

# Pakistan's Infrastructure Investment and Returns. Evidence of Increasing Pakistani Governmental Dependence on Chinese Investment since the Launch of the Belt and Road Initiative.

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## **Abstract**

This paper analyzes the extent to which the China-Pakistan Economic Corridor affects Pakistan's economic outcomes and gives insight into whether some of the conclusions of the World Bank's Report on China's Belt and Road Initiative in regard to unrealized economic gains but also the existence of potentially unsustainable debt in partner countries are valid. At the center of the paper is a measurement of Pakistan's economy in relation to China before and after the start of the China-Pakistan Economic Corridor as part of the Belt and Road Initiative that was initiated in 2013. Through the indicators of foreign direct investment, gross domestic product, net exports, and national debt, and freight railways earnings. Using multiple regression analysis and data from CEIC, it concludes that the findings of the World Bank appear to exist at the government to government country-level. This paper does not however consider the impacts of the infrastructure investments in the Pakistani private sector.

## **Keywords**

Belt and Road Initiative, China-Pakistan Economic Corridor, foreign direct investment, government debt, trade deficit.

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# **1 Introduction**

## **1.1 The Belt and Road Initiative Background**

In 2013, Chinese President Xi Jinping announced that China would begin an initiative for a new ‘Silk Road Economic Belt’ that would reestablish strong economic ties with Central Asian countries in the vein of the historical Silk Road (Ministry of Foreign Affairs, 2013). Since then, the project has continued to broaden in scope to include partnerships with other countries outside of Central Asia, and has since been dubbed the Belt and Road Initiative (BRI). The goal of the initiative is to create a more interconnected network of trade routes with partner countries via over half a trillion dollars in funding of various types of infrastructure projects over the course of decades (Ruta et al., 2019). Given the long term nature of this initiative, many of the announced partner countries have yet to see substantial progress made towards large infrastructure projects being co-financed with China. However, the goal of this paper is to narrow the scope down to one partner country, Pakistan, and examine the way it is indicative of the countries’ relationships towards the BRI in general. The purpose of this task is to extrapolate on the conclusions of the comprehensive 2019 World Bank Report: “Belt and Road Economies: Opportunities and Risks of Transport Corridors,” which evaluates the regional consequences and opportunities of China’s Belt and Initiative for partner countries across the world, but whose own scope states: “The study looks at the Belt and Road Initiative as a whole and does not provide cost-benefit analysis for individual corridors or projects. Since it focuses on connectivity and economics, it does not analyze energy infrastructure issues or geopolitical considerations” (Ruta et al., 2019). The selection of Pakistan as a case study for BRI stems from Pakistan’s physical proximity to China and the announcement of China-Pakistan Economic Corridor (CPEC) (Stevens, 2015), which is US\$62bn series of projects in Pakistan to modernize the port, road, and rail infrastructure, and is also one of the cornerstones of the Belt and Road Initiative (The Economist Intelligence Unit, 2017). Using the CPEC, this paper seeks to first establish the relationship between BRI & CPEC and the growing investment and trade in and with Pakistan by China respectively.

## 1.2 Pakistan's Economy Background

Pakistan, the world's fifth most populous country, currently ranks somewhere between 43rd and 47th in terms of largest economies in the world by GDP (nominal). This puts a country like Finland, which has around 1/40 the population of Pakistan as a larger economy in nominal terms. Therefore, it can be easily concluded that in per capita terms Pakistan's GDP per capita remains low as illustrated in Figure 1 below:

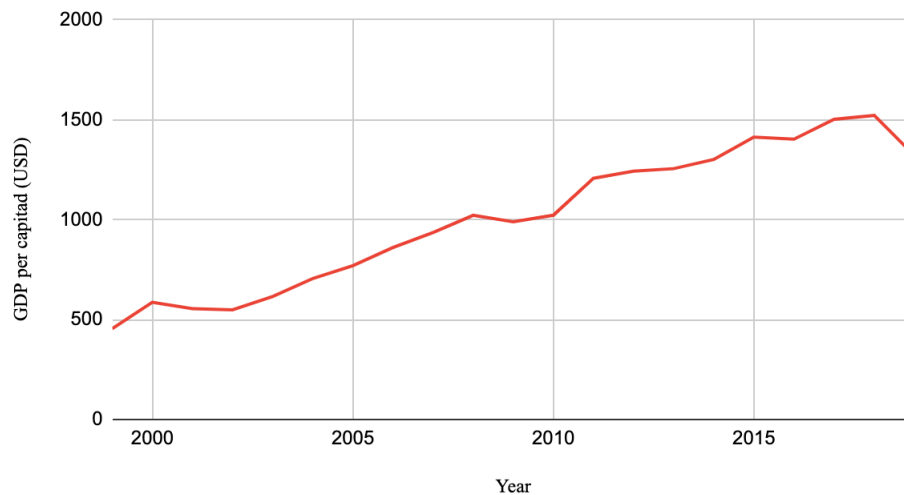


Figure 1: Pakistan - GDP per capita (USD) versus Year (1999-2019)

*Note: This graph uses CEIC data and measures Pakistan's GDP per capita in United States Dollars over 20 years (Source: CEIC Database).*

Likewise from the graph above, it shows that Pakistan's economy experiences multiple frequent recessions (2000-2002; 2008-2010; 2015-2016; 2018-2019) as indicated by the downward sloping parts of the line. Moreover, when examining Pakistan's inflation rate, it demonstrates that concurrently with the low GDP per capita, and high number of recessions, Pakistan's inflation is an indicator of how stable the country's currency is as shown in Figure 2:

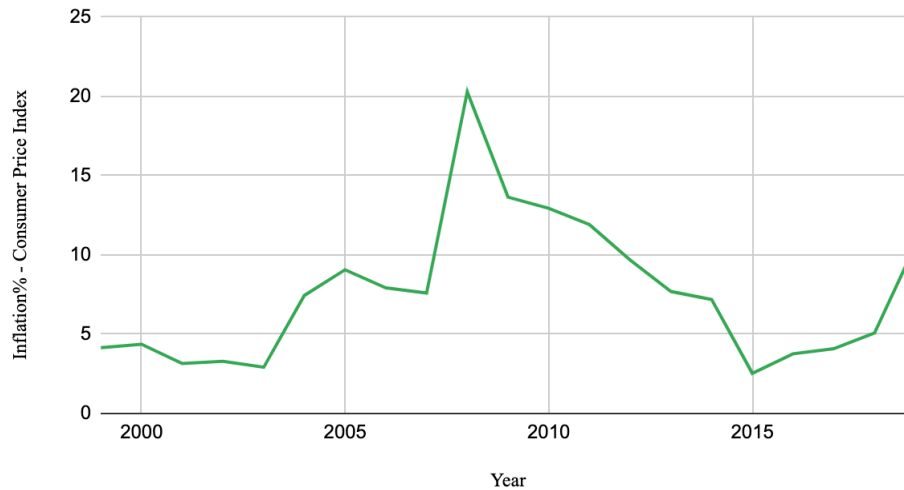


Figure 2: Pakistan - Inflation% (Consumer Price Index) versus Year (1999-2019)

*Note: This graph uses CEIC data and measures Pakistan's inflation rate in Pakistani rupee over 20 years (Source: CEIC Database).*

From here it can be seen that Pakistan's yearly inflation rate is well above around 2% which would be average for a developed country like the United States or Japan. In fact, from Figure 2, inflation even peaked at around 20% in 2008 indicating a short period of hyperinflation. This indicates, in conjunction with the low GDP per capita and multiple recessions in 20 years, that the macroeconomic stability of Pakistan has remained relatively weak over the past two decades.

### 1.3 China and Pakistan's Growing Trade Relationship

In order to give context to the models that will be discussed in the next section, it is important to understand the political context behind Pakistan and China's trade and investment relationship. Prior to the 21st century, China and Pakistan did not foster a significant investment relationship. Despite being geographical neighbors and China growing into becoming the second largest economy in the world, China invested very lightly in Pakistan. However, three key events are important to understanding the current Sino-Pakistani investment and trade relationship. The first event was the China Pakistan Free Trade Agreement of 2006 (Ministry of Commerce of the People's Republic of China, 2006), which began to see significant Foreign Direct Investment (FDI) from China inflow into Pakistan. The next key event was the launch of the Belt and Road Initiative in 2013, in which China's FDI began to grow exponentially. However, the third key event was the scaling back of BRI under Imran Khan after he ascended to the prime ministership

of Pakistan in 2018 (The Economic Times, 2018). All of these key dates (plus a few month lag) is clearly shown on Figure 3 below:

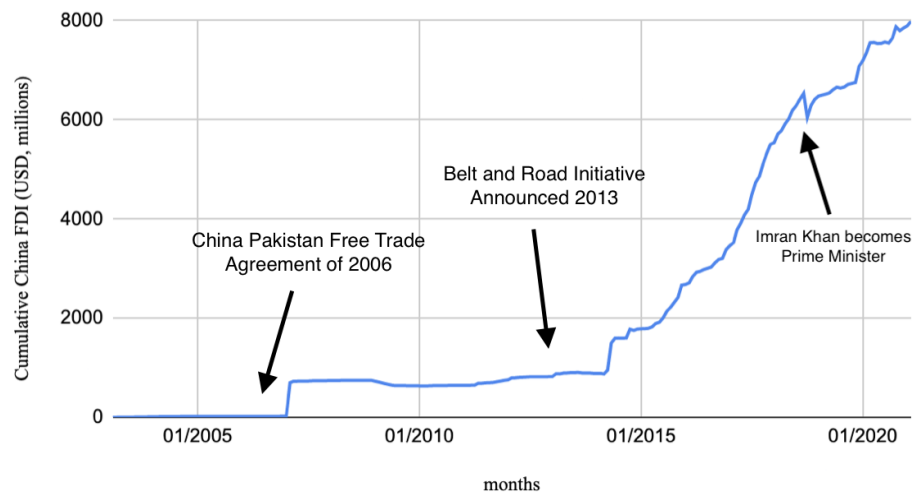


Figure 3: Pakistan - Cumulative China FDI (USD, millions) versus months

*Note: This graph uses CEIC data and measures China's inflow of Foreign Direct Investment into Pakistan while also highlighting key dates in Pakistan's history that affect this relationship between China and Pakistan, notice the 4-6 month lag of effect after a policy announcement (Source: CEIC Database).*

Here it is quite easily visualized the impact of these three policy announcements and gives insight into one of the indicators that will be measured to assess China's economic influence in Pakistan: Foreign Direct Investment.

Another indicator that is indicative of China's growing involvement in Pakistan's economy is the Pakistani trade deficit to China. While Pakistan operated a mild trade deficit with China (the value of Pakistani exports to China minus the value of Chinese imports to Pakistan) since the early 2000s, it has since grown significantly since the beginning of the CPEC as part of BRI. This is illustrated in Figure 4 below:

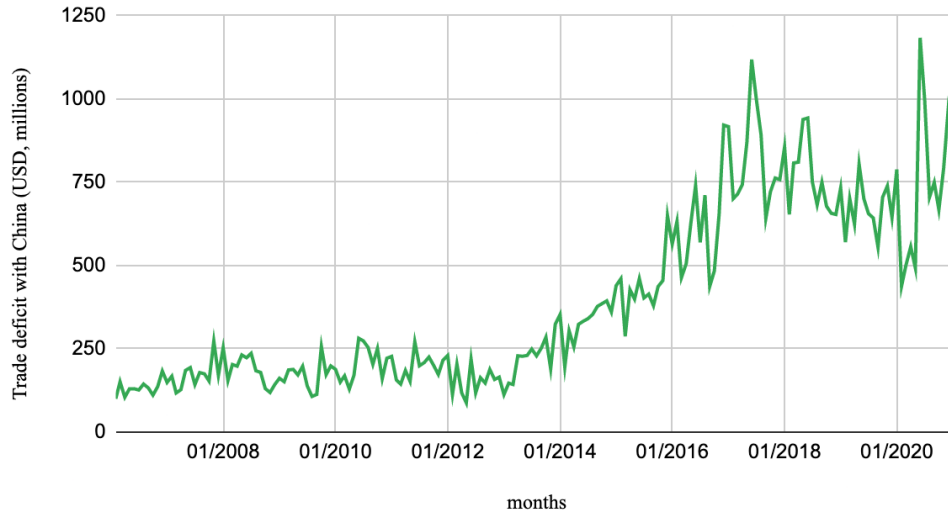


Figure 4: Pakistan - Trade Deficit with China (USD, millions) versus months

*Note: This graph uses CEIC data and measures the value of Pakistani exports to China minus the value of Chinese imports to Pakistan which has grown significantly in absolute terms from 2013 onward (Source: CEIC Database).*

While it is harder to pinpoint an exact moment where the deficit begins to grow in absolute terms, it is discernible that the deficit grows larger on average beginning in 2013 around the announcement of BRI. Moreover, this is the monthly trade deficit for Pakistan. Therefore, the cumulative deficit has grown even more significantly as each monthly deficit compounds onto each other. This highlights the importance of trade deficits towards understanding the impact of CPEC and BRI in general, and partially explains the rationale behind choosing the trade deficit as an indicator as well, which will be extrapolated on in the following section.

## 1.4 Data Models Introduction

### 1.4.1 Indicators Background

At the centerpiece of the paper is an analysis of how the previously discussed China's foreign direct investment is tied to the increasing economic ties between the two countries over time. Moreover, this relationship to external debt, trade deficits, and freight rail earnings highlights the importance of China's FDI on Pakistan's economic outlook, with the intended goal to validate the assertion made in the World Bank Report, "The analysis shows that Belt and Road transport corridors could substantially improve trade, foreign investment, and living conditions for citizens in participating countries—but only if China and corridor economies adopt deeper

policy reforms that increase transparency, expand trade, improve debt sustainability, and mitigate environmental, social, and corruption risks” (2). By using said foreign direct investment, trade deficits, and freight earnings, and Pakistani external debt, it can be tested whether foreign direct investment, debt sustainability, expanded trade, and improved transport can be tested.

Furthermore, the selection of freight rail earnings over other measurements is chosen, both because of available data on CEIC as well as the World Bank claims that, “The Russian Federation, Kazakhstan, Ukraine, the Slovak Republic, and the Czech Republic form a corridor of relatively good rail infrastructure, while most Southeast Asian countries and the countries southwest of China, such as the Kyrgyz Republic and Pakistan, are perceived as having some of the lower quality rail infrastructure” (2). This highlights the rationale behind the key the aforementioned indicators that will be tested in four separate models introduced below.

#### **1.4.2 Model 1 Introduction**

The first of these models tests Pakistan’s total FDI inflow from all countries against China’s portion of the FDI inflow over time. Using a simple ordinary least squares (OLS) linear regression, the results find that China has become an increasingly larger percentage of Pakistan FDI inflow over time, indicating that China is contributing a plurality of the public investment into Pakistan, in line with the conclusions of the significance of BRI from the World Bank Report.

#### **1.4.3 Model 2 Introduction**

The second of these models uses OLS multivariable regression of Pakistan’s cumulative trade deficit and time to estimate China’s FDI. To a high degree of correlation, the results find that Pakistan’s growing cumulative trade deficit correlates to an increase in China’s FDI inflow into Pakistan with time. Surprisingly, this result is actually in contrast to the initial model setup and hypothesis that China’s FDI inflow correlates to an increase in Pakistan's growing cumulative trade deficit with time. Due to a high p-value a null hypothesis in this second scenario could not be rejected with high certainty like in the first scenario. The results of these two separate hypotheses suggests that the trade deficit may be driving the investment, rather than

the other way around. Moreover, it also suggests that there is a possibility that unsustainable trade deficits increases investment perpetuating the deficits further. Highlighting a potential concern about debt sustainability in BRI from the World Bank Report quoted before.

#### **1.4.4 Model 3 Introduction**

The third of these models also uses OLS multivariable regression of Pakistan's External Debt and time to estimate China's FDI inflow into Pakistan. This tested hypothesis estimates a higher correlation value China's FDI inflow into Pakistan than cumulative trade deficits with time does. This result suggests that Pakistani external debt to China is a better predictor of FDI inflows than trade deficits are with time. Moreover, when building several alternative hypotheses consisting of FDI, trade deficits, external debt, and time. The results suggest that external debt and trade deficits could not be regressed together as estimators for FDI because they broke the OLS assumption of no linear dependence between input variables. However, this does help give insight into the setup of the fourth model.

#### **1.4.5 Model 4 Introduction**

The fourth, and final, of these models also uses OLS multivariable to estimate the impact of China's FDI on freight rail earnings, a central improvement goal of CPEC as mentioned above in the World Bank Report conclusions. Using FDI, freight rail distance in Pakistan, and time to estimate the national freight rail earnings for Pakistan, the results suggest that China's FDI inflow into Pakistan correlates strongly with not just more freight rail distance growth but also higher freight rail earning per distance. Likewise since both cumulative trade deficits and external debt are from models 2 and 3 are estimators and potential derivatives of FDI, it can be seen how growing debt to China may result in better freight earnings for Pakistan. This brings up again one of the central claims of the World Bank Report that BRI can foster trade development but at the expense of growing debt to China. However, the limitations of this conclusion will be explained in the next section.



## 1.5 Limitations and Rationale

There are several limitations of this paper that are pertinent to furthering the research on the topic the Belt and Road Initiative and the China-Pakistan Economic Corridor. First, the aforementioned indicators above mostly only predict intergovernmental financing. Any data from Pakistani or Chinese companies and/or any other private sector data are left out of the scope of the analysis. This leaves the private sector as a potential avenue for further research into this topic. Moreover, examining the trade and investment relationships for either other BRI partner countries, or individual projects in Pakistan like the Ganwar Port are left open for future analysis. As for the data used in this paper, it does all come from one centralized source, the CEIC, making the number of observations consistent across variables in each model. However, any sort of panel regression analysis is left out due to some simplifying assumptions based on linearity of the graphed data as well as the chosen variables being separated. One could attempt to do a panel regression analysis of all the indicators, such as FDI, trade deficits, external debt, GDP, freight earnings etc. but the goal of this paper is to confirm that already visual relationships from the graph, as well as the key political dates affecting the data, that were explained previously in the introduction. Furthermore, the rationale for pursuing this topic, and why there are a lot of avenues to further analyze this data and study this topic, is due to the surprisingly limited non-political science literature surrounding the Belt and Road Initiative outside of the World Bank Report, even though the project is now approaching 8 years since its announcement. A further explanation of this circumstance will be explained in more detail in the following section.

## 2 Literature

In the field of political science, some of most preliminary research on this topic of trade and government stability stems from Ian Bremmer's *The J Curve: A New Way to Understand Why Nations Rise and Fall* (Bremmer, 2006). The central model of the book is the analytical framework of the J Curve model itself; in which he defines the x-axis as "openness" (freedom, trade, etc.) and the y-axis as "stability" (government, society, etc.). The referenced 'J' shape of the curve suggests that free and open societies like the United States and European Union experience high stability as well as closed regimes like Maoist China and Cuba. Those countries that transition from one to the other, like Soviet Union states, experience decreases in stability

during the transition. Economic baseline in resources also affect shifts in the curve so a resource rich country can have higher stability at any point on the curve than a lower one. This is one of the most intuitive and straightforward models behind this research question, but it lacks the depth of a true economic problem model as it is mainly a political model.

Beyond Bremmer's book, after searching through several databases and journals, there is disappointingly very little written about China's Belt and Road Initiative in the realm of economic models, despite being launched 8 years ago. In terms of theory, Bhavna and Kobayashi (2018) discuss the alarming financing structure of the Belt and Road Initiative in lower-income countries as predatory in nature by China, offering massive infrastructure projects for bad credit rating areas. However, the paper does not go into a model made of linear regression, and only applies a contextual backdrop for the issue. Moreover, similarly lacking a central regression model, Melecky et al. (2018) discuss that the China-Pakistan Economic Corridor should center on improving individual lives over just decreasing trade costs. Likewise, and perhaps the most comprehensive of the research done is by Ruta, et al. (2019) who investigate the long term economics and political reasons for the Belt and Road Initiative as well as its detailed prospects. These included the unrealized investments in more politically unstable countries due to conservative risk averse investments, to the growing labor and resource markets in Asia and Africa, as well as addressing the long term positive policy goals of China's Initiative in partner countries. This baseline information from the World Bank will be a great foundation for understanding what are the country specific aspirations of the Belt and Road Initiative that can help underline a future theoretical model of trade, debt, railways and foreign direct investment. The World Bank report does a comprehensive review of the Belt and Road Initiative but does not go into country specific projects, this allows for this paper to forward the economic research of this topic at a country specific level by examining Pakistan's role in the Belt and Road Initiative via the China-Pakistan Economic Corridor.

## **3 Data**

### **3.1 Data Sources**

The singular data set used for this paper is from CEIC, which sources its data directly from the International Monetary Fund, The World Bank, and Pakistani Government Economic

Data from 2007-2020 accounting for roughly 6 years of pre. and post-BRI announcement data (2013). Likewise, much of the data used for these regression analyses are on a monthly basis, this gives more statistical information to cover a 14 year period than would be otherwise available at an annual interval basis, increasing the sample size from 15 to 97.

## **3.2 General Assumptions and Exclusions**

As mentioned in the introduction, these models exclude private sector activity on a company by company basis, and only seek to explain the relationship between intergovernmental public sector financing. The models use current United States dollars to minimize the impact of inflation on the results, compared to relatively higher inflation of Pakistani rupee outlined in the introduction. Moreover, the goal of these models is to show that some of the general assertions made at a regional level about the Belt and Road Initiative by the World Bank Report hold true at the country level in Pakistan, this does not confirm or deny these other assertions for other countries' contexts.

## **3.3 Methodology and Model Background**

Ordinary Least Squares (OLS) regression models were chosen to conduct these four analyses. The rationale behind this choice lies upon a few key assumptions. The first assumption is that the relationships between variables would be linear. Having graphed these variables before building the models, this assumption appeared to hold. The second assumption is that there is no multicollinearity; this was also accounted for when swapping estimators and estimates in alternative hypotheses that failed. The third assumption is there is no homoscedasticity and autocorrelation due to the shape of individually graphed variables, and the fact that no regression consists of more than three independent variables. A panel regression model would be more appropriate of an option if the goal was to examine the relationship between all variables at one time, but because each model here serves a separate explanatory function for the World Bank Report, a panel regression model was not selected.

### 3.4 Indicators Selection

The following indicators were selected from CEIC's database for linear regression on the given bases:

#### 3.4.1 Time (months; years)

Models 1-3: *time (months)*, due to the sequential nature of the Belt and Road Initiative announcement in the middle of the data set, time was selected as an independent variable in the linear regression to help explain the estimates in Models 1, 2, and 3 as a function of time.

Model 4: *time (years)*, due to the less available data for freight distance and freight earnings in Pakistan, only an annualized version of the data could be used instead of the monthly basis in the previous three models.

#### 3.4.2 Pakistan Foreign Direct Investment: Inflow - China (% of total)

Model 1: *Pakistan Foreign Direct Investment: Inflow - China (% of total)*, in order to measure the impact China has on controlling investment in Pakistan, this indicator was chosen to be regressed, as it is indicative of whether Pakistan is becoming increasingly reliant on Chinese foreign direct investment in comparison to the total foreign direct investment from all countries.

#### 3.4.3 Pakistan Foreign Direct Investment: China (USD, millions)

Models 2-3: *Pakistan Foreign Direct Investment: China (USD, millions)* was chosen for models 2 and 3 because unlike the indicator in 3.4.2, this indicator isolates the Chinese only FDI into Pakistan and puts it into numerical terms. USD, millions was chosen instead of Pakistani rupee both for consistency and more familiarity with an international readership. Likewise, FDI is one the most rigid ways to measure direct investment between countries, and as such would estimate the effects of BRI rather effectively.

#### 3.4.4 Pakistan Cumulative Trade Deficit to China (USD, millions)

Model 2: *Pakistan Cumulative Trade Deficit to China (USD, millions)*; the cumulative trade deficit to China was chosen over either just exports or imports as a way to measure the

imbalance of trade as imports from China in Pakistan are much greater in value than exports to China. Likewise, the original CEIC data was in the monthly deficit form. It was therefore augmented via a sum function into a cumulative form to better represent a linear growth relationship in model 2.

### **3.4.5 Pakistan External Debt - China (USD, millions)**

Model 3: *Pakistan External Debt - China (USD, millions)*; Pakistani external debt was also chosen to form an alternative hypothesis to 3.4.4 for estimating China's FDI as external debt is not as limited as trade deficits, as it accounts for all wealth held in a foreign currency/outside the country. It was therefore important to regress this variable against FDI as well to see if it is a good estimator for the influence and perhaps unsustainability of BRI investment strategies.

### **3.4.6 Pakistan: Annual Freight km (millions)**

Model 4: *Pakistan: Annual Freight km (millions)*, because CPEC is one of the most central projects of BRI, and because it focuses on physical infrastructure like rail, roads and shipping. Pakistani annual freight km was chosen both because of its relation to CPEC and because it offered the most consistent data out of the other listed infrastructure indicators in CEIC's database.

### **3.4.7 Pakistan Freight Gross Earnings (USD, millions)**

Model 4: *Pakistan Freight Gross Earnings (USD, millions)*; like the indicator in 3.4.6, Pakistan freight gross earnings was chosen as an indicator in accordance with freight km to see if the earnings/km ratio increased, decreased, or stayed the same in a regression model. If it increased, this would suggest that not only is more freight rail being built (3.4.6) but also it is being used more efficiently, demonstrating one of the central goals of BRI: lowering freight costs while expanding trade.

## 4 Results

### 4.1 Model 1:

#### 4.1.1 Equation 1:

$$\hat{Y}_i = \beta_0 + \beta_1 x_i + \varepsilon_i$$

$$\hat{Y}_i = \text{fdi (China's \% of total)}; \quad x_i = \text{time (months)}; \quad \varepsilon_i = \text{error term}$$

Here we can see that the time is being used to estimate China's inflow of Foreign Direct Investment (FDI) into Pakistan via a linear estimation.

#### 4.1.2 Variable Summary Table 1:

$\hat{Y}_i = \text{fdi (China's \% of total)}$				Number of observations = 97		
$x_i = \text{time (months)}$				F(1, 95) = 16.36		
$\varepsilon_i = \text{error term}$				Probability > F = 0.0001		
				$R^2 = 0.1471$		
				Adjusted $R^2 = 0.1381$		
				Root MSE = 20.21		
Variable	Coefficient	Std. Err.	t	P >  t	[95% Confidence Intervals]	
time	0.0097474	0.0024081	4.05	0.000	0.0049667	0.014528
constant	-174.8491	49.73643	-3.52	0.001	-273.5884	-76.10981

Note: Table 1 - time = time (months); constant = y-intercept (Source: CEIC Database).

### 4.1.3 Figure 5:

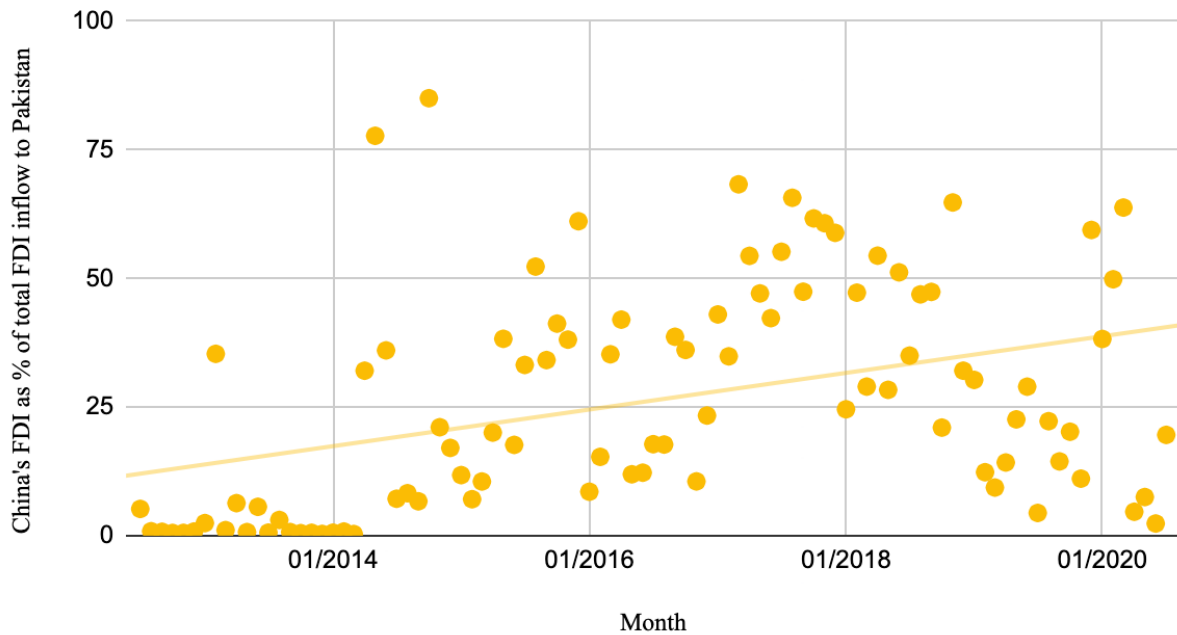


Figure 5: Foreign Direct Investment: Inflow: China as % of Direct Investment: Inflow (Total) versus months.

*Note: This figure plots the relationship between China's FDI inflow into Pakistan as % of total FDI inflow into Pakistan represented in Model 1 (Source: CEIC Database).*

### 4.1.4 Model 1 Results

Using this linear regression model and Figure 5, it can be seen that there is a mild correlation of statistical significance between FDI from China and its growth as a total share of Pakistan's total FDI inflow, indicating an increasingly reliant relationship between Pakistan and China for foreign direct investment into Pakistan. Moreover, given the p-value is not greater than 0.5, as well as the confidence intervals for time not containing zero, it can be concluded that the null hypothesis can be rejected. This shows that the correlation between China's FDI inflow as a percent of total FDI inflow into Pakistan does increase mildly over time with reasonable certainty. However, given  $R^2 = 0.1471$ , and 0.0097474 as the time coefficient -  $\beta_1$ , this is only a mild trend.

## 4.2 Model 2:

### 4.2.1 Equation 2:

$$\hat{Y}_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \varepsilon_i$$

$\hat{Y}_i$  = FDI (USD, millions);  $x_{i1}$  = time (months);  $x_{i2}$  = Cum. Trade Def. (USD, millions);  
 $\varepsilon_i$  = error term

### 4.2.2 Variable Summary Table 2:

$\hat{Y}_i$ = FDI (USD, millions)	Number of observations = 97					
$x_{i1}$ = time (months)	F(2, 94) = 2875.16					
$x_{i2}$ = Cum. Trade Def. (USD, millions)	Probability > F = 0.0000					
$\varepsilon_i$ = error term	R <sup>2</sup> = 0.9839					
	Adjusted R <sup>2</sup> = 0.9836					
	Root MSE = 374.12					
Variable	Coefficient	Std. Err.	t	P >  t	[95% Confidence Intervals]	
time	2.53187	0.1249496	20.26	0.000	2.283779	2.77996
CTD	0.0012808	0.0001794	7.14	0.000	0.0009247	0.001637
constant	-409303.64	2484.239	-19.85	0.000	-54236.15	-44371.12

Note: Table 2 - Where time = time (months); CTD = Cumulative Trade Deficit (USD, millions); constant = y-intercept (Source: CEIC Database).

### 4.2.3 Model 2 Results

Looking at the results of Model 2 in Table 2, the R<sup>2</sup> = 0.9839, produces a very strong and compelling correlation between cumulative trade deficits to China and time as estimators for China's foreign direct investment into Pakistan. Moreover, the confidence intervals for time and



trade deficits both exclude zero. Likewise, when an alternative hypothesis was tested first, given by the equation below:

$$\hat{Y}_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \varepsilon_i$$

$\hat{Y}_i$  = Cum. Trade Def. (USD, millions);  $x_{i1}$  = time (months);  $x_{i2}$  = FDI (USD, millions);  
 $\varepsilon_i$  = error term

The regression model produced a lower  $R^2$  of 0.9175, still statistically significant, but also higher p-values for time (0.04). This suggested that the current model hypothesis should also be tested, of which produced the higher  $R^2$  of 0.9839, indicating that the reverse relationship (trade deficits and time estimating FDI) had more statistical significance. Furthermore, with the estimate of  $\beta_2 = 0.00128$ , there is a mild increasing relationship between trade deficits and FDI with time, as time's coefficient is also positive.

### 4.3 Model 3:

#### 4.3.1 Equation 3

$$\hat{Y}_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \varepsilon_i$$

$\hat{Y}_i$  = FDI (USD, millions);  $x_{i1}$  = time (months);  $x_{i2}$  = Pak. Ext. Debt. (USD, millions);  
 $\varepsilon_i$  = error term;  $R^2 = 0.9898$

#### 4.3.2 Variable Summary Table 3

$\hat{Y}_i$ = FDI (USD, millions)					Number of observations =	97
$x_{i1}$ = time (months)					F(2, 94) =	4580.82
$x_{i2}$ = Pak. Ext. Debt. (USD, millions)					Probability > F =	0.0000
$\varepsilon_i$ = error term					$R^2$ =	0.9898
					Adjusted $R^2$ =	0.9896
					Root MSE =	297.29
Variable	Coefficient	Std. Err.	t	P >  t	[95% Confidence Intervals]	

time	2.402443	0.0899528	26.71	0.000	2.22384	2.5810457
PED	96.07461	8.250366	11.64	0.000	79.69332	112.4559
constant	-451221.71	1448.366	-35.37	0.000	-54097.47	-48345.94

Note: Table 3 - Where time = time (months); PED = Pakistan External Debt - China (USD, millions); constant = y-intercept (Source: CEIC Database).

### 4.3.3 Model 3 Results

The results of model 3 offer up an alternative prediction model of estimating China's FDI into Pakistan. Using Pakistani external debt to China as an indicator of foreign direct investment instead of cumulative trade deficits, it shows that there is an even stronger correlation between the two. The  $R^2$  in model 3 increases to 0.9898 from 0.9839, indicating that with near 100% certainty can a model be built to estimate FDI via external debt and time. Moreover, given the increasing nature of external debt, trade deficits, and FDI since 2013, as shown visually in the introduction, it can be concluded that the correlation between debt or deficits to FDI is of high statistical significance.

Likewise, an alternative hypothesis was originally proposed that used the following equation:

$$\hat{Y}_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \varepsilon_i$$

$\hat{Y}_i$  = FDI (USD, millions);  $x_{i1}$  = time (months);  $x_{i2}$  = Pak. Ext. Debt. (USD, millions);  
 $x_{i3}$  = Cum. Trade Def. (USD, millions);  $\varepsilon_i$  = error term

This model produced an  $R^2$  of 0.9899, nearly identical to the Model 3 hypothesis. However, the p-value (0.637) for cumulative trade deficits was higher than 0.5, and the 95% confidence interval contained zero. This indicated that perhaps either trade or external debt may be linearly dependent upon the other. Therefore, it was important to separate the cumulative trade deficits and external debt into two separate predictors of FDI. Furthermore, the coefficient  $\beta_2$ , was estimated to be 96.07 suggesting that Pakistani External debt increases rapidly in relation to FDI growth, confirming one of the key assertions of the World Bank Report and also producing a

larger increasing relationship than the estimation of  $\beta_2$  in Model 2. This again confirms that Pakistani External Debt is a better indicator for predicting China's Foreign Direct Investment.

## 4.4 Model 4:

### 4.4.1 Equation 4

$$\hat{Y}_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \varepsilon_i$$

$\hat{Y}_i$  = Freight Gross Earnings (USD, millions);  $x_{i1}$  = time (years);  
 $x_{i2}$  = ann. freight km (millions);  $x_{i3}$  = FDI (USD, millions);  $\varepsilon_i$  = error term

### 4.4.2 Variable Summary Table 4

$\hat{Y}_i$ = Freight Gross Earnings (USD, millions)				Number of observations =		19
$x_{i1}$ = time (years)				F(2, 94) =		79.69
$x_{i2}$ = ann. freight km (millions)				Probability > F =		0.0000
$x_{i3}$ = FDI (USD, millions)				R <sup>2</sup> =		0.9410
$\varepsilon_i$ = error term				Adjusted R <sup>2</sup> =		0.9292
				Root MSE =		20.125
Variable	Coefficient	Std. Err.	t	P >  t	[95% Confidence Intervals]	
time	5.068467	1.177081	4.31	0.001	2.559577	7.577356
AF km	0.242729	00.22814	10.64	0.000	0.0194102	0.0291355
FDI	0.0326318	0.0123549	2.64	0.019	0.006298	0.0589646
constant	-10023.45	2365.746	-4.24	0.001	-15065.92	-4980.981

Note: Table 4 - Where time = time (years); AF km = annual freight km (millions); FDI = China FDI (USD, millions); constant = y-intercept  
(Source: CEIC Database).

### 4.4.3 Model 4 Results

Table 4 yields interesting results for Model 4. First, with a  $R^2 = 0.9410$ , and no p-values above 0.5, nor confidence intervals containing zero, it can be concluded that there is a relationship between FDI, time, and annual freight kilometers for estimating freight rail earnings. Although the FDI coefficient is estimated to be 0.0326, it is still of statistical significance in regard to the increase of freight rail earnings. Moreover, when an alternative hypothesis was given by the equation:

$$\hat{Y}_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \varepsilon_i$$

$\hat{Y}_i$  = FDI (USD, millions);     $x_{i1}$  = time (years);     $x_{i2}$  = ann. freight km (millions);  
 $\varepsilon_i$  = error term

The confidence interval for annual freight kilometers at 95% confidence included zero (p-value was 0.115), indicating that the null hypothesis could not be rejected at this confidence level. This is to conclude that FDI is probably not dependent on the variable annual freight kilometers. Therefore, the original hypothesis for Model 4 holds, and shows that investment into Pakistan by China correlates to improving not just the number of freight rail kilometers, but also the earnings increase from existing rail with time. A Model that had freight earnings and freight rail kilometers with time for estimating FDI, but freight earnings and freight rail kilometers were not considered linearly independent.

### 4.4.4 Model 4 Limitations

Due to the linear regression relationship between FDI and trade deficits or external debt from Models 2 and 3 respectively, one could set up a logarithmic regression that included an exponential function including time and either external debts or trade deficits in replacement for the FDI in Model 4. This would confirm the combined conclusions of Models 2, 3, and 4 that trade deficits or external debt with time (exponential) and freight rail kilometers estimate freight rail earnings. This was not evaluated for this paper, but could be built upon for further research.

## 5 Conclusion

The findings of this paper suggests that using linear regression there was a mild correlation of statistical significance between FDI from China and its growth as a total share of Pakistan's total FDI inflow, indicating an increasingly reliant relationship of Pakistan from China for foreign direct investment (Model 1). In an attempt to explain this phenomenon there should have been an expectation that FDI results in larger trade outcomes. Looking at the data for imports and exports between Pakistan and China, it was clear that while Pakistani trade deficits to China began to increase significantly around the launch of the Belt and Road Initiative (Figure 4). In order to find the relationship between FDI and trade outcomes, the cumulative Pakistani monthly trade deficits with China were regressed against monthly Chinese FDI inflows into Pakistan from 2012 to 2020. Interestingly, while both trade deficits and FDI were correlated higher than regressed against time alone, and with an  $R^2$  above 0.9, there was a higher  $R^2$  and lower p-value for FDI as the dependent variable and trade deficits as the independent variable than when regressed in the reverse explained by the Model 2 alternative hypothesis. This counterintuitiveness, highlights that perhaps trade deficits affect China's willingness to invest in Pakistan, instead of investments leading to higher trade deficits.

Next, it was important to measure the impact on FDI from trade and Pakistan's government held external debt. If the government held debt correlated highly with the increased trade deficits and more inflow of FDI from China, then it would be indicative of a more unsustainable nature of investment dependent on trade and debt confirming the cited conclusions of the World Bank Report in the introduction. Using linear regression, a model was created (using the same data as in the last model) to set time, Pakistan's external government held debt, and cumulative trade deficits to China as independent variables and FDI as the dependent variable. After a series of regressions, it was determined that this regression had a stronger correlation (higher  $R^2$ ) than the model before. However, the p-value for trade deficits was above 0.5 which indicates that trade deficits and external debt may not both be a contributing factor to FDI and could be codependent. Looking at just debt and time as the independent variables, the  $R^2$  was more highly correlated than just trade deficits and time. Likewise, the estimation of the external debt slope was much greater than trade deficits was, this indicated that government held external debt is more likely to be indicative of FDI inflow from China than trade deficits, as well as explain the growing linear relationship more strongly.

When looking at one of the key components of the China-Pakistan Economic Corridor, rail plays an important role in increasing the trade relationship between China and Pakistan. Using linear regression, a model was built to examine the relationship between foreign direct investment and railway outcomes. Setting up indicators of annual FDI by China, and annual freight rail km (millions) in Pakistan, and time. The regression analysis of independent variables, freight rail km (millions) and time produce mild correlation of statistical significance with annual FDI by China ( $R^2 > 0.5$ ). Next, it was important to account for railway earnings in Pakistan to show whether the increase in FDI and freight rail km per year produced stronger railway earnings. The results of railway earnings, freight rail km (millions), and time as the independent variables against China's FDI as the dependent variable produced a stronger  $R^2$  of over 0.6. However, multiple p-values were above 0.5. Thereafter, putting freight rail earnings as the dependent variable, and the others (time, freight rail km, FDI) as independent variables showed a much more significant statistical correlation ( $R^2 > 0.9$ ) and no p-values above 0.5, indicating that China's FDI and freight rail km (millions) produced greater freight rail earnings over time.

These regressions concluded that there is likely a strong correlation between Pakistan's increased freight capacity and economic growth in earnings from freight networks due to China's foreign direct investment in Pakistan via the China-Pakistan Economic Corridor as part of the Belt and Road Initiative (Model 4). Likewise, this said FDI investment can be predicted from increasing Pakistani external debt (Model 3), which has become a larger portion of Pakistan's FDI inflow over time (Model 1). These conclusions mirror the conclusions of the World Bank Report in which the report notes that while China is heavily involved in boosting the capacity of regional infrastructure, an area of underdevelopment and unrealized economic gains for countries like Pakistan and in Central Asia, the nature of Chinese investments shows a large debt burden and increasingly reliant countries on China's investments. As a result, the data suggests that the World Bank Report's conclusions hold up at the country specific level for Pakistan especially given that Pakistan's overall economy is relatively weak, as explained in the introduction.

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