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ECONOMY WIDE IMPACT OF ENERGY COMPONENT OF CHINA PAKISTAN ECONOMIC CORRIDOR (CPEC): A SUSTAINABLE DEVELOPMENT APPROACH

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Abstract: *THE LONGSTANDING RELATIONSHIP BETWEEN PAKISTAN AND CHINA HAS YIELDED SUBSTANTIAL BENEFITS, NOTABLY THROUGH THE CHINA-PAKISTAN ECONOMIC CORRIDOR (CPEC). THIS STUDY EVALUATES THE ECONOMIC IMPACT OF THE ENERGY INVESTMENTS WITHIN CPEC USING THE COMPUTABLE GENERAL EQUILIBRIUM (CGE) MODEL AND GTAP 9.0 DATA. FINDINGS REVEAL SIGNIFICANT POSITIVE EFFECTS ON PAKISTAN'S REAL GDP, MERCHANDISE EXPORTS, AND IMPORTS, WITH AN OVERALL INCREASE IN HOUSEHOLD INCOME AND EMPLOYMENT. THE COAL ENERGY PROJECTS ARE PROJECTED TO BOOST ECONOMIC GROWTH, REDUCE POVERTY, AND ENHANCE ENERGY ACCESSIBILITY. WHILE THE STUDY HAS LIMITATIONS, SUCH AS THE STATIC NATURE OF THE MODEL AND LIMITED FOCUS ON THE SERVICE SECTOR, IT UNDERSCORES THE TRANSFORMATIVE POTENTIAL OF CPEC'S ENERGY INVESTMENTS FOR PAKISTAN'S ECONOMY AND RECOMMENDS FURTHER DYNAMIC MODELING FOR COMPREHENSIVE INSIGHTS.*

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Keywords: CHINA-PAKISTAN ECONOMIC CORRIDOR, COMPUTABLE GENERAL EQUILIBRIUM, GROSS DOMESTIC PRODUCT, POVERTY, ENERGY.

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1. INTRODUCTION AND LITERATURE REVIEW

Relationships of Pakistan with China can be traced since 1950. The relationship always remained productive and fruitful except in first half of 1950s and 1970s due to confusions on some issues but both nations facilitated each other at critical times. Pakistan helped China to become permanent member of United Nation's Security Council.

Similarly, China assisted the country to build the infrastructure. Ordinance factory in East Pakistan and in Texila along with Aero-nautical complex Kamra are examples of such cooperation (Javaid & Jahangir, 2015).

During the difficult times especially of 1980s, 1990s and 2000s when USA imposed sanctions on Pakistan, China not only continued its support but increased it to every field of life. Although most of the cooperations and deals from China were kept secret to avoid criticism from other nations. Andrew Small (2015) called it"Cooperation in Shadows".

Foreign policy of China always paid special attention to Pakistan for future endeavors. China-Pakistan Economic Corridor (CPEC) is considered the most important example. Sincelong time (almost two decades) both nations were working on this concept. Both countries worked very hard for the smoothly implement the project. Joint declaration of 2003 and free trade agreement in 2006 aided to finalize the shape of this project and lift the trade. The trade volumewhich was $1 billion in 1998 reached to $15.15 billion in 2015 due to continuous mutual cooperation(Vandewalle, 2015).

Pakistan is always committed to greater regional connectivity and the newly conceived China Pakistan Economic Corridor (CPEC)is an example. Total investment of CPEC is $US46 billion. CPEC is often understood solely in terms of transportation infrastructure, but as Chinese President Xi Jinping explained (in 2015) that it's a "1+4" cooperation framework. The figure "1" stands for CPEC and the "4" represents the, energy, the industrial cooperation, the Gwadar Port and transport infrastructure. This study aims to calculate the economy wide outcomes of the energy investment component of PCEC by using GTAP data.

Pakistan is facing energy crises since long time and this short fall is resulting massive decline in real GDP and wellbeing of household (approximately 4-7%). Current per capita consumption of electricity in Pakistan is approximately 320kwh and only 65 per cent of the population are catered for. It means thirty-five percent population od Pakistanis is still away from this facility.This is the reason, the CPEC is considered as game changer due to its expanding investment in energy sector. It will not only increase the productivity (economic growth) but also the per capita income.

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1.1 Overview of Pakistan China Trade

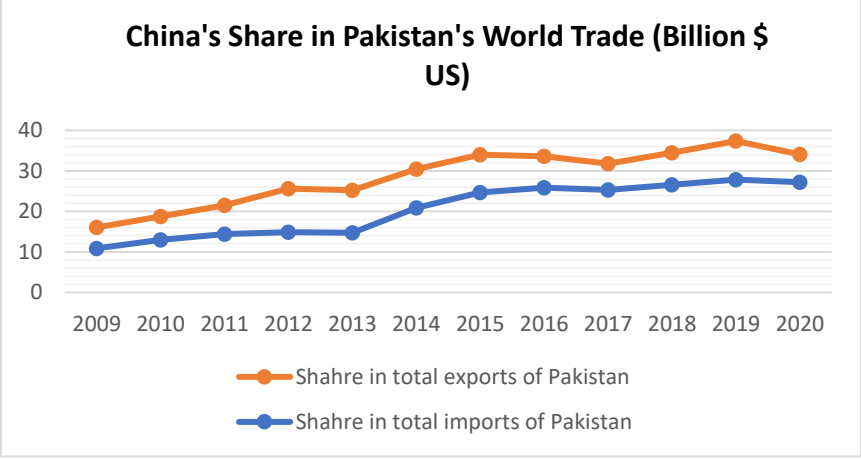
In January 2006, a program between China and Pakistan was initiated under the title "Early Harvest Program (EHP)" and at the end of same years a Free Trade Agreement (FTA) also started working. Trade volume in 2012 was $9.31 Billion(Government of Pakistan, 2018-19). Pakistan started enjoying duty free access for home textiles, tiles and sports and leather goods as well as industrial alcohol. On the other hand China is benefitting from the market access on the commodities involved in industrial growth (Khan J. , 2012).

High growth has primarily been in Cotton and its derivates (yard and Fabrics) and raw Material. Cereal exports also witnessed tremendous boom as its export growth has multiplied in 2012. All other major Pakistani exports during the last decade to China have grown except for Ores, Slag and Ash(Government of Pakistan, 2019).

Imports have grown up for Pakistan top five imported item from China as clearly shown in the figure. Although imports of manmade filaments get decreased during 2012. This is blessing in disguise for domestic textile industry that the import of manmade filaments has fallen(PBC, 2019).

Figure 1: Pakistan-China Trade

Figure 2: China's share in Pakistan's world Trade



Source: United Nation Commodity Trade Statistics Database

1.2 Objectives of the Study

The project is mainly aimed to investigate the impact of the energy investment component of PCEC on the economy of Pakistan. The study will specify the following objective:

1. Impact of Coal Energy Project under CPEC: Impact of proposed coal projects in CPEC on Pakistan economy.
2. Suggest policy recommendations to government of Pakistan for future plans.

The study intends to address the following five **Sustainable Development Goals**.
No poverty: The study will highlight the possible outcomes of the energy projects. The results will also calculate the increase in per capita income in Pakistan.
Zero Hunger: The increased per capita income due to different energy projects will reduce the hunger in the region.
Affordable and clean Energy: This is the primary objective of the project. It will highlight the importance of energy projects in Pakistan and especially the clean energy that is more affordable to household and industry.
Decent Work and Economic Growth: Around 35% population in Pakistan is living without electricity. The access to electricity will not only increase their per capita income but also help to live a sophisticated live.
Industry Innovation and Infrastructure: ensuring energy at affordable prices, will motivate the industry towards innovation and further industrial units.

2. METHODOLOGY

The global version of CGE model will be employed to obtain the results. A brief introduction and working of GTAP will be discussed in this section. The main idea of simulation was drawn from Khan (2015).

2.1 CGE Models

In order to calculate the complex relations of various sectors of the economy, it is believed that CGE models are best tool. With the help of behavioral equations these models help to interlink various sectors of the economy. The results of a policy reforms in the economy are shown numerically which helps to judge the possible outcomes (Savarad, 2003).
According to Winters et al., (2004) economic theory in not sufficient to provide the distributionary effects in numbers. For this purpose CGE models are best tool to calculate the effects of an economics reform on different sectors of the economy. These models are base on different behavioural equations that can be solved by using diggerent sotwares like GAMS and GEMPACK. (Ahmed & O' Donoghue , 2008) further explained that CGE models are based on the idea of neo classical where the household intends to optimise the resources and the purpose of the producer is to maximise the profit through cost minimization.
Shaik et al., (2012) discussed that the Computable General Equilibrium models are applicable widely in any economy and have the ability to calculate not only the direct effects but also the indirect effects of any economic policy matter. CGE models are designed to capture the impact of policies related to trade and then examine the impact of that policy on different sectors. The policies can be finalised after assesing the impact on different secotrs.
GTAP is the global version of CGE models which provides the data base for the global framework. The next section is explaing the working of GTAP briefly.

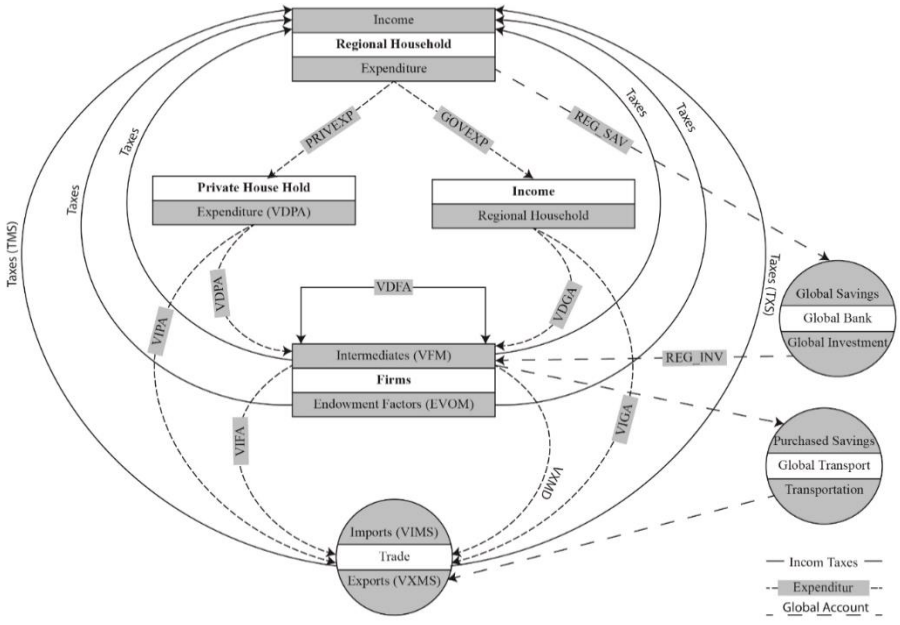
2.1.1 What is GTAP?

The study intends to use the GTAP 9.0 which is latest available in the market GTAP 9.0 with three base years i.e. 2004, 2007 and 2011. The study will analyse the results of the simulation by using the base year of 2011. The GTAP comprises of the different economic linkages i.e. trade linkages among different regions and different countries. It also provides details on the transportation and protection data. The GTAP model is multi-region and multi-sector be defaultaiming comparative static analysis of any policy reforms associated to trade (Francois & McDonald, 1996). The data base of GTAP is upgraded annually and available publicly.Moreover, the researchers are encouraged to use the data base regularly. Hertel & Reimer (2005)exposed that these models can be used for general equilibrium analysis because these are multi-sector and multi-region in nature.

The GTAP model aggregates the utility function and it contains representative regional household. The regional expenditures are distributed among government, private saving and consumption. The regional household offers its endowment to receive income. The firm along with intermediary goods received the household endowments to produce the final goods that are being demanded by the individuals. These goods are purchased by government as well as private household. The private household purchases capital goods for its saving. Hence it becomes a circular flow of goods and expenditures in a closed economy.

Two types of equations are used in the GTAP model. The first type deals with the accounting relationships of all receipts and expenditures related to all economic agent in an economy while the second type deals with optimizing agent` behavior.

Figure 3: Income and Expenditure Flows in GTAP Model



Source: Walmsley & Minor 2013; Based on Brockmeier 2001.

The global bank and transport sectors are included in an open economy. The global saving and regional investment are linked to global bank sector that ultimately consider the activities of trade and transportation. Figure 5 briefly explained the working of GTAP.

2.2 Simulation Design

The exogenous variable is modified to calculate a change in the trade policy. The study is based on only one simulation.

S: Impact of Coal Energy Project under CPEC: Impact of proposed coal projects in China-Pak Economic Corridor on the economy of Pakistan.

3. RESULTS AND DISCUSSION

The results of the simulation will be discussed in this section

3.1 Macro level Impact

It is understood that availability of resources leads to increase in exports if these resources are used efficiently. It means that it will help the economy to increase the real GDP and hence economic growth. The results of the simulation for macroeconomic indicators is explained Table 1 with base year 2011-12. The changes in real GDP, Equivalence Variation (EV) and Terms ofTrade (TOT) and explained according to the base year. All the variables are showing positive changes.

Table 1: Change in Real GDP (Base year 2011)

Real GDP (US$ million)				**Equivalent Variation**	**Change in TOT**
Base year Value	**SimulationImpact**	**Change in Real GDP**	**Percentage**	**Change**	**Percentage**
213686.2	218773.19	5087.33	2.38	5831.43	0.02

"Source: Author's simulation results using GTAP 09 program"

The results presented in the table 1 showed positive changes in the real GDP of Pakistan which means that real output will be increased by 2.38% due to coal energy projects. This means that increase output will leads to increased employment level and decrease in poverty within Pakistan.
The study used the values of equivalence variation and terms of trade in order to obtain the welfare effects of the policy option. The equivalence variation calculates the value of income that an economy would gain or loose after a policy option. The purpose of any economic policy is to gain the income which means positive value of EV (Brown et al., 2005 and Siriwardana, 2006, 2007). The results show a encouraging change in the vaules of EV for pakistan economy which means that country`s income will be increased.

The values of Terms of Trade reprents the ratio of value of money that an economy gets for its exports and pays for its imports. Positive value of TOT means that the economy is getting benefits for the policy option in terms of net exports. The values presented in table 1 show a positive change in the TOT which means that pakistan will gain income in terms of net exports due to coal energy projects.

The results presented in the table are not different from the previous studies. It means that it is not an easy job for any economy to progress without the growth in energy sector. The shortfall of energy will never let an economy to grow faster. The growth of energy sector will difinatly help the economy to

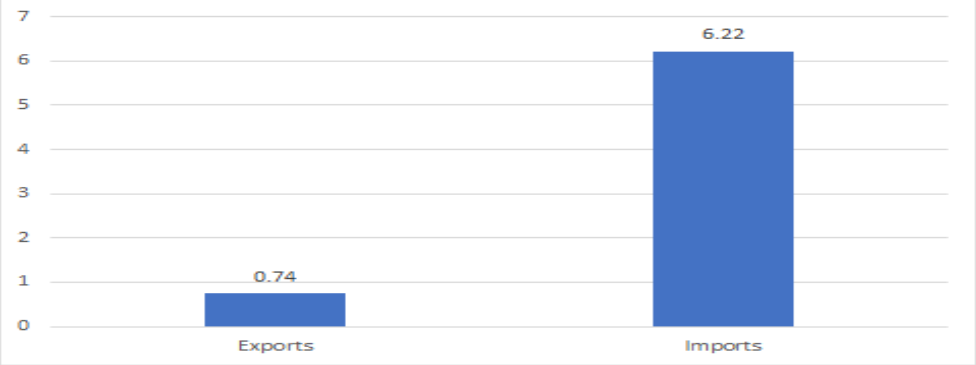
increase productivy and hence export. The increase demnd for exports may also put a prseeur on domestic prices and imports of similar commodities may also rise. This also that imports of capital goods will also increase. The above argument was also supported by (Esfahani, 1991) and (Senguptaa & Espanab, 1994). Similarly (Ekanayake, 1999), (Jung & Marshall, 1985) and(Feasel, Kim, & Smith, 2001) examined the same results.

3.2 Changes Traded Goods of Pakistan

Economic growth is not possible without a balance trade. Exports are payments that foreigners made on domestic goods and services while imports are opposite. Every economy tries to maximize the exports in order to gain maximum foreign income (Mankiw, 2007).

It is believed that exports and imports of Pakistan will be increased after the successful completion of the coal energy projects. The increase in import is more than an increase in the exports. It is because after the energy crises, more production will start that would require more inputs. These inputs will be imported from other countries.

Figure 4: Percentage change in Merchandise Exports and Imports



"Source: Author`s simulation results using GTAP 09 program"

The effects of these energy projects can be sector wide in the economy. The results projected an encouraging change in the out of different goods along with need for more imported goods to be used as inputs. Similarly, imports will also increase due to this project and output of domestic goods may deteriorate due to availability of imported goods at economical prices. The impact of this policy option is not smooth on all sectors, but it is different for different sectors of the economy.

Table 2: Commodity wise imports and exports

Commodities	Exports	Imports
Grains and Crops	-8.72	9.45
Vegetable and Fruit	-3.33	4.43
Meat Stock	-19.44	11.44
Extraction	-5.12	5.55
Processed Food	-10.43	8.18
Leather	-20.59	14.2
Wearing Apparel	10	10.7
Textile	10	9.33
Light Manufacture	-8.32	7.8

Heavy Manfufacture	-0.16	4.73

"Source: Author's simulation results using GTAP 09 program"

Tables 2 explains the changes in exports and imports of Pakistan after completion of energy projects related to coal. The table explains that apparel and textile sectors will get the maximum benefit from this opportunity while rest of the sectors may face decline in out put. The maximum deterioration is seen in the leather sector which is because leather sector is comparatively less affected by the energy crises. Moreover, the leather sector is already declining due to worldwide changing demands.

3.3 Change in household and Factor Income

Payment to factors of production is very important for the progress of an economy. All the inputs are required to be compensated at reasonable rate. Labor force whether technical or non-technical are considered more important than other factors but obviously the other factors also require maximum compensation.

Table 3: Percentage change in Factor Income

Factor	**Percentage Change**
Land	1.89
Technical Staff	3.04
Clerks	3.13
Services Shops	3.13
Office Managers	3.04
Agriculture workers	3.13
Capital	2.79

"Source: Author's simulation results using GTAP 09 program"

Table 3 represents the percentage change in the income of different factors that are used in the production process. The results of the simulation show a positive change in the income of factors of production. The minimum gain is shown in the case of land that is because the rent to land is not as much affected with the energy crises so after the installation of coal plants, land would be least beneficiary in terms of rise in income.

The study has categories the household into 17 categories according to the Social Accounting Matrix (SAM). The results of the simulation show a positive change in all types of household. The details of household categories and percentage change in their income is represented in table 4. This increase in household income means reduction in poverty in Pakistan and improvement in the distribution of household income. There is an average increase of household income by 3.01 percent.

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Table 4: Changes in Household income (Percentage Change)

Household Code	Household Description	Change in Income
MainHHLD	Average HH Income	3.01
hhd_rs1	Rural Small Farmer (quartile 1)	1.81
hhd_rs234	Rural Small Farmer (quartile 234)	2.12
hhd_rm1	Rural Medium + Farmer (quartile 1)	0.78
hhd_rm234	Rural Medium + Farmer (quartile 234)	2.19
hhd_rl1	Rural Landless Farmer (quartile 1)	1.68
hhd_rl234	Rural Landless Farmer (quartile 234)	2.16
hhd_rw1	Rural Farm worker (quartile 1)	1.97
hhd_rw234	Rural Farm worker (quartile 234)	2.46
hhd_rn1	Rural non-farm (quartile 1)	2.65
hhd_rn2	Rural non-farm (quartile 2)	2.83
hhd_rn3	Rural non-farm (quartile 3)	2.96
hhd_rn4	Rural non-farm (quartile 4)	3.16
hhd_u1	Urban (quartile 1)	2.93
hhd_u2	Urban (quartile 2)	3.11
hhd_u3	Urban (quartile 3)	3.31
hhd_u4	Urban (quartile 4)	3.42

"Source: Author's simulation results using GTAP 09 program"

4. CONCLUDING OBSERVATIONS

The study employed the GTAP model to observe the effects of the coal energy projects of Pakistan under CPEC.The study designed a simulation to calculate the sector wise impact of coal energy project in Pakistan.

The results of the simulation conclude a general rise in the real GDP of Pakistan. Due to this project. The results of the simulation show an increase in the real GDP merchandise exports and merchandise imports. Similarly, positive change in the values of equivalence variationand terms of trade can be seen.

5. LIMITATIONS AND POLICY RECOMMENDATIONS

Like any other study, this study also has some limitations. The model used in this study is of static nature and by using dynamic model, the results can be more accurate and purposeful. Moreover,

service sector is not given more space in these models. Besides the limitations, these models are very useful to calculate the possible effects of any economic policy.

The model developed for this study provided reliable implications for Pakistan that can be used to clarify the recent discussion about the CPEC effects on production, exports and household income. The study with MyGTAP (Using SAM) can be used for assessing the benefits of this policy for individual household. Similarly, a regional GTAP with dynamic characteristics can also be developed for better results.

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