natural gas. Due to the affordable cost, widespread availability, and low extraction requirements of fossil fuel, it is unlikely to be replaced by renewable energy in the near future. In recent decades, funding for renewable energy has primarily been directed towards enhancing its infrastructure and advancing technological development. However, transitioning from a fossil fuel-based energy supply to renewable energy-based power generation is a lengthy process. It involves replacing infrastructure, updating technology, and transforming people's cognitive concepts. As such, the impact of FDI can only be realized after a prolonged period of development. Therefore, investing in renewable energy is a long-term initiative and does not result in immediate effects [10].

To achieve global carbon neutrality and sustainable development, Pakistan must actively pursue renewable energy development and attract foreign investment in this field. It should prioritize enhancing technology and infrastructure to comprehensively construct renewable energy infrastructure during the coming decades, reducing dependence on fossil fuels, improving the national standard of living, and positively impacting the ecological environment.

3. Conclusion

For the promotion of economic cooperation between China and Pakistan, the Pakistani government has responded positively by enacting legislation that encourages import and export and establishes relevant economic laws and regulations. Additionally, they have made efforts to improve technology and conduct research and development. These actions have not only increased Pakistan's GDP and improved the quality of life for its citizens, but have also fostered economic cooperation between China and Pakistan, which is beneficial for the long-term development of both countries. In certain countries, their economic and technological disadvantages result in poor implementation of their own capital, leading to the acceptance of FDI but practical implementation challenges. Consequently,

investments made by the home country in the host country's economy and other areas may not yield a significant return. To fully utilize financial resources, it is important to refine local laws and regulations prior to financing. This prevents a waste of credibility and financial resources.

Underdeveloped countries face challenges in developing their economies due to limited access to advanced technology and capital. Investment from other countries can provide financial support during the development stage. In the case of Pakistan, inadequate funds and outdated technology hinder its ability to supply electricity to residents. However, with abundant natural resources and potential, foreign direct investment (FDI) can be a beneficial and disguised blessing. For instance, China's direct investment in Pakistan has not only promoted the Pakistani economy but also enhanced China's position. Therefore, China's FDI in countries with superior legislation and natural resource potential could boost its economic returns and international standing. The exchange of FDI funds and technology has the potential to enhance economic cooperation and, to some extent, strengthen political ties between the two nations. Additionally, it can have a positive impact on consolidating the national defense force and improving border security.

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