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Does Chinese FDI, Climate Change, and CO₂ Emissions Stimulate Agricultural Productivity? An Empirical Evidence from Pakistan

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Abstract: Pakistan's agricultural sector growth is dwindling from the last several years due to insufficient foreign direct investment (FDI) and a drastic climate change-induced raise in temperature, which are severely affecting agricultural production. The FDI has paramount importance for the economy of developing countries as well as the improvement of agricultural production. Based on the time series data from 1984 to 2017, this paper aims to highlight the present situation of the agriculture sector of Pakistan and empirically analyze the short-run and long-run impact of Chinese foreign direct investment (CFDI), climate change, and CO₂ emissions on agricultural productivity and causality among the variables. The Autoregressive Distributed Lag Model (ARDL) model and Granger Causality test were employed to find out the long-run, short-run, and causal relationships among the variables of interest. Furthermore, we have employed the Error Correction Model (ECM) to know the convergence of the equilibrium path. The bound test results verified the existence of a long-run association, and the empirical findings confirmed that Chinese FDI has a significant and positive impact, while climate change and CO₂ emissions has negative impact on the agricultural growth of Pakistan both in the short-run and long-run. Granger Causality test results revealed that variables of interest exhibit bi-directional and uni-directional causality. The sector-wise flow of FDI reveals that the agriculture sector of Pakistan has comparatively received a less amount of FDI than other sectors of the economy. Based on the findings, it was suggested to the Government of Pakistan and policymakers to induce more FDI in the agriculture sector. Such policies would be helpful for the progress of the agriculture sector as well as for the economic growth of Pakistan.

Keywords: agricultural growth; Chinese FDI; climate change; carbon emissions; ARDL

1. Introduction

Agriculture is one of the leading sectors for developing as well as the developed world, which is a basic sector of the national economy. The best way to impede food calamities is to invest in the agriculture sector [1]. A World Bank Organization report [2] summarized that a country should be

more successful with faster growth by linking the agriculture sector with other sectors. In Pakistan, the agriculture sector is the primary source of livelihoods and ensure food availability to rural and urban residents. It also provides raw material to the industrial sector and enables the country to earn foreign exchange through exporting the finishing goods [3]. The Pakistan agriculture sector consists of five sub sectors such as livestock, fisheries, major crops, minor crops, and forestry. The major crops are cotton, wheat, sugarcane, rice, and maize and the minor crops are bajra, jowar, gram, barely, and tobacco. The major crops accounts for 25.6 percent in agriculture value addition and it contributes 5.3 percent in Gross Domestic Product (GDP) whereas the share of minor crops in agriculture value addition is 11 percent and it contributes 2.3 percent towards GDP. Additionally the contribution of other sub sectors like livestock, fisheries and forestry also have a meaningful contribution in GDP of Pakistan [4].

Additionally, the Government of Pakistan, GoP (2017–2018) [3] emphasized that the agriculture sector has a dominant role in the overall economy; its share is 18.5% to gross domestic products and employed 38.5% of the total labor force of the country. The agriculture sector performance can boost the overall economic growth and a smart source for the eradication of rural poverty. Over the last decade, the performance of agriculture is not promising mainly because of the deteriorated production of all essential crops.

Currently, the agriculture sector of Pakistan is facing many challenges such as unpredicted changes in climatic factors, continuous increase in temperature, changing patterns of rainfall, emission of CO₂, water shortage, lack of improved seed and advanced technologies, and shortage of finance to secure the basic inputs for agriculture production [5]. Pakistan has a strategic location in the South Asia region and attracted many developed countries to invest in different sectors of the economy, but unfortunately, despite much importance of the agriculture sector, it was always neglected in terms of foreign direct investment [6]. Subsequently, foreign direct investment (FDI) had a crucial role in accelerating the growth of the agricultural sector by filling the gaps in investment and technology, which were mainly raised due to limited sources of income and credit [7]. Accordingly, Krugman [8] states that FDI has the distinctive feature which focuses on resource transfer and sustaining a high-level investment. Therefore, the Pakistani government has taken steps to attract foreign direct investment by providing special incentives so that the agricultural sector gets benefits from technological spillovers and ensures an increase in production and growth. Such FDI inflows trends in different developing countries showed significant role in enhancing economic growth, boosting technological level of country and created huge employment opportunities [9–12].

Pakistan and China relish handy and responsive relations since the establishment of diplomatic relations in May 1951. Over time, the relationship has bloomed into an all-weather strategic cooperative partnership. In 1978, both countries constructed Karakoram Highway, a construction miracle linking the mountainous Gilgit Baltistan with western China. Investment from China in Pakistan started from the 1980s and both countries signed an agreement for the protection of investment in 1989. Both countries signed many agreements to develop tourism, infrastructure, bilateral trades, and different investment projects in Pakistan. After 2013, investment from China suddenly boosts up because of the investment in the projects under the China Pakistan Economic Corridor. Through this project, China has invested about 46 billion US dollars in Pakistan to strengthen the economy by the construction of modern transportation networks, numerous energy projects, and a special economic zone. China is one of the top FDI investors in the world and the single largest investor in Pakistan in the recent last decade [12]. According to the Lahore chamber of commerce and industries (LCCI), agricultural technology has now been introduced to the agriculture sector of Pakistan by China Pakistan Economic Corridor (CPEC). According to this plan, the agricultural technology would be transferred to the agro-chemicals, pesticides, seeds, and fertilizers. This plan would be helpful to educate farmers and with latest machinery; farmers can give more agricultural output with better quality [13].

Since the last two decades, the agriculture sector growth of Pakistan's economy has been severely devastated due to unpredicted climatic changes. Continuous increase in temperature, a series of floods

from 2010 to 2014, long span of droughts, and occurrence of new pests and diseases has greatly affected the agricultural production [14,15]. It is worth noting that climatic changes declined the agricultural production and solemnly threatened the food security of the country. Uncontrollable changes in climatic scenarios disturbing the livelihoods of all stakeholders related to the agriculture sector severely damaged the infrastructure and created many difficulties in innovating new and advanced technologies for combating the adverse impact of climate change on agriculture sector [16].

By considering all the above facts, the adverse impact of climate change and the lower growth rate of the agriculture sector, FDI seems to be an effective solution to stabilize and enhance the growth of the economy, particularly agriculture sector growth. Pakistan's agriculture sector has enough potential to support the overall economy; however, the lack of foreign investment and negative influences of climate change and CO₂ emissions are restraining agricultural productivity in the country. Therefore, the agriculture sector emphasizes the need to revisit the investment pattern in which FDI could be an essential determinant or input.

In Pakistan, a number of studies focused on the relationships between FDI and the growth of GDP with different techniques, "such as [17–20]." While some researchers examined the role of FDI in different economic sectors of Pakistan (Ali and Asghar [21] and Ullah [10]), not a single study was conducted to check the specific effect of Chinese FDI with climate change and CO₂ emissions on the agricultural sector of Pakistan. The reason for exploring the effect of Chinese FDI is that in the last decade, China has invested a huge amount in different sectors of Pakistan's economy, so it is worthy to estimate its impact on the least growing sector (agriculture) of Pakistan. Thus, this study is a new attempt to investigate the impact of Chinese FDI, Climate Change, and CO₂ emissions on agricultural growth of Pakistan.

Figure A1 in Appendix B shows the inflow of foreign investment in Pakistan from abroad for the fiscal years 2001–2017, which indicates that the USA, UK, and UAE were leading investor countries from 2001–2012. From 2013, however, while Mainland China is a leading investor country.

Figure A2 in Appendix B shows the inflows of sector-wise foreign direct investment in Pakistan from 2001–2017. Data shows that the agriculture sector is getting a little amount of FDI as compared to other sectors in the study. Sectors of communication, power, mining and quarrying, and oil and gas are the favorable sectors to attract significant inflow of FDI.

To take an excellent view of FDI in the agriculture sector, it is imperative to interpret the government policies to attract a comprehensive amount of FDI into the sector. To the best of our knowledge, no empirical study has been investigated in the context of Pakistan to investigate the flow of FDI from Mainland China and its impact on agriculture sector growth. This paper aims to investigate the impact of Chinese FDI and causality among the variables in the context of Pakistan. This paper highlights the overall structure of the agriculture sector and major constraints in the progress of the said sector. Finally, this paper suggests policy implications for the progress of the agriculture sector.

The rest of the paper is organized as follows. Section 2, "literature review" covers and summarizes opinions about the study. Section 3 discusses the methodologies used in this paper which includes the model specification and justification of variables with data collection methods and sources. Section 4 presents data analysis results with a discussion of results. At last, Section 5 presents conclusions and recommendations.

2. Literature Review

This study aims to empirically examine the effect of Chinese investment, CO₂ emissions, and climate change effects on agricultural growth of Pakistan. In economics, growth has been considered a burning topic. Many theories propose to highlight the factors affecting growth, such as Keynesian theory, classical theory, neo-classical theory, and endogenous growth theory [22–24]. Theories determine those factors which are attracting more FDI, such as Keynesian theory 1930, primarily focused on total spending on the economy and its output, where the economist concentrated on government policies and intervention to prevent an economic recession. Solow [23] outlines that the technological process

is an essential factor in stimulating the growth of economics. According to the theory, continuous progress in technology could achieve long-run economic growth, while the neoclassical growth theory suggests that the labor, capital, and technology are important factors to bolster the economy.

Dickey [25] determined that FDI not only increases the investment level or capital stock but also pushes economic growth. Quattara [26] explores that the affiliation of foreign aid has adverse effects on domestic savings in the context of Côte d'Ivoire. Public infrastructure and FDI together lead to economic growth as the study conducted by Ridzuan et al. [27] examined the role of FDI in three main pillars of sustainable development, like economic growth, environmental quality, and income distribution. They applied Autoregressive Distributed Lag Model (ARDL) and concluded results that show the inflow of FDI push to higher economic growth enhances environmental quality and disparity in the case of Singapore. Similarly, the case of Pakistan Javaid [28] concluded that FDI is a positive determinant to enhance the gross domestic product and further added that the main issues are high population growth rate, low income, low savings, and burden of external debts. Hence, FDI is a powerful tool to overcome these issues and to promote economic development [21]. The report regarding "Foreign Direct Investment for Development" published by Organization for Economic Co-Operation and Development (OECD) in 2002 suggests that FDI influences growth by raising total factor productivity, and it proposes the appropriate policies for host countries. In the meantime, FDI prompts technology spillovers, backing human capital formation, contributing to international trade integration, and it supports to create a more competitive business environment as well as enhance enterprise development. Additionally, FDI helps to improve environmental and social conditions in host countries by transferring cleaner technologies [29].

China is the largest FDI recipient country in the world and a single huge investor in Pakistan by using annual time series data from 1980 to 2014 with ARDL bound testing approach. Hussain and Hussain [12] concluded that market size of China, its inward FDI, and direct investment in Pakistan have a positive and significant impact on the inflow of FDI in Pakistan.

The higher inflow of investment in the agriculture sector leads to the meaningful contribution of a country's economic growth. The study conducted by Ogbanje et al. [30] analyzes the performance of the agriculture sector with the inflow of direct investment from abroad in Nigeria. Similarly, Oloyede [31] shows a positive influence of FDI on the agriculture sector of Nigeria in both the short and long run. Epaphra and Mwakalasya [11] applied the classical linear regression model to conclude the affiliation between FDI and agriculture value-added, they found that FDI does not impose any effect on the agriculture sector in the case of Tanzania.

Iddrisu [32] used the Johansen Cointegration test to elucidate the long and short-run association of FDI on the performance of agriculture sector in Ghana from 1980 to 2013 and concluded that the impact of FDI was negative on the productivity of agriculture in the long-run, but in short-run there was a positive impact of FDI on agricultural productivity. In some countries, the relationship between FDI and agriculture was shown as positive, "such as [30,33]." For example, in Nigeria, the investment from FDI to agriculture boosts the production of this sector; however, the government always ignores the development of agriculture. Osifo [34] elaborated on the role of direct investment from abroad in different sectors like agriculture, manufacturing sector, service sector, and contribution of these sectors to the overall growth of the economy. The results from the Robust Standard Error Model concluded that the role of FDI in the agriculture and manufacturing sector is significant, and both sectors contribute to economic growth. Osifo et al. further added that the manufacturing sector is advantageous and poses a vital role in economic growth.

The agricultural FDI has u-shaped relationships in the long term. FDI in agriculture will promote the agricultural gross total factor productivity (GTFP) in the short-run. However, it will inhibit the growth of agricultural GTFP after a certain critical point [35]. In response to Chinese FDI in Western Africa, Fofana [36] investigated the contribution of Chinese foreign investment in agriculture sectors and economic growth of West African countries and concluded that Chinese FDI is supporting agriculture, domestic investment, and economic growth.

Environmental pollution, climate change, and global warming are the harmful emission of carbon dioxide and has a positive and essential relationship with the agricultural-environmental system [37]. According to the report written by the Lahore University of Management, London School of Economics and Political Science, World Wide Fund for Nature Pakistan, the change in climate pattern has negative impacts on agricultural productivity. Moreover, in 2014, the German Watch Index declared Pakistan is among the world's top 10 vulnerable countries regarding climate change. GoP [38] states that the weather conditions and climate changes are not stable, which are the biggest challenges for the economic sectors of Pakistan, particularly for the agriculture sector. These changes decrease the water resources, and insufficient water is harmful to agricultural productivity. The study conducted on 20 agrarian commodities in different regions [39] investigated that the influence of climate change differs in diverse regions. Many climatologists found that climate change negatively affects agricultural production in some regions but promotes in other areas. Kaiser [40] found that climate change is increasing the risk for the agriculture sector, while Janjua et al. [41] states that climate change leads to a high temperature, which affects water availability that may be a critical factor for wheat cultivation in the future. The estimated results from Vector Auto regression (VAR) model suggested that there is a negative relationship between climate change and wheat productivity.

The immediate development in agriculture and mechanization of the agronomic industry caused significant growth in the consumption of energy and CO₂ emission as per study outcomes, and the long-run result showed a positive relationship between CO₂ emissions and cropped area, energy use, fertilizer off-take, gross domestic product per capita, and water availability, while there is a negative relationship between improved seed distribution and total food grains [16]. Climate change in Pakistan is basically produced by the emission of greenhouse gases and human activities such as urbanization, industrialization, transportation, agriculture, livestock, and energy use [42]. It is proved that climate change and CO₂ emissions linked with agricultural productivity because the agricultural sector is an important source of carbon dioxide emission. It is very important to decrease the emissions related to the agriculture sector and extend low carbon agriculture, which is necessary for economic development and to control the environment and energy [43,44]. According to the World Resources Institute's Climate Analysis Indicator Tool (WRICAIT) the contribution of agriculture in greenhouse gas (GHG) emission is 41% of total GHG emissions. Achieving sustainable economic growth without any adverse effect on the natural environment is crucial these days. Demissew Beyene and Kotosz [45] shows that the long-run association between the economic growth and CO₂ emission is not as Kuznets assumed (an inverted-shape), but instead of bell-shaped which means that the relationship between GDP per capita and CO₂ emission is negative until the GDP per capita reaches to a certain point and once it reaches to a certain point the relationship between the stated variable is positive. The study conducted in the USA for the period of 1960–2013 by Dogan and Turkekul [46] to investigate the relationship between CO₂ emissions energy consumption, real output the square of real output, trade openness, urbanization, and financial development by using ARDL bound testing approach and Vector Error Correction Model (VECM) revealed that the main source of CO₂ emission is energy consumption in the USA and urbanization also has a positive impact on CO₂ emission. Dogan et al. conducted the study to investigate the validity of Environmental Kuznets Curve (EKC) hypothesis for the MINT (Mexico, Indonesia, Nigeria, and Turkey) countries and pointed out that the environmental Kuznets curve hypothesis is valid for each of the MINT countries and the anthropogenic pressure on the environment is because of fossil fuel energy consumption, exports, urbanization, and financial development [47]. Moreover, Moutinho et al. [48] confirmed that the negative changes in CO₂ emission in the last decade is because of the financial development and productivity of renewable sources like renewable electricity generation per GDP.

Attracting FDI is the central issue for all countries. Countries that have improving physical and financial infrastructure attract more FDI than others [49]. Multinational Firms are investing in other countries to get advantages based on low factor cost and low trade cost, the availability of cheap labor and extensive local market encourage foreign investment in a host country, charitable institutions,

and well infrastructure also attract FDI in developing countries. Based on factors like political stability, property rights, and corruption, investors decide to invest in host countries where low corruption and stable economies attract more FDI [50]. It's commonly proved that inflows of FDI lead to economic growth, but the economies with high growth also attract more inflows of FDI, hence the high economic growth is a potential factor to attract more investment volume in host countries. Higher economic growth and business-friendly environment with the internal size of the market and balance of trade are essential elements to attract inflows of FDI [51].

Countries with a higher GDP growth rate and advanced infrastructural setup are attracting more FDI as compared to low GDP growth economies [52]. Jadhav [53] focused on the factors that are attracting more FDI, consist of economic, institutional, and political factors in BRICS countries (Brazil, Russia, India, China, and South Africa) results confirmed that economic factor is a powerful determinant to attract more investment in the above countries because most investors are promoting by market seeking purpose. Other factors, such as institutional and political factors, are unable to attract a significant amount of FDI. Bernanke and Gürkaynak [54] narrate foreign direct investment is a vital aspect of building capital in developing countries since the flow of foreign investment in developing countries is a powerful tool of economic growth.

As an Indian News Paper, the Economic Times [55] reported that China is investing in different sectors of Pakistan for market seeking opportunities. Sino-Pak Economic Corridor known as (CPEC) is the largest megaprojects ever undertaken in terms of Chinese foreign direct investment. The actual cost of Sino-Pak Economic Corridor is to be expected at 75 billion US dollars, out of which 45 billion-plus US dollars will be invested in the corridor, which will be functional in 2020. The rest will be invested in different projects like infrastructural development and energy in Pakistan. The construction of Gwadar international airport, seaport, and expansion of the Karakoram highways are also part of this mega project. Karakoram highway connects China with Pakistan in Beautiful Gilgit Baltistan, which is the gateway to this mega project. This project will create employment opportunities for the whole of Pakistan, which is a positive sign for Pakistan to decrease the unemployment rate in the region.

3. Material and Methods

3.1. Variable and Data Source

The data used for this research paper collected from different sources like the Pakistan Meteorological Department, State Bank of Pakistan, and World Bank database (WDI) covering the period from 1984 to 2014. The time duration was selected based on available data. The data for agricultural annual growth, carbon dioxide emissions (CO₂), the labor force in agriculture (agricultural employment), agricultural raw material exports, GDP per capita annual growth, and inflation (CPI) were collected from the World Bank. Data for Chinese foreign direct investment in Pakistan were gathered from the State Bank of Pakistan. Finally, data for climate change (temperature) and precipitations (rainfall) have been taken from the Meteorological Department of Pakistan. Table 1 shows the detailed description of variables and data sources.

Table 1. Variables Description and Data Source.

Variable	Description	Data Source
Agricultural Annual Growth (AG)	The agriculture value-added annual growth consists of all sector's net output and subtracting intermediate inputs. Sectors consist of forestry, hunting, fishing, cultivation of crops, and livestock production. (Growth always measured in percentage.)	World Bank (WDI)
Chinese Foreign Direct Investment (CFDI)	The total inflow of foreign direct investment (FDI) from Mainland China (China and Hong Kong) in Pakistan from (1984–2017) for each year will be used as an independent variable. We have converted data into log form to remove sharpness, measured in a million US dollars.	State Bank of Pakistan (SBP)
Agricultural Employment (AGEM)	The active people are working in the agricultural sector, considered a labor force. This data has been divided into the total labor force. (Labor force for agriculture sector was taken as a percentage of a total labor force of the country.)	World Bank (WDI)
Agricultural Exports (AGEX)	The exports of raw material agricultural goods are taken as agricultural exports in this study and measured in percentage of total merchandise exports.	World Bank (WDI)
GDP Per Capita Annual Growth (GDPPC)	Annual percentage growth rate of GDP per capita based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP per capita is gross domestic product divided by midyear population.	World Bank (WDI)
Inflation (CPI)	The annual percentage change in the cost to acquire goods, measured by the consumer price index.	World Bank (WDI)
Climate Change (CLM)	Average temperature change (°C) data has been used in our study.	Pakistan meteorological department
Precipitation (RF)	Average rainfall (mm) data has been used in this study.	Pakistan meteorological department
Carbon Dioxide (CO ₂) Emissions	All emission estimates are stated in thousand metric tons of carbon and converted into log form.	World Bank (WDI)

3.2. Methodology

The sample model for our study is as below, where Y_t is a dependent variable, and x_1 to x_8 are the dependent variables, while ε_t represents the error term.

$$Y_t = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \varepsilon_t \quad (1)$$

Agricultural annual growth is the explained variable of our study. Chinese FDI, climate change, CO₂ emissions, carbon dioxide emissions, agricultural employment, inflation, exports of the agriculture sector, and GDP per capita annual growth are the explanatory variables. To investigate Chinese FDI, climate change and CO₂ emissions impact on the agriculture sector of Pakistan, we have developed the following functional form:

$$AGG = F(CFDI, CLM, CO_2, RF, AGEM, AGEX, CPI, GDPPC) + \varepsilon \quad (2)$$

We can write our equation as below

$$AGG = \alpha + \beta_1 CFDI + \beta_2 CLM + \beta_3 CO_2 + \beta_4 RF + \beta_5 AGEM + \beta_6 AGEX + \beta_7 CPI + \beta_8 GDPPC + \varepsilon \quad (3)$$

where AGG = Agricultural Growth, CFDI = Chinese Foreign Direct Investment, CLM = Climate Change, CO₂ = Carbon Dioxide Emissions, RF = Precipitation, AGEM = Labor Force in Agriculture, AGEX = Agricultural Raw Material Exports, CPI = Inflation, GDPPC = GDP per capita annual growth, and ε = Error Term.

We considered Equation (1) as a long-run model. For the confirmation of the long-run relationship in our model, we applied the bound testing approach. We can confirm the long-run association from the negative and significant value of error correction term, too. We applied the Autoregressive Distributed Lag Model (ARDL) for analysis, and this technique is firstly used by Pesaran et al. [56] and further extended by Pesaran et al. [51]. If the variables are stationary in mix orders that some variables stationary in I(0) and some stationary in I(1), then the autoregressive distributed lag model is the appropriate model to investigate both the short and long-run cointegration [51]. This approach is being utilized if stationary at various levels. ARDL Model is a cutting edge, broadly used, and adaptable procedure to apply. It has many advantageous conditions. It can be connected when the factors are incorporated at various levels [56].

ARDL model has many advantages over the other methods. First, it does not restrict the integration and gives accurate results if the variables are stationary at I(0) and I(1). Second, at the same time, we can evaluate the results for both short and long-run analyses, and additionally, the most suitable model for small sample data as compared to the other co-integration techniques. Third, the ARDL model has a single equation to show the long-run association Pesaran et al. [56]. Finally, Pesaran et al. further elaborated that in ARDL model bound testing technique, there is the involvement of unrestricted ECM.

3.3. Model Specification

In the 1950s and 1960s, Economists focused on the growth theories, where they considered the factor of production as an essential driving force for economic growth. Improvement in production techniques leads to a rise in per capita income. According to the economic growth theories, machines and labors are the essential factors, so investment in the factors leads to economic growth in the long-run. Domar [57] and Harrod [58] implied progress strategies of Africa, Asia, and Latin America on the second world war and represented the economic growth model, and Solow [23] contributed to aggregate production function and technology lead to increase GDP. Finally, Bernanke and Gürkaynak [54] supported that Solow [23] growth model helps evaluate various types of growth models. In the endogenous framework, the model is called Solow's model.

To find the long-run and short-run connotation between Chinese foreign direct investment, climate change, CO₂, precipitation, and agricultural growth by using ARDL Model in line with previous studies "such a [46,47,59,60] and Rehman et al. [16], this study contemplates the following equations.

$$\begin{aligned} \Delta AG_t = & \alpha_0 + \beta_1 (AG)_{t-1} + \beta_2 (CFDI)_{t-1} + \beta_3 (CLM)_{t-1} + \beta_4 (CO_2)_{t-1} + \beta_5 (RF)_{t-1} + \beta_6 (AGEM)_{t-1} \\ & + \beta_7 (AGEX)_{t-1} + \beta_8 (CPI)_{t-1} + \beta_9 (GDPPC)_{t-1} + \sum_{i=1}^p \phi_i \Delta (AG)_{t-1} \\ & + \sum_{i=0}^q \omega_i \Delta (CFDI)_{t-1} + \sum_{i=0}^q \gamma_i \Delta (CLM)_{t-1} + \sum_{i=0}^q \omega_i \Delta (CO_2)_{t-1} + \sum_{i=0}^q \omega_i \Delta (RF)_{t-1} \\ & + \sum_{i=0}^q \delta_i \Delta (AGEM)_{t-1} + \sum_{i=0}^q \varphi_i \Delta (AGEX)_{t-1} + \sum_{i=0}^q \vartheta_i \Delta (CPI)_{t-1} + \sum_{i=0}^q \vartheta_i \Delta (GDPPC)_{t-1} \\ & + \varepsilon_t \end{aligned} \quad (4)$$

From the above model where p and q = lag lengths. Where AG, CFDI, CLM, CO₂, RF, AGEM, AGEX, CPI, and GDPPC are agricultural growth, Chinese foreign direct investment, climate change, carbon dioxide, precipitation (rainfall), agricultural employment, agricultural export, inflation, and GDP per capita, respectively. Moreover, Δ denotes the difference between the variables and ε_t denote the error term of the model.

When there is a long-run association that occurs from Equation (4), then we can go further to the long-run coefficients as following models.

$$\begin{aligned}
AG_t = & \alpha_0 + \sum_{t=1}^{i=p1} \phi_i(AG)_{t-1} + \sum_{t=0}^{i=q1} \beta_1(CFDI)_{t-1} + \sum_{t=0}^{i=q2} \beta_2(CLM)_{t-1} + \sum_{t=0}^{i=q3} \beta_3(CO_2)_{t-1} \\
& + \sum_{t=0}^{i=q4} \beta_4(RF)_{t-1} + \sum_{t=0}^{i=q5} \beta_5(AGEM)_{t-1} + \sum_{t=0}^{i=q6} \beta_6(AGEX)_{t-1} \\
& + \sum_{t=0}^{i=q7} \beta_7(CPI)_{t-1} + \sum_{t=0}^{i=q8} \beta_8(GDPPC)_{t-1} + \varepsilon_t
\end{aligned} \quad (5)$$

Condition of the short-run dynamics in the ARDL model can be prompt by creating the error correction model.

$$\begin{aligned}
\Delta AG_t = & \alpha_0 + \sum_{t=1}^{i=p1} \phi_i \Delta(AG)_{t-1} + \sum_{t=0}^{i=q1} \omega_i \Delta(CFDI)_{t-1} + \sum_{t=0}^{i=q2} \gamma_i \Delta(CLM)_{t-1} + \sum_{t=0}^{i=q3} \delta_i \Delta(CO_2)_{t-1} \\
& + \sum_{t=0}^{i=q4} \delta_i \Delta(RF)_{t-1} + \sum_{t=0}^{i=q5} \varphi_i \Delta(AGEM)_{t-1} + \sum_{t=0}^{i=q6} \vartheta_i \Delta(AGEX)_{t-1} \\
& + \sum_{t=0}^{i=q7} \vartheta_i \Delta(CPI)_{t-1} + \sum_{t=0}^{i=q8} \vartheta_i \Delta(GDPPC)_{t-1} + \psi ECM_{t-1} + \varepsilon_t
\end{aligned} \quad (6)$$

where ECM_{t-1} is the error correction term, it offers the speed of adjustment towards long-run equilibrium. It can be well-defined as follow:

$$\begin{aligned}
ECM_t = & AG_{t-1} \alpha_0 - \sum_{t=1}^{i=p1} \beta_1(AG)_{t-1} - \sum_{t=0}^{i=q1} \beta_2(CFDI)_{t-1} - \sum_{t=0}^{i=q2} \beta_3(CLM)_{t-1} - \sum_{t=0}^{i=q3} \beta_4(CO_2)_{t-1} \\
& - \sum_{t=0}^{i=q4} \beta_5(RF)_{t-1} - \sum_{t=0}^{i=q5} \beta_6(AGEM)_{t-1} - \sum_{t=0}^{i=q6} \beta_7(AGEX)_{t-1} - \sum_{t=0}^{i=q7} \beta_8(CPI)_{t-1} \\
& - \sum_{t=0}^{i=q8} \beta_9(GDPPC)_{t-1}
\end{aligned}$$

All coefficients of the short-run equation are coefficients concerning the short-run dynamics of the model's convergence to equilibrium, and ψ signifies the speed of adjustment.

4. Results and Discussion

4.1. Unit Root Test

In an econometric analysis of time series data, it is necessary to examine the stationary of variables data. To determine the presence of unit roots in our data, we have applied the Augmented Dickey-Fuller test [25,61], and the Phillips-Perron test. This method is used to check to stay away from the likelihood of spurious relapse. As indicated by the Dickey-Fuller bound test (test to find out the long-run relationship in the model), concerned with the stationary of variables, the variables should be stationary either in level $I(0)$ or in first difference $I(1)$. To estimate further ARDL estimation, none of the variables should be stationary at the second difference $I(2)$. If the variable stationary at $I(2)$, the F statistic measurement provides the wrong outcomes, meaning that nonsense results [26]. Therefore, to estimate ARDL estimates, no variable of the study should be stationary at $I(2)$. As Table 2 unit root results show, none of the variables is stationary in $I(2)$, all our study variables are stationary at $I(0)$ or $I(1)$. Having these properties of variables, the ARDL model is recommended for further analysis, which is firstly presented by [51]. For the optimal lag selection, we have followed the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) criteria and presented the results of the bound test in Table 2.

Table 2. Unit Root Test Results.

Variables	(Intercept)		(Intercept and Trend)	
	Level	1st Diff	Level	1st Diff
Augmented Dickey-Fuller (ADF)				
AGG	−7.42778 ***	−6.5289 ***	−8.39193 ***	−6.41033 ***
CFDI	−1.40522	−7.53086 ***	−3.24381 *	−3.76886 **
CLM	−3.06923 **	−5.85179 ***	−4.76092 ***	−5.6516 ***
CO ₂	−1.79625	−6.93732	−0.0311	−8.10705 ***
RF	−4.71987 ***	−7.38886 ***	−5.27797 ***	−5.59636 ***
AGEM	−1.888404	−7.9397 ***	−4.08942 **	−7.86734 ***
AGEX	−3.44183 **	−2.18439	−2.94501	−2.44391
CPI	−2.43073	−6.95844 ***	−2.35335	−6.954 ***
GDPPCG	0.631707	−2.92444 *	−2.01701	−3.01691
Phillips and Peron (PP)				
AGG	−7.32724 ***	−34.6427 ***	−17.02 ***	−33.6609 ***
CFDI	−0.94016	−8.5356 ***	−3.17616	−12.5254 ***
CLM	−3.01681 **	−11.8965 ***	−4.76092 ***	−11.5872 ***
CO ₂	−1.57093	−6.78963 ***	−0.48264	−8.10705 ***
RF	−5.23567 ***	−16.3526 ***	−5.72863 ***	−16.9898 ***
AGEM	−1.65517	−14.8406 ***	−3.86305 **	−19.904 ***
AGEX	−1.30361	−8.91929 ***	−3.2063 *	−13.8872 ***
CPI	−2.5253	−6.92295 ***	−2.42421	−7.01998 ***
GDPPCG	−0.61261	−3.46352 **	−2.30142	−3.3413 *

Source: Author estimation using Eviews 10. ***, **, * shows the significance level of coefficient at 1%, 5%, and 10%.

4.2. Bound Test

The long-run relationship existence is an important indicator to proceed with further ARDL tests. Based on the presence of a long-run relationship, the techniques of ARDL can be used for long-run estimations. The results from the bound testing technique confirmed the presence of the long-run association. The calculated F-test value in Table 3 (20.61821) is higher than the value of the upper bound (3.77) I(1). Thence, it is proved that the long-run association among variables in our study exists though we proceed to test the long-run coefficient of the model. To calculate the F statistic value, we applied the bound test technique. To compare and check the significance level, we followed the upper and lower critical bound suggested by [62], to confirm the existence of long-run relationships. From the negative and significant value of ECM also, we can verify the presence of the long-run relationship.

Table 3. Bound Test for Cointegration.

Significance	Bounds Critical Values		F-Calculated
	Lower Bound I(0)	Upper Bound I(1)	
10%	1.85	2.85	20.61821
5%	2.11	3.15	
2.5%	2.33	3.42	
1%	2.62	3.77	

4.3. Long-Run Analysis

According to the long run results, almost all of the variables were found to be significant, except agricultural exports and influencing the growth of the agriculture sector as represented in Table 4. The estimated results indicate that Chinese foreign direct investment (CFDI) had a substantial and expressive role in the Agricultural productivity of Pakistan. It means that the inflow of CFDI into the agriculture sector leads to an increase of the agricultural growth. These findings are consistent with the findings of previous studies such as Oloyede [31] and Ali and Asghar [21]. They also concluded that

FDI has a crucial role in improving and stabilizing the production and growth of the agriculture sector in the respective developing countries. There are some reasons behind the positive impact of FDI on agricultural growth. Firstly, FDI leads to an increase in investment of Pakistan's agriculture which effectively fulfills the demand of shortage of fund in the said sector. Second, the FDI fills the gap of shortage of fund in the agriculture sector of Pakistan and promotes agricultural growth; these findings are similar with the findings of [35]. As per our empirical results, the estimated coefficient of CFDI is small (0.0034) and affects the agriculture sector of Pakistan positively; the reason behind the small coefficient is that the agriculture sector is receiving less FDI as compared to other sectors, because the chunk of CFDI was invested in energy, power, and infrastructure development projects. In the context of Pakistan, Latief [63] also confirmed that the energy and power sectors have comparatively received a higher amount of FDI than other sectors. Pakistan's government is taking some influential measures to attract more FDI in the agricultural sector, which ultimately boosts up the technological innovations in the sector and consequently improves the growth of the agriculture sector. In previous decades, this sector was neglected for FDI inducement, but from the last decade, the government is much more conscious of improving the agriculture sector performance by injecting more FDI from the CPEC project. In response to FDI on agricultural productivity, many studies showed significant and positive effects. For instance, the findings of Furtan [64] verified that USFDI significantly improves the agricultural growth and food security of Canada. In addition, Ogbanje et al. (2010) also verified the strong and positive relationship between FDI and the agriculture sector growth in the case of Nigeria.

Table 4. Long-run results.

Variable	Coefficient	Standard Error	t-Statistic
CFDI	0.003371 **	0.001502	2.244129
CLM	−.38891 ***	0.059773	−6.506472
CO ₂	−0.62402 **	0.212042	−2.942912
RF	0.714577 **	0.258110	2.768503
AGEM	0.2886 **	0.129354	2.230763
AGEX	0.067844	0.116854	0.580590
CPI	0.147576 **	0.069777	2.114987
GDPPC	0.71065 ***	0.182904	3.885387
C	−38.0789 **	13.56867	2.806387

Source: Author estimation using Eviews 10. ***, ** shows the significance level of coefficient at 1%, and 5%, respectively.

The role of agricultural employment on agricultural growth is definitive with significant impact, and this empirical evidence is identical with the findings of Epaphra and Mwakalasya [11] who found similar results in the case of Tanzania and also confirmed the significant and affirmative impact of labor participation on agricultural production. Agricultural exports and inflation are stimulating agricultural growth, according to our results. However, the effect of agricultural export is not significant because most of the agricultural exports are in the form of raw material and earned mere foreign exchange. These outcomes are compatible with the findings of Iddrisu et al. [32] and Furtan and Holzman [64]. Furthermore, Gilani [65] also showed a decisive role in agricultural exports on agricultural productivity, the reason behind the insignificant relationship between agricultural exports and the growth of the agriculture sector in the context of Pakistan is the tough competition in the world market. Exports of primary and raw agrarian products are unable to compete in the international market because of intense competition, low quality, and high prices. These results are coordinating with the findings of Mahmood and Munir [66].

The negative and highly significant coefficient of climate change showed that the rising temperature in Pakistan has an adverse impact on agricultural productivity. A decrease in agricultural production leads to a reduction in the growth of the agriculture sector. In South Asia and especially in Pakistan, there are a number of influencing factors that are affecting agricultural productivity negatively such

as continuous increase in temperature, unpredicted precipitation, long span of droughts, and the occurrence of new pests and diseases and some natural hazards (earthquake and violent storms). These findings follow the findings of Abid et al. [14]. Furthermore, Pakistan is one of the most water-stressed countries in the world, and the two largest dams, the Terbela and Mangla dams, have seen a decline in their storage capacity because of excessive deposits of silts, and the decline in water flow is a serious threat for the livelihood of farmers in Pakistan. These findings revealed that changing climatic conditions adversely influencing the growth of agriculture, while the role of carbon dioxide emission is negative and statistically significant in the long run estimations. It exhibits that once carbon dioxide emissions increased, it will lead to a decrease in agricultural productivity. The greenhouse gasses emissions are the primary causes of climate change in Pakistan, and human activities like deforestation, urbanization, transportation, energy use, and massive use of livestock's products are the key sources that are significantly contributing to CO₂ emission in Pakistan Hussain et al. [42]. Some studies underline the adverse repercussion of CO₂ emissions and overpopulation on agricultural productivity (Himics et al. 2018; Zafeiriou and Azam [67,68]. Precipitation is playing an imperious role in the growth of agriculture in the long run association as most of the developing countries depend upon the rain fed due to less operational irrigation system and decreasing trends of rainfall in the country up surging the water shortage problem for agriculture irrigation that is most necessary input for crops production. These results are similar to the findings of a previous study conducted by Ali et al. [17]. Similar results were determined by Rehman et al. [16] and Janjua et al. [41]. They found that climate change and CO₂ emission had an adverse impact on agricultural productivity in the context of Pakistan. Increasing temperature severely affected crop production and also decreased livestock production, which has the major contribution (60%) in the agriculture sector [15]. Increases in temperature for a long time ultimately leads to drought and shortage of water availability that is essential for agricultural production and results in decreased agricultural production. Climate change is the biggest challenge for water resources, energy sector, health, and particularly for agricultural productivity GoP [38]. The role of GDP per capita annual growth for agricultural growth is meaningful in the long-run; these results coincide with the findings of Osifo et al. [34], and they also determined similar results for the Nigerian agriculture sector.

4.4. Short-Run Analysis

Table 5 represents the short-run coefficients of the model. The coefficient of the error correction model (ECM) is negatively significant, and the negative coefficient value (−1.1113) signifies a converging to the equilibrium path. The coefficient of ECM magnitude shows a short-term adjustment process.

The role of CFDI is potential and significantly leads to the agricultural growth of Pakistan as per our empirical results. These results are in accordance with the results of Oloyede [31], and Ajuwon and Ogwumike [69] also found the potential role of FDI in the agriculture sector in their studies. The short-run results of Iddrisu et al. [32] also presented the same influence of FDI on the agricultural sector in Ghana. Special intentions are needed to increase the potential of the agriculture sector by increasing FDI. While the agricultural raw material exports in the short-run play a significant role, these results are identical to the results of Gilani [65], and his findings also expressed a potential role in case of Pakistan for the short-term.

The agricultural labor participation rate (AGEM) is a significant factor in boosting up the growth of the agriculture sector. The coefficient of the lag of CPI has a negative and significant impact on agricultural growth in the short-run analysis. GDPPC annual growth is a highly significant and positive impact on agricultural growth in the short-run results. We observed an adverse effect of inflation (CPI) in the short-run. The rainfall (precipitation) coefficient is positive and significant in the short run, and the findings of Janjua et al. [41] also highlighted the role of these variables is potential in case of Pakistan.

Table 5. Error Correction Representation and Short-Run Results.

Variable	Coefficient	Standard Error	T-Statistic
C	−42.31542 ***	13.75760	−3.075786
AG(−1)	−1.11126 ***	0.103870	−10.69850
CFDI(−1)	0.003746 **	0.001532	2.445590
CLM	−0.432181 ***	0.054567	−7.920182
CO ₂	−0.633512 ***	0.234092	−2.706252
RF	0.794078 **	0.305208	2.601755
AGEM	0.32066 **	0.138731	2.311404
AGEX(−1)	0.075392	0.129274	0.583197
CPI(−1)	0.163995 **	0.075104	2.183577
GDPPC(−1)	0.789716 ***	0.213517	3.698615
D(CFDI)	0.000889	0.001589	0.559480
D(AGEX)	0.310371 **	0.141447	2.194250
D(CPI)	−0.204956 **	0.090276	−2.270338
D(GDPPC)	1.226505 ***	0.198517	6.178326
ECM(−1)	−1.111255 ***	0.063751	−17.43122
R-squared	0.969742	Test statistic	LM Version
Adjusted R-squared	0.965419	Serial Correlation	0.882136
S.E. of regression	1.049077	Heteroscedasticity	12.42088
Log-likelihood	−45.69504	Normality	1.0246160
Durbin-Watson stat	2.025931		LM Version
			F version
			Prob. F (2,17)
			Prob. F (13,19)
			0.599111

Source: Author estimation using EvIEWS 10. ***, ** shows the significance level of coefficient at 1%, and 5%.

Furthermore, the second portion of Table 5 shows the diagnostic tests of the model. The R² value is 0.969, indicating about 97 percent change in the agriculture sector by independent variables. The Durbin Watson Statistics is 2.025, which is around 2.0, indicating the absence of correlation issues in our model. As per the results of the diagnostics test, there is no indication of serial correlation and heteroscedasticity and according to the Jarque-Bera test, the residuals are normally distributed in the model.

4.5. Stability Test Graph

We assess the long-run association of AGG, CFDI, and other variables. We depend on the tests “CUSUM” and “CUSUM” square to check our model stability. Figure 1 shows the stability of the coefficients during the estimation period. The straight line shows 5 percent critical bounds for the CUSUM and CUSUM squares used to investigate the parameter stability. In both graphs, plots lie between the critical bounds indicating the stability of the parameters in the model, so there are no structural breaks in our model.

Figure 1. Diagnostic graphs for stability.

4.6. Causality Test

We have adopted causality test through VECM, in order to estimate the direction of the long-run relationship among the variables. The results from Granger Causality test through the vector error correction model is represented in Table A1 in the Appendix A. The Granger Causality test is an important test to find the cointegration relationship among the analyzed variables. So, we will see the causal relationship between AGG, CFDI, CLM, CO₂ emissions, AGEM, AGEX, precipitation, CPI, and GDPPC in our study. The existence of a long-run relationship among variables indicates that there must be causality, at least in one direction Granger [70].

As per the results from the Granger Causality test, there are bidirectional relationships between agricultural growth (AGG) and employment in agricultural sector (AGEM), AGG and CPI, AGEM and GDPPC, GDPPC and AGEX as well there is bidirectional relationship between the GDPPC and CPI. Meanwhile, we have observed unidirectional relationships in our results between AGG to AGEX and CO₂, AGEX to CO₂, precipitation to CLM, AGEM, and GDPPC. The unidirectional relationship is also running from CPI to CFDI, CLM, CO₂ emissions, precipitation, and GDPPC. Lastly, no causality is determined from CFDI, CLM, and CO₂ to any other variables. The Causal connection between Agricultural productivity and CO₂ emissions is in line with Appiah et al. [71], and the causal connection from agricultural productivity to agricultural export in accordance with the results of Memon et al. [72].

5. Conclusions and Recommendations

Agriculture is the backbone for the entire economy of Pakistan; it plays an essential role in the economic growth and development process. The primary purpose of this empirical study is to investigate the role of Chinese foreign direct investment, climate change, and CO₂ emission from 1984 to 2017 on agricultural growth of Pakistan in the short and long-run. For stationarity of each variable, we have applied ADF and PP test. The results of these tests confirmed that none of a variable is stationary at the second difference I(2); however, our study variables are stationary at the level I(0) and at first difference I(1). Once it's confirmed that our variables are stationary at I(0) and I(1), we have employed ARDL bound testing technique and Granger Causality test (VECM) to find the causality among variables in short-run and long-run.

Empirical findings reveal that CFDI in the agriculture sector has a significant and positive influence on the agricultural productivity of Pakistan. However, the slight value of coefficient stated lower marginal influence on agricultural growth. The lower coefficient of Chinese foreign direct investment in our study shows that the agriculture sector is receiving less Chinese foreign direct investment among other sectors of Pakistan. The decisive role of Chinese foreign direct investment in the agriculture sector shows that concerned authorities take necessary steps to boost investment in the sector. So, the concerned authorities in the government must ensure sufficient investment in the sector and take the steps needed to attract more FDI in the agricultural sector.

On the other hand, climate change and CO₂ emissions are not supporting agricultural growth both in short-run and long-run associations. The reason behind the negative impact of climate change on agricultural growth is changing weather patterns; the temperature is increasing continuously. Climate change is a big environmental challenge that is affecting all economic sectors in the country and especially the agriculture sector. The government of Pakistan already took some initiatives on the adverse impact of climate change; however, the government should show much more concern about this issue to protect agriculture, which is the backbone for the overall economy in Pakistan because its contribution has an essential role in the GDP of the country and this sectors absorbs about 45 percent of total labor force. The government should adopt strategies to minimize the negative influences of changing climate and CO₂ emissions, which would be helpful to agricultural production as well as the growth of the economy. CFDI caused the boost of agricultural production in Pakistan, while climate change and CO₂ decreases productivity. However, the exporters of agricultural products failed to compete in the world market. It is the responsibility of the government of Pakistan to

encourage exporters and provide necessary services and adopt friendly policies towards agricultural products exports.

Finally, the Granger Causality results indicate that there is strong long-run and short-run causal relationships in some variables, as the results show a bidirectional relationship between agricultural growth (AGG) and employment in the agricultural sector (AGEM). Based on the Granger Causality test results, the government of Pakistan should take into account the importance of agricultural exports, agricultural employment, and GDPPC to increase the agricultural productivity of Pakistan.

While the above analysis provides interesting insights in ARDL, Bound Testing, and Causality test, it should be noted that the development of efficient environmental policies likely to reduce temperature and CO₂ emissions is necessary to increase productivity in the agricultural sector. The government should adopt specific policies to help agricultural producers to improve agricultural productivity by advancing farming technologies and provide basic inputs with approved quality (scientifically improved seeds, fertilizer, and effective pesticides) and local governments should observe and regulate the irrigation system for producing quality output with efficient utilization of resources so they can compete in international markets.

The study also has some limits in terms of access to data and included few variables for the analysis. Historical data for FDI before the 1980s has the reliability issue due to a lack of documentation. For future research, researchers can extend it to the provincial level with the most recent data and can devise the most influential policy at the regional level because some provinces such as Punjab and Sindh are specialized in agricultural production.

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Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Appendix A

Table A1. Granger Causality test results under vector error Correction Model (VECM).

Dependent Variable	χ^2 -Statistics (Probability)									χ^2 -Stat (Prob) For EC_{t-1}
	ΔAGG	$\Delta CFDI$	ΔCLM	ΔCO_2	ΔRF	$\Delta AGEM$	$\Delta AGEX$	ΔCPI	$\Delta GDPC$	
ΔAGG	-	−24.66955	0.41082	0.000152	0.091368	0.349962 ***	0.112181	0.7063 ***	−0.205057	−0.6559 **
		−16.4856	−0.5193	−0.00246	−0.05269	−0.15876	−0.0939	−0.21532	−0.12742	−0.30567
		[−1.49643]	[0.79111]	[0.06150]	[1.73392]	[2.20432]	[1.19474]	[3.28050]	[−1.60929]	[−2.14609]
$\Delta CFDI$	−0.003210	-	0.003613	−2.3005	0.001708	0.001498	0.000291	0.0098 ***	−0.003248	−0.251953
	−0.00482		−0.00944	(4.5E−05)	−0.00096	−0.00289	−0.00171	−0.00391	−0.00232	−0.14034
	[−0.66582]		[0.38284]	[−0.51318]	[1.78394]	[0.51911]	[0.17056]	[2.49939]	[−1.40265]	[−1.79528]
ΔCLM	−0.237263	−6.211309	-	0.001365	0.0887 ***	0.099027	0.044846	0.2936 **	−0.080449	0.156185
	−0.14971	−9.30221		−0.00139	−0.02973	−0.08958	−0.05298	−0.1215	−0.0719	−0.59828
	[−1.58483]	[−0.66772]		[0.98146]	[2.98452]	[1.10542]	[0.84644]	[2.41671]	[−1.11892]	[0.26106]
ΔCO_2	−54.063 **	12.29523	16.65031	-	−2.819670	−35.922 **	−18.0588 *	−43.3063 *	−13.52613	0.002401
	−26.8115	−1665.94	−52.4773		−5.32499	−16.0435	−9.4886	−21.7587	−12.8764	−0.00284
	[−2.01644]	[0.00738]	[0.31729]		[−0.52952]	[−2.23904]	[−1.90321]	[−1.99030]	[−1.05046]	[0.84563]
ΔRF	0.9840 **	24.87983	−0.606258	0.000922	-	0.125436	−0.147972	−0.7628 **	0.285113	−0.023671
	−0.44509	−27.656	−0.87117	−0.00413		−0.26634	−0.15752	−0.36121	−0.21376	−0.06071
	[2.21093]	[0.89962]	[−0.69591]	[0.22295]		[0.47097]	[−0.93939]	[−2.11198]	[1.33381]	[−0.38991]
$\Delta AGEM$	−0.7725 **	−8.316493	−0.414555	−0.003678	−0.11215 *	-	−0.019088	−0.024878	−0.3130 **	0.127361
	−0.3009	−18.6964	−0.58894	−0.00279	−0.05976		−0.10649	−0.24419	−0.14451	−0.18291
	[−2.56746]	[−0.44482]	[−0.70390]	[−1.31584]	[−1.87672]		[−0.17925]	[−0.10188]	[−2.16649]	[0.69631]
$\Delta AGEX$	1.1029 ***	20.59554	−0.352367	−0.003833	0.046908	−0.126814	-	−0.384318	0.5588 ***	−0.0018 **
	−0.27653	−17.182	−0.54124	−0.00257	−0.05492	−0.16547		−0.22441	−0.1328	−0.0008
	[3.98876]	[1.19867]	[−0.65104]	[−1.49236]	[0.85410]	[−0.76639]		[−1.71255]	[4.20845]	[−2.34679]
ΔCPI	−0.4204 **	1.019946	0.260197	0.000546	0.032469	0.075894	−0.058370	-	−0.17566 *	−0.143997
	−0.20845	−12.9521	−0.40799	−0.00194	−0.0414	−0.12473	−0.07377		−0.10011	−0.24807
	[−2.01697]	[0.07875]	[0.63775]	[0.28212]	[0.78428]	[0.60845]	[−0.79124]		[−1.75473]	[−0.58048]
$\Delta GDPPC$	−0.677956	63.05147	−0.172535	−0.000378	−0.697 ***	−0.9863 **	−0.895 ***	−1.495 ***	-	−0.001396
	−0.69949	−43.4628	−1.36908	−0.0065	−0.13892	−0.41856	−0.24755	−0.56766		−0.00108
	[−0.96922]	[1.45070]	[−0.12602]	[−0.05814]	[−5.01829]	[−2.35664]	[−3.61591]	[−2.63443]		[−1.28687]

***, **, * shows the significance level of coefficient between 1%, and 5%.

Appendix B

Figure A1. Country-wise FDI (US\$) inflows in Pakistan from 2001–2017 Source: State Bank of Pakistan (SBP).

Figure A2. Sector-wise FDI (US\$) inflows in Pakistan from 2001–2017 Source: State Bank of Pakistan (SBP).

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