



## Research article

# Does regional integration matter for sustainable economic growth? Fostering the role of FDI, trade openness, IT exports, and capital formation in BRI countries

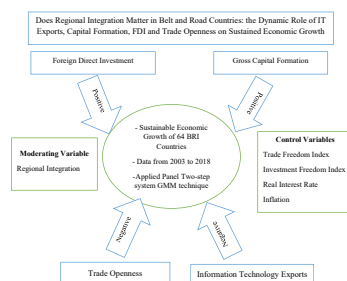


Mubasher Zaman <sup>a</sup>, Chen Pinglu <sup>a</sup>, Sayed Irshad Hussain <sup>b</sup>, Atta Ullah <sup>a,\*</sup>, Ningyu Qian <sup>a,\*\*</sup>

<sup>a</sup> School of Management, Huazhong University of Science and Technology, Wuhan, China

<sup>b</sup> Department of Social Sciences, SZABIST, Karachi, Pakistan

## GRAPHICAL ABSTRACT



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## ABSTRACT

IT exports, capital formation, FDI, and trade openness are the key elements to bring sustainable economic growth to any country, since these act as a lifeline to bring sustainability to countries. This study aims to estimate the impact of IT exports, gross capital formation, FDI, and trade openness on sustainable economic growth with regional integration of BRI countries using the annual panel data from 2013 to 2018. Moderating variable is regional integration, while the trade freedom index, investment freedom index, real interest rate, and inflation are control variables. The two-step system GMM technique is applied to the sample as the number of moment conditions is greater than the number of parameters. The results suggest that FDI and gross capital formation have a substantial positive impact on economic growth, whereas IT exports and trade openness have a negative, insignificant impact. The overall results suggest that China's outward FDI has boosted the economic growth in countries while trade openness has a negligible since most developing countries need to invest in industrialization and encourage exports based growth.

## 1. Introduction

The Belt and Road Initiative (BRI) is China's most noteworthy global monetary aspiration, which was initially inaugurated in the fall of 2013

by President Xi Jinping, who desires to incite provincial mix among China and other Asian, African, and European nations through upgradation of framework and institutional linkages. It implies constructing a "worldwide network with shared interests, predetermination, and

\* Corresponding author.

\*\* Corresponding author.

E-mail addresses: [attaullah142@gmail.com](mailto:attaullah142@gmail.com) (A. Ullah), [qianningyu@hust.edu.cn](mailto:qianningyu@hust.edu.cn) (N. Qian).

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obligation". The BRI could encompass a wide range of activities in its broadest definition for over more than 64 nations and 4.4 billion people, as well as an estimated 30% of the worldwide Gross Domestic Product (GDP). The BRI conveys monetary goals, including office availability, unrestricted exchange, and budgetary incorporation, and its financial and money-related activities will be supplemented by more prominent strategy coordination and more profound social and staff trades [1].

The initiative is conceived to reconfigure China's outward area to advance with its concrete progress. The activity gives an outline of the solid incorporation of China into the world economy and expresses the responsibility of the Chinese government to a more open economy. With fast economic development, China has risen as a significant exporter of the capital and not just as enormous unfamiliar trade holds that generally deposit resources into the United States (US) government bonds, yet additionally in the direct venture. In 2019, according to Statista online record, China's FDI outflow was USD 117.12 billion. China also overwhelmed Japan to turn into the second-biggest nation of the outbound venture.

The financial and international inspirations driving the BRI have been generally discussed. For instance [2, 3], contended that the requirement for encouraging China's homegrown financial progress and the reaction to the US Asia turn strategy have been the main drivers after Beijing's BRI. They additionally propose that the declaration of BRI spoke to the move of China's international strategy position from inactive and receptive to preemptive. Nonetheless [4], contends that BRI mirrors a characteristic extension of China's technique for the sub-public provincial turn of events, as opposed to another methodology driven by global international contemplations.

The degree of progress in any economy cannot be completely inspected without a detailed understanding of the involvement of capital formation in its economic progress. Capital formation has been known as a significant aspect that decides the evolution of any economy. Capital formation refers to the fraction of current income kept and spent to enhance future output and income. It typically affects the acquirement of a new factory, along with machinery, equipment, and all productive capital goods. Capital formation logically plays a key role in economic growth. It has consistently been viewed as a planned development appealing player. It impacts the public ability to create, which further influences economic development. The lack of capital development has been referred to as the most genuine imperative to maintainable financial development. Consequently, it is not bewildering that the investigation of capital development is undergoing one of the fundamental problems in exact macroeconomics [5].

Investment is an essential factor in economic development. It uncovers real interest, thereby creating beneficial productivity for an impending creation. Nonetheless, the degree of impact of investment on economic development relies upon the strength of its determinants. Hence, these variables could be reserve funds, foreign direct investment (FDI), GDP, loan cost, populace development, cash supply, and conversion scale. FDI assumes a fundamental part in the economic development of a nation. After the modern transformation, FDI is viewed as one of the primary variables of the monetary turn of events. It causes the host nation to propel the framework, the way of life, and the daily environments of the overall population. Developing and immature nations are reliant on monetarily devolved nations for money-related help to achieve monetary steadiness. Developing nations are interested in various areas, particularly in feeble areas of the economy, where the host nation needs more assets to make those areas. By doing this, developing nations can achieve the most extreme advantage of their venture, as it offers the chance to the nations to reinforce their frail areas and to form greater business openings. FDI is characterized as speculation that has been made by any individual, organization, adventure having a place with another nation in another aspect of the world on proprietorship, or host nation venture and intrigue premise [6, 7, 8].

FDI has a huge direct impact on economic development and broadens the potential increases related to FDI [9]. FDI additionally improves the monetary pointers of any nation, since it helps the agricultural nations in

acquiring a modern transformation of the nation. At this point, when an agricultural nation gets FDI for the recovery of its businesses, it helps the nation in expanding its fares and fortifying the conversion scale of the non-industrial nations. It eventually expands the cash flow in the economy and limits swelling in non-industrial nations. The serious issues with the greater part of the agricultural nations are related to achieve a decrease in their import/export imbalance, control swelling, and increment the cash gracefully in the economy to lessen unemployment and shortage of assets. The majority of the low-income regions have a chronicled import/export imbalance. This implies that the nation's imports are consistently more prominent than trades. Therefore, imports assume an overwhelming function in a nation's outer area.

FDI prompts higher extra development in emerging economies [10]. Besides [11], investigated the connection between FDI and economic development in South Korea where they utilized an example time of 29 years for the period 1980–2009 with yearly time arrangement. His exploration moored on endogenous development hypothesis, and his discovery demonstrates that FDI has a positive and significant effect on economic development. There is a boundless acknowledgment and conviction among specialists, professionals, and strategy creators that FDI can help monetary development. However [12], examined the impact of the FDI on monetary development in Cambodia, and he declared that the optimistic influence of FDI is illuminated by 'innovative dispersion' starting from companies abiding unacquainted capital and scattering to associated firms in a kind of particular assistance. The examination secured the period in the range of 1998 and 2010. Moreover, he further uncovered that there is a constructive connection between FDI and economic development (GDP).

The association between exchange transparency and monetary expansion has acquired attention, both in the theoretical and exact script during the last thirty years. Notwithstanding, there is no settlement on whether more noteworthy accessibility to exchange animates economic development. As per the hypothesis of a similar bit of leeway, if a nation needs to exchange with another nation, the last will deliver merchandise in which it has a relative preferred position. It has some expertise in the area for which it has better factor gifts and creates merchandise for a bigger scope. Thus, profitability and fares of this area will increase, and this will support the general monetary development. In addition [13], utilize the instrumental variable to manage a board of 41 Sub-Saharan African nations. They found that exchange transparency increments economic development. On the other hand [14], examine the instance of Kenya and found that exchange transparency has a positive effect on speculation proportion; however, not on the pace of monetary development. Different examinations repudiate the presence of a positive connection between the exchange and economic development (for example [15, 16]). The merged conclusions from the experimental script may be attributed to the econometric methods, the illustration of countries, and the market exploited as a transitional for exchange accessibility. Moreover [17], found that exchange transparency blocks economic development in South Africa. Finally [17], apply the ARDL philosophy to Nigeria and found an adverse effect of exchange receptiveness on economic development yet a positive development effect in the short run. Additional, a two-way causality was established among the two factors.

The function of the capital interest in monetary development has been viewed as one of the fundamental standards of financial aspects. Numerous specialists presume that the pace of capital arrangement is critical to decides the pace of monetary development [18, 19]. Besides [20], uncovered a positive and solid reciprocal relationship of capital arrangement in advancing monetary development. To look at the connections between inflation, FDI, and economic development between the period 1980 to 2013 [12], utilized the ARDL (autoregressive appropriated slack) model and explained that the inflation rate did not significantly affect FDI, while GDP per capita had a noteworthy positive relationship with FDI.

The causal association among FDI, trade openness and economic growth in BRICS countries have been examined using the data from 1990

to 2018. ARDL was applied to check co-integration with the Dumitrescu and Hurlin Granger causality tests. The outcomes suggested that the FDI and trade openness have an optimistic effect on long tenure economic growth. The researchers found that there is a long-run relationship from both the actual exchange rate and gross capital formation to economic growth. The outcomes revealed that there is bidirectional interconnection from FDI to economic growth, trade openness to FDI, and unidirectional interconnection from trade openness to FDI [21].

The uniqueness of this paper is that it covers the data of 64 nations, 4.4 billion people, and 30% of the worldwide GDP. We have contemplated various logical factors was utilized to dissect the sustainable economic development of these nations exclusively. However, according to our knowledge, there has been no analysis on the effect of these factors on sustainable economic development considering all BRI nations simultaneously. The motive for considering all the BRI nation-states is that before the BRI initiative, these states were facing challenges in heaving FDI, IT exports, and gross capital formation empowering streamlined commerce relations and integrating the financial relations. Due to these issues, there was an increased poverty rate and unemployment in these nations; however, this activity has helped the nations to come together and make long haul exchange relations in order to increase jobs and new business ventures. The existing literature provided mixed results when the economic growth through various variables was examined. This study considered the findings of all the above-mentioned studies. In this study, we have applied two-step system GMM technique with untapped set variables due to its robustness and efficiency, and it provides more accurate results when the number of individuals is greater than the time of the dataset. Although this study also gave mixed results, it explains that most of the partner countries in BRI are developing and they must focus to attain economic stability and enhance the growth objectives. Study contribute that the developing countries must provide an atmosphere to the investors to attract foreign direct investment and also focus on increasing the gross capital formation to improve the country's outlook. Moreover, developing countries need to adopt technology advancement and increase the use of information technology. The developed countries are far ahead in this area, and hence, developed countries have the edge on information technology exports, whereas due to less focus on information technology, poor countries are disadvantaged in terms of IT exports. Moreover, developed countries are flourishing because of the concept of industrialization with strong exchange rates; however, developing countries have weak industry and they find it difficult to compete in the competitive environment.

In light of the above discussion, it is important to examine the effect of FDI, trade perspective, IT exports, and gross capital formation on sustainable economic growth regarding regional financial integration in Belt and Road Countries for the time of 2003–2018. After experiencing different examinations and surveys, we have detailed the accompanying hypotheses:

**H1:** The One Belt One Road Initiative boosts the need for Foreign Direct Investment to bring economic growth in all BRI Countries.

**H2:** The One Belt One Road Initiative encourages the need for Trade Openness between all BRI Countries to bring economic growth.

**H3:** Information technology exports have a positive impact on the economic growth of BRI Countries.

**H4:** Gross Capital formation has a positive impact on the economic growth of BRI Countries.

## 2. Data and methodology

### 2.1. Data

This study examines the impact of foreign direct investment, trade openness, ICT exports, and gross capital formation on the economic

growth of the BRI countries. The dependent variable is economic growth and it is derived as the rate of change of real GDP. The explanatory variables are foreign direct investment and trade openness. The other factors are information technology exports, gross capital formation, trade freedom index, investment freedom index, inflation, and real interest rate. The moderating variable is regional integration. We have used the annual time series data of 64 countries and the period covered is from 2003 to 2018. Moreover [22], has also taken data of 64 BRI countries and for the same time period, from 2003 to 2018. The authors have taken sustainable development as a dependent variable and they also employed the two-step system GMM technique.

### Dependent Variable

“Measures/ Subgroup”	“Indicators/Description”
Economic Growth	The rate of change of real GDP. Source: World Bank [23, 24, 25] took economic growth as a dependent variable and took several explanatory variables to analyze their impact on economic growth in the context of Turkey, Pakistan, and OPEC developing economies respectively.

### Independent Variables

“Measures/Subgroup”	“Indicators/Description”
Foreign Direct Investment	FDI percentage of GDP. Source: World Bank [25] used FDI as an independent variable to analyze its impact on economic growth in the context of Turkey.
Trade Openness	Trade openness is the combination of imports and exports total as a percentage of GDP. Source: World Bank [25, 26] used Trade Openness as an independent variable in their study while seeing its impact on economic growth.
Information Technology Exports	IT Exports percentage of total goods exports. The United Nations, Definition: ICT goods exports contain computers and peripheral tools, communication tools, user electronic tools, automated modules, and other IT goods (miscellaneous).
Gross Capital Formation	Yearly percentage growth. Source: World Bank [26] used gross capital formation as an independent variable to see its impact on economic growth in the context of Pakistan.

### Control Variables

“Measures/Subgroup”	“Indicators/Description”
Trade Freedom Index	TFI (0–100) The Global Economy Website
Investment Freedom Index	IFI (0–100) The Global Economy Website
Real Interest Rate	Bank lending rate – inflation. Source IMF
Inflation	Percentage variation in the consumer price index.

### Moderating Variable:

“Measures/ Subgroup”	“Indicators/Description”
Regional Integration	Regional Integration used Dummy variable proxy, One before One Belt One Road Initiative and Zero after OBOR Initiative Integration.

### 2.2. Methodology

Generalized Method of Moments (GMM) technique was applied on the data of 64 BRI countries due to a greater number of countries N than the time period T. When there is a connection between the explanatory variable and the error term in a model, GMM is a robust panel data estimator that checks for the endogeneity of the lagged dependent variable in a vibrant panel model. The two-step GMM is improved as it checks for misplaced variables bias, undetected panel heterogeneity, and measurement errors. It is more effective and vigorous to heteroscedasticity and autocorrelation [26]. When the distribution of the dependent variable is unknown, the two-step system GMM is

considered as the reliable technique to use. To make GMM a dynamic model and to address the factor of autocorrelation in the static regression model, the lag-value of economic growth is considered. Hence, by adjusting the lag-effect of its dependent variable that is economic growth in the long term to forecast the future more precisely, GMM is preferred [27].

In addition, the AR1 p-value should be significant with less than 5% value, while the AR2 p-value should be insignificant with more than 5% value. Moreover, Hansen's p-value should be between 0.10 to 0.25. In some cases, it can be 0.30; however, if the value is less than 0.10 or above 0.30, the results are not reliable [28]. GMM first controls autocorrelation, then differentiates and analyses the outcomes of a research panel dataset more efficiently. To improve the analysis, the Hansen and Sargan test was used, which investigates the instrument's dependability and regulates the overidentifying restrictions that further improve the accuracy and reliability of the results [29].

The two-step system GMM functional form is expressed as;

$$y_{it} = X_{it} \beta + \theta \gamma_{i,t-1} + \varepsilon_i + \mu_{it} \tag{1}$$

$$\Delta \gamma_{it} = \Delta X_{it} \beta + \theta \Delta \gamma_{i,t-1} + \varepsilon_i + \mu_{it} \tag{2}$$

where  $\Delta$  is the differenced operator in Eq. (4).

Direct Impact equations can be as follows

Static Model is explained as follows;

$$EG(RCRGDP)_{i,t} = \alpha_0 + \beta_1(FDI)_{i,t} + \beta_2(TO)_{i,t} + \beta_3(Control\ factors)_{i,t} + \mu_i + \varepsilon_{it} \tag{3}$$

The two-step system GMM dynamic econometric model is explained as follows;

$$EG(RCRGDP)_{i,t} = \alpha_0 + \beta_1 EG(RCRGDP)_{i,t-1} + \beta_2(FDI)_{i,t} + \beta_3(TO)_{i,t} + \beta_4(Control\ Factors)_{i,t} + \mu_i + \varepsilon_{it} \tag{4}$$

An econometric moderating variable interaction term for the static model is as follows;

$$EG(RCRGDP)_{i,t} = \alpha_0 + \beta_1(FDI)_{i,t} + \beta_2(FDI * RI)_{i,t} + \beta_3(TO)_{i,t} + \beta_4(TO * RI)_{i,t} + \beta_5(Control\ factors)_{i,t} + \mu_i + \varepsilon_{it} \tag{5}$$

Moderating variable Interaction term dynamic model of two-step system GMM can be explained as follows;

$$EG(RCRGDP)_{i,t} = \alpha_0 + \beta_1 EG(RCRGDP)_{i,t-1} + \beta_2(FDI)_{i,t} + \beta_3(FDI * RI)_{i,t} + \beta_4(TO)_{i,t} + \beta_5(TO * RI)_{i,t} + \beta_6(Control\ factors)_{i,t} + \mu_i + \varepsilon_{it} \tag{6}$$

where EG = Economic Growth, RCRGDP = Rate of change of real GDP, FDI = Foreign Direct Investment, TO = Trade Openness, control factors include IT exports, gross capital formation, trade freedom index, investment freedom index, inflation, and real interest rate,  $\mu$  = error term While,  $\varepsilon$  would hold the properties as follows:  $E[c_i] = E[\varepsilon_{it}] = [c_i \varepsilon_{it}] = 0$ , reflecting idiosyncratic shocks.

The past studies [28, 30, 31, 32, 33, 34, 35] have taken economic growth as a dependent variable and a combination of different independent variables have been taken to get favorable results. In all these above-mentioned studies, the GMM technique has been applied and considered as the best technique because the number of cross-sections is greater than the time and the method is robust and efficient. As we have data of 64 countries and all countries are encouraging trade relations and promoting foreign direct investments and exports under the umbrella of the Belt and Road Initiative, we have considered regional integration as a moderating variable along with four control variables that include trade freedom index, investment freedom index, inflation, and real interest rate.

### 3. Analysis results

#### 3.1. Descriptive analysis

Descriptive statistics of variables are shown in Table 1, where it can be seen that all variables are normally distributed. The measures of central tendency, i.e., mean of all variables, are visible in the table and the values suggest that the information technology exports have the maximum mean value and foreign direct investment has the minimum mean value. All other mean values lie between these two values. The range of data shows the maximum and minimum values of the variables, and it further demonstrates that the trade openness has the highest maximum value among other variables and gross capital formation has the highest minimum value in the table. The value of standard deviation illustrates the normal space among the values of the data in the set and the mean. A smaller value of SD shows that the data points tend to be very close to the mean and a high SD specifies that the statistics points are spread out over an enormous series of values. In this table, we can see that trade openness has a high standard deviation value whereas regional integration and economic growth have the lowest standard deviations. Table 1 is shown below:

#### 3.2. Relationship among variables

Correlation analysis in Table 2 depicts the movement of variables and the relationship between different variables. The correlation value varies from 1 to 0 to -1. If the correlation value is positive and close to one, it means that the two variables are positively correlated and are similar to each other, whereas if the correlation value is negative and close to -1, it shows that the two variables are negatively correlated and are different to each other. The very positively correlated variables have an overall negative impact on the results because there is a factor of multicollinearity that both variables are similar and one variable should be removed from the dataset to get more accurate and reliable results. As per the correlation matrix, we can see that all the variables are correlated with each other, and no value indicates the factor of multicollinearity since the value of the threshold is less than 80% [33]. The correlation matrix shows that the FDI, gross capital formation, and inflation are positively correlated with economic growth at a significant level of 1%, while trade openness, IT exports, trade freedom index, investment freedom index, and real interest rate are perfectly negatively correlated with economic growth. The detailed results are demonstrated below in Table 2.

#### 3.3. Results of direct channel: two-step system GMM

During the association of explanatory variable and the error term in a model, the two-step system GMM checks for the endogeneity of the lagged dependent variable in a vibrant panel model. Two-step system

Table 1. Descriptive analysis.

Variables	Obs.	Mean	Std. Dev.	Min	Max
Economic Growth	1024	4.953	4.098	-14.81	34.47
FDI	1024	4.498	6.162	-46.12	55.08
Trade Openness	1024	94.126	54.385	.17	437.33
IT Exports	1024	120.286	35.736	54.92	290.93
Gross capital formation	1024	9.458	24.038	-137.635	435.616
Trade Freedom Index	1024	73.71	12.171	23	90
Investment freedom index	1024	51.169	19.621	5	90
Inflation (CPI)	1023	5.329	5.734	-18.1	59.2
Real interest rate	1024	4.7	7.335	-31.92	48
Regional Integration	1024	.625	.484	0	1

**Table 2.** Correlation matrix.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) EG	1.000									
(2) FDI	0.186***	1.000								
(3) TO	-0.040	0.367***	1.000							
(4) IT Exports	-0.055*	-0.011	-0.002	1.000						
(5) GCF	0.332***	0.096***	-0.009	0.015	1.000					
(6) TFI	-0.255***	0.083***	0.308***	0.196***	-0.160***	1.000				
(7) IFI	-0.259***	0.116***	0.365***	0.096***	-0.067**	0.419***	1.000			
(8) Inflation (CPI)	0.144***	0.025	-0.158***	-0.029	0.089***	-0.137***	-0.379***	1.000		
(9) Real interest rate	-0.120***	0.000	-0.052*	-0.107***	-0.074**	0.003	0.132***	-0.336***	1.000	
(10) Regional Integration	-0.183***	-0.131***	0.028	0.000	-0.103***	0.239***	0.179***	-0.211***	0.150***	1.000

\*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

GMM checks for omitted variables bias ignored panel heterogeneity and measurement errors.

The results in Table 3 show that two-step GMM technique is the most reliable and effective approach to analyze the results. It can be seen that the constant value is higher from explanatory variables and its impact cannot be ignored. Therefore, system GMM is a better technique shown in column 5 than fixed-effect or pooled OLS techniques. Hence, the results of economic growth confirm the dynamic nature of the model positively at a

significance level of 1%. Moreover, the results also suggest that on average ceteris paribus, a percentage change in FDI is associated with coefficient value [0.081] increase in economic growth at the 1% significance level. Hence, FDI and economic growth exhibit an elastic relationship. Therefore, the outcomes validate the first alternate hypothesis (H1) of a significant positive relationship between FDI and economic growth.

Trade openness and economic growth exhibit a negative relationship as trade openness and its effect on economic growth coefficient

**Table 3.** Direct impact of FDI, TO, IT exports and GCF on economic growth results.

Dep. variable	(1)		(2)		(3)		(4)		(5)	
	Static Model				Dynamic Model					
	Panel Pooled OLS	EG	Panel Fixed effect	EG	Panel Pooled OLS	EG	Panel Fixed Effect	EG	Finanl model Two-Step System GMM	EG
L. Economic Growth - EG (t-1)					0.446***		0.322***		0.442***	
					(0.026)		(0.028)		(0.015)	
FDI	0.129***		0.103**		0.082***		0.088***		0.081***	
	(0.020)		(0.050)		(0.018)		(0.020)		(0.026)	
Trade Openness	0.000		0.021***		-0.002		0.019***		-0.003	
	(0.002)		(0.007)		(0.002)		(0.005)		(0.002)	
IT Exports	-0.002		-0.002		-0.004		-0.004		-0.006***	
	(0.003)		(0.007)		(0.003)		(0.006)		(0.002)	
Gross Capital Formation	0.046***		0.039**		0.062***		0.060***		0.059***	
	(0.005)		(0.018)		(0.005)		(0.005)		(0.003)	
Trade Freedom Index	-0.049***		-0.070***		-0.019*		-0.046***		-0.016**	
	(0.011)		(0.017)		(0.010)		(0.015)		(0.007)	
Investment Freedom Index	-0.041***		-0.049**		-0.023***		-0.033***		-0.029***	
	(0.007)		(0.021)		(0.006)		(0.012)		(0.009)	
Inflation (CPI)	-0.004		-0.035		-0.050**		-0.075***		-0.054***	
	(0.023)		(0.045)		(0.021)		(0.024)		(0.014)	
Real Interest rate	-0.043***		-0.086***		-0.043***		-0.075***		-0.045***	
	(0.017)		(0.030)		(0.015)		(0.018)		(0.005)	
Constant	10.047***		10.588***		5.465***		6.911***		6.057***	
	(0.804)		(1.822)		(0.785)		(1.374)		(0.472)	
<b>Post Analysis</b>										
Observations	1,024		1,024		960		960		960	
R-squared	0.223		0.186		0.442		0.337			
AR 1 (p-value)	-4.923 (0.0000)									
AR2 (p-value)	-1.806 (0.0709)									
Hansen (p-value)	57.14 (18.152)									
Wald- Chi2 (p-value)	8838 (0.000)									
No. of Instruments	41									
Sample Groups	64									

Note: Standard errors in parentheses are \*\*\* depicts 1 percent, \*\* depicts 5 percent, and \* depicts 10 percent level. In Stata 15 xtabond2 command was used.

value is [-0.003]. It shows that a percentage change in trade openness will affect decrease in economic growth at the 1% significance level. Therefore, findings reject the alternate hypothesis (H2) of significantly positive relation and endorse the null hypothesis. IT exports and economic growth also show an negative relationship because, on average ceteris paribus, a percentage change in IT exports is associated with a negative coefficient value [-0.6] decrease in economic growth at the 1% significance level. Therefore, findings reject the alternate hypothesis (H3) and accept the null hypothesis.

The gross capital formation effect on economic growth coefficient is [0.059] and it exhibits an positive relationship because a percentage change in gross capital formation will affect increase in economic growth at the 1% significance level. Thus, findings validate the first alternate hypothesis (H4) of a significant positive relationship between FDI and economic growth. The trade freedom index is a control variable and its effect on economic growth with coefficient value [-0.016], which means a fraction change in the trade freedom index is related to a 0.016% decline in economic growth at the 5% significance level on typical ceteris paribus. Hence, the trade freedom index exhibits an elastic relationship.

The effect of the investment freedom index and real interest rate on economic growth coefficient is [-0.029] and [-0.054], respectively, therefore demonstrating that a percentage change in investment freedom index and real interest rate is associated with a 0.029% and 0.054% decline in economic growth at the 1% significance level. Hence, both have a positive relationship with economic growth. The last variable is inflation and its effect on economic growth coefficient value is [-0.045]. It shows that a percentage change in the independent variable will affect a 0.045% reduction in economic growth at the 1% significance level, thereby exhibiting an significant positive relationship.

Further, post-analysis values of AR1 and AR2 are accurate since AR1 is less than 5% while AR2 is greater than 5%. The Hansen p-value is 0.18, which is also accurate, since the value must be between 0.1 to 0.25 to be accurate. The number of instruments/J-statistics is 41 whereas the sample group is 64 so it also validates the statement that the two-step GMM technique is a valid instrument because number of instruments are less than number group. Overall, all these values state that the two-step system GMM technique has best stated the results, and the authenticity and accuracy of data are justified. Table 3 is shown below;

**Table 4.** Regional Integration and Interaction term FDI\*RI impact of Economic Growth.

Dep. variable	(1)		(2)		(3)	(4)	(5)
	Static Model				Dynamic Model		
	Panel Pooled OLS	Panel Fixed effect	Panel Pooled OLS	Panel Fixed Effect	Panel Pooled OLS	Panel Fixed Effect	Finanal model Two-Step System GMM
	EG	EG	EG	EG	EG	EG	EG
L. Economic Growth					0.442*** (0.026)	0.314*** (0.028)	0.397*** (0.016)
FDI	0.156*** (0.024)	0.142*** (0.046)	0.110*** (0.023)	0.129*** (0.025)	0.170*** (0.025)		
RI	-0.103 (0.295)	-0.092 (0.339)	0.254 (0.260)	0.253 (0.270)	-0.520*** (0.117)		
FDI*RI	-0.098** (0.040)	-0.117*** (0.035)	-0.076** (0.035)	-0.104*** (0.035)	0.115*** (0.020)		
Trade Openness	0.000 (0.002)	0.021*** (0.005)	-0.002 (0.002)	0.019*** (0.005)	-0.002 (0.001)		
IT Exports	-0.003 (0.003)	-0.002 (0.007)	-0.005 (0.003)	-0.004 (0.006)	-0.004** (0.002)		
Gross Capital Formation	0.045*** (0.005)	0.038** (0.018)	0.062*** (0.005)	0.058*** (0.005)	0.069*** (0.005)		
Trade Freedom Index	-0.044*** (0.011)	-0.058*** (0.016)	-0.019* (0.010)	-0.042*** (0.015)	-0.020*** (0.008)		
Investment Freedom Index	-0.040*** (0.007)	-0.038* (0.019)	-0.023*** (0.006)	-0.028** (0.012)	-0.032*** (0.006)		
Inflation (CPI)	-0.010 (0.023)	-0.046 (0.045)	-0.052** (0.021)	-0.079*** (0.024)	-0.058*** (0.014)		
Real Interest rate	-0.042** (0.017)	-0.083*** (0.030)	-0.044*** (0.015)	-0.075*** (0.018)	-0.050*** (0.008)		
Constant	9.900*** (0.803)	9.303*** (1.774)	5.438*** (0.784)	6.302*** (1.418)	5.838*** (0.566)		
<b>Post Analysis</b>							
Observations	1,024	1,024	960	960	960		
R-squared	0.231	0.198	0.445	0.344			
AR 1(p-value)	-4.810 (0.00000151)						
AR2 (p-value)	-1.843 (0.0653)						
Hansen test(p-value)	58.08 (21.15)						
Wald- Chi2 test (p-value)	4989 (0.000)						
No. of Instruments J-Stat.	58						
Number of Sample Groups	64						

Note: Standard errors in parentheses are \*\*\* depicts 1 percent, \*\* depicts 5 percent, and \* depicts 10 percent level. In Stata 15 xtabond2 command was used.

**Table 5.** Regional Integration Interaction Term Trade openness TO\*RI impact of Economic Growth.

Dep. variable	(1)	(2)	(3)	(4)	(5)
	Static Model		Dynamic Model		
	Panel Pooled OLS	Panel Fixed effect	Panel Pooled OLS	Panel Fixed Effect	Finanal model Two-Step System GMM
	EG	EG	EG	EG	EG
L. Economic Growth			0.445*** (0.026)	0.320*** (0.028)	0.401*** (0.018)
FDI	0.122*** (0.020)	0.097* (0.049)	0.081*** (0.018)	0.086*** (0.020)	0.126*** (0.026)
Trade Openness	0.002 (0.003)	0.025*** (0.007)	-0.001 (0.003)	0.021*** (0.006)	-0.004*** (0.001)
RI	-0.088 (0.477)	-0.012 (0.442)	-0.182 (0.416)	-0.134 (0.426)	-0.363** (0.155)
TO*RI	0.004 (0.004)	0.006 (0.004)	0.002 (0.004)	0.003 (0.004)	0.002** (0.001)
IT Exports	-0.002 (0.003)	-0.003 (0.007)	-0.004 (0.003)	-0.005 (0.006)	-0.002 (0.002)
Gross Capital Formation	0.046*** (0.005)	0.039** (0.018)	0.062*** (0.005)	0.059*** (0.005)	0.073*** (0.004)
Trade Freedom Index	-0.045*** (0.011)	-0.060*** (0.016)	-0.019* (0.010)	-0.044*** (0.015)	-0.022*** (0.007)
Investment Freedom Index	-0.040*** (0.007)	-0.041** (0.021)	-0.023*** (0.006)	-0.031** (0.012)	-0.031*** (0.007)
Inflation (CPI)	-0.010 (0.023)	-0.046 (0.046)	-0.051** (0.021)	-0.078*** (0.025)	-0.057*** (0.019)
Real Interest rate	-0.041** (0.017)	-0.084*** (0.031)	-0.043*** (0.015)	-0.075*** (0.018)	-0.048*** (0.007)
Constant	9.861*** (0.811)	9.557*** (1.806)	5.404*** (0.791)	6.607*** (1.424)	6.062*** (0.718)
<b>Post Analysis</b>					
Observations	1,023	1,023	959	959	959
R-squared	0.227	0.191	0.443	0.338	
AR 1(p-value)	-4.873 (0.0000)				
AR2 (p-value)	-1.910 (0.0562)				
Hansen test(p-value)	56.49 (23.91)				
Wald- Chi2 test (p-value)	17821 (0.000)				
No. of Instruments J-Stat.	57				
Number of Sample Groups	64				

Note: Standard errors in parentheses are \*\*\* depicts 1 percent, \*\* depicts 5 percent, and \* depicts 10 percent level. In Stata 15 xtband2 command was used.

### 3.4. Results of regional integration as moderating variable

Overall, the results validate the statement that FDI and gross capital formation have a significant and positive impact on economic growth, whereas trade openness and information technology exports exhibited insignificant and negative relationships on economic growth. The results validate the statement that China's outward FDI has greatly helped the developing countries in attaining the goal of economic growth, and ultimately, countries have increased their gross capital formation to attain the objective of economic growth. The trade openness and IT exports variables have a negative impact because the developing countries face a challenge in maintaining the exchange rate, the balance of payments, and current accounts balance. Moreover, due to low investments in the IT sector, developing countries are less advantaged with respect to IT exports as compared to developed countries. The findings of this study are different from past studies as we have also incorporated regional integration as moderating variable along with the four control variables, which greatly influenced the overall results.

In column 5 of Table 4, the impact of moderating variables has been analyzed concerning the effect of foreign direct investment on economic

growth. It shows that the regional integration as a moderating variable when interacted with foreign direct investment has an significant positive relationship with economic growth, as on an average ceteris paribus, the impact of foreign direct investment on economic growth is 0.115% at a significance level of 1%. Post analysis shows that the AR (1) p-value is less than 0.05 and AR (2) p-value is greater than 0.05%. Hence, the results suggest that regional integration has a significant negative impact as moderating variable when interacted with foreign direct investment. Further, results depict that the number of instruments/J-statistics is 58 and the same size is 64 so it means that the two-step GMM is a valid instrument because number of instruments are less than number group. Table 4 reported below;

In column 5 of Table 5, the effect of regional integration has been analyzed concerning the effect of trade openness on economic growth. Regional integration as a moderating variable when combined with trade openness has an inelastic relationship with economic growth since the impact of trade openness on economic growth is 0.002% at a significance level of 1% on an average ceteris paribus. The AR (1) p-value is less than 5% and AR (2) p-value is greater than 5%. Hence, the results suggest that regional integration has not any significant impact as

moderating variable when interacted with trade openness. Further, the number of instruments/*J*-statistics is also less than the total sample size, meaning that the two-step GMM technique is a valid instrument. Table 5 demonstrated below;

#### 4. Discussion of results

This study is specifically designed to analyze the impact of foreign direct investment, gross capital formation, trade openness, and information technology exports on the economic growth of 64 BRI countries. As per the descriptive analysis, the values of mean and standard deviation validated our statement that the variables are normally distributed. The values are encouraging and state that trade openness has a high standard deviation whereas economic growth and regional integration have the lowest standard deviation. Further, correlation matrix results revealed that there is no multicollinearity found in the data and the relationship between variables is normal. Further, results are based on the two-step system GMM technique. Another uniqueness of this research paper is that we have considered 64 BRI countries based on the data availability for a maximum number of years for the partner countries, and the analyses show that the FDI and gross capital formation has a significant positive impact on the economic growth of BRI countries, whereas trade openness and information technology exports have a negatively insignificant impact on BRI countries. The findings of the first hypothesis FDI and economic growth are in line with the of the studies of [36] who conducted a study in the context of Saudi Arabia [25], who researched on the context of Turkey, and with [37] who researched in the context of MENA countries. Current study findings and past findings endorse that FDI significantly positive impact on the economic growth in BRI countries. Thus, countries should encourage and promote an environment where foreign investors feel safe and secure to invest in their home country, which will lead to economic growth.

The second objective related to hypothesis (H2) considered the trade openness variable and gave consistent findings with [25, 26, 31] that the countries should promote trade relationships with other countries. Moreover, they should keep their industry and markets functional and operational activities so that people choose domestic products over imported products. It will encourage trade relationships with other countries and simultaneously boost the domestic industry's performance. Moreover, the study of [38] researched the impact of high technology exports on economic development in OECD countries and the outcomes depict that long term relationship between high technology exports and economic growth exists in the OECD countries, while our outcomes of hypothesis (H3) are contradictory by indicating that information technology exports have a negative and insignificant relationship in the case of BRI countries. Therefore, our findings endorse the null hypothesis (H3). The results are also consistent with [39], who researched the impact of research and development and high technology exports on the economic progress of Turkey and South Korea and concluded that the results are different in both countries. High technology exports have an important effect on economic growth in the case of South Korea and the case of Turkey, it has a partial positive influence in the short run. Moreover [40], has researched the effect of capital formation and its determinants on the economic growth of Nigeria and the results depict consistent findings that gross capital formation has an important positive influence on economic growth. Our results endorse the alternate hypothesis (H4) and also show that gross capital formation brings economic growth in the BRI countries. Moreover, control factors investment freedom, trade freedom, inflation, and interest rate outcomes show the significantly negative impact on sustainable economic growth in Belt and Road countries that require improvement.

#### 5. Conclusion and recommendations

This paper has assessed the impact of IT exports, gross capital formation, FDI, and trade openness on sustainable economic growth with regional integration of BRI countries using the annual panel data from

2013 to 2018. The two-step GMM method has been employed to analyze the data due to its robustness and efficiency. Also, several studies recommended the system GMM technique to analyze the impact of these variables on economic growth. Findings conclude that most of the BRI countries are developing and to bring economic growth and stability, it is important to attract new foreign direct investments and to increase the gross capital formation in the countries. It will boost the economic activities in the countries, which will lead to increased employment opportunities, development, and growth. Foreign direct investment has a considerable positive impact on the economic growth of BRI nations, and China's outward FDI is critical in enabling developing countries to benefit from FDI-driven economic development.

Most of the BRI countries are underdeveloped and developing where resources are scarce, and unemployment, inflation and poverty are on the rise, with slow economic activities. With China's initiative, countries are getting investments from the developed world to revive their economies. The study is limited to panel data set of all BRI countries and considered untapped variables in this study including information technology exports and gross capital formation. FDI and gross capital formation have a substantial optimistic influence on the economic growth of BRI countries, whereas IT exports and trade openness have an adverse and insignificant effect on the sustainable economic growth of BRI countries.

This research paper provides a better and clear picture to the investors and the policymakers to identify the countries where there are investment opportunities and where they can boost economic growth by promoting trade relationships. FDI and trade relationships among the BRI countries are the most important variables that can contribute to the overall economic revivals in the case of developing countries. The policymakers would be able to identify that China's BRI initiative is and will be the most attractive and encouraging project for BRI partner countries, and it's the future for the world economy because of huge investment and trade prospects economies are linked under this project. However, the poor countries face a crisis in the shape of heavy import bills because their local industry is not efficient enough to compete in the global markets, therefore the trade openness is sufficient up to a certain level, and if the level exceeds, it harms the economic growth of the countries.

Following are the recommendations for researchers and the future perspectives of this study.

- A few other explanatory variables can also be used to examine the economic progress of BRI nations. The researchers should study the growth by the combination of different explanatory variables to get more accurate results and interpret accordingly. Future studies may untapped the relation of explanatory variables with green growth (such as by taking adjusted net savings from World Bank) or green finance (by using mitigation finance \$USD proxy from Asian Development Bank) concerning the role of multi-dimensional regional integration as moderating factor.
- To carry this research study to the next level, researchers can form two categories of the list of countries, such as developed countries and developing countries in BRI countries, and conduct a comparison study on the role of developed countries and developing countries in the BRI Initiative.
- Due to the current COVID-19 outbreak, the foreign direct investment, trade volumes, and exports of countries are reduced in developing countries and its impact on all BRI countries is huge. In future studies, researchers can utilize this study on recent data and report this year as a black swan/economic crisis as it has greatly affected the economic growth of BRI countries.

#### Declarations

##### Author contribution statement

Mubasher Zaman: Analyzed and interpreted the data; Wrote the paper.



Chen Pinglu: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.

Sayed Irshad Hussain: Analyzed and interpreted the data.

Atta Ullah: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Ningyu Qian: Contributed reagents, materials, analysis tools or data.

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## Appendix 1

Sample countries		
China	Armenia	Egypt
Mongolia	Azerbaijan	Israel
Pakistan	Belarus	Jordan
Bangladesh	Bulgaria	Kuwait
Bhutan	Croatia	Lebanon
India	Czech Republic	Oman
Nepal	Estonia	Qatar
Sri Lanka	Georgia	Saudi Arabia
Brunei	Hungary	Algeria
Cambodia	Latvia	Burkina Faso
Indonesia	Lithuania	Djibouti
Laos Lao PDR	Macedonia	Ethiopia
Malaysia	Moldova	Gambia
Myanmar	Poland	Mali
Philippines	Romania	Mauritius
Singapore	Russia/Russian Federation	Morocco
Thailand	Serbia	Rwanda
Vietnam	Slovakia/Slovak Republic	Senegal
Kazakhstan	Slovenia	South Africa
Kyrgyzstan/Kyrgyz Republic	Turkey	Kenya
Tajikistan	Ukraine	
Albania	Bahrain	

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