

# The Nexus Amongst the Interest Rate, Inflation and Economic Growth in Pakistan: Evidence from Simultaneous Equation Modeling

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## Abstract

The main objective of this empirical study is to analyze the nexus amongst the interest rate, inflation and economic growth in Pakistan: evidence from simultaneous equation modeling, for the period from 1970-2019. The estimate of the ADF test shows that all variables are a mixed order of integration, and the Johansen cointegration estimate reveals that there exist long-run relations amongst the variables. The estimate of the robust least square shows that inflation, unemployment, money supply, exchange rate, and budget deficit, have a positive effect on GDP per capita, while interest rate, total investment, and FDI have a negative effect on GDP per capita. Moreover, inflation and exchange rate have a positive effect on interest rate, while money supply, budget deficit, and FDI have a negative effect on interest rate. Furthermore, the interest rate has a positive effect on inflation, while unemployment and money supply have negative effects on

inflation. Policymakers should adopt a sound macroeconomic policy to enhance economic growth and control the interest rate and inflation.

**Keyword:** Interest Rate, Economic Growth, Inflation, Simultaneous Equation Modeling, Pakistan.

**JEL:** A10, A11, A12

## Introduction

The interest is the amount of income that must be paid over a duration of time as a percentage of the total borrowed or credited (called the principal amount). The interest on a loan for a specific period is usually articulated as a percentage prescribed for a year (Wikipedia (2022)). There are significant differences in the practice of loan duties as a strategy means to stimulate monetary progression on the other side, the study also indicates that declining loan rates as because of inflation strategy might stimulate to be economical due to improved financial activities (Jelilov et al., 2016). Thus having a healthy and noteworthy influence on

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financial development (Campos et al., 2012). Meanwhile, a slow growth of the economy due to effective monetary measures taken by the government can lead the economy to Decline (Odhiambo, 2009). This may be due to the undesirable and momentous statistical influence of loan rates (Udoka and Anyingang 2012). The relationship between interest rate and economic growth was examined by Hansen and Seshadri, (2013) and they found that there is no such relationship between interest rate and economic growth. While Maiga (2017) found that the interest rate did not influence the economic growth of a country, although the interest rate can influence investment. The finding shows that interest rates may not be a significant upshot on development; however, the Nigerian economy may benefit from lower interest rates that also have a healthy impact on savings. Moyo and Lee (2018) found that interest rate variations on the functioning of The Southern African Development Community (SADC) countries had a healthy effect on the economic strategies of SADC. One of the main points of McKinnon's (1973) argument is whether an increase in the real interest rate may encourage a benefit in the economy, allowing for some savings. This can go ahead to a fusion of financial asset buildup and capital gains. The focus of financial sector globalization in emerging states is based on steps intended to be taken by the Central Bank in an independent area that aids the elimination of "financial pressure" by reintroducing loan taxes, permitting for new financial means, and reducing targeted debt. This also allows for greater flexibility in terms of outside cash flow of various kinds. Financial constraints force the allocation of unprofitable assets, a lower rate of return on savings, financial soaring charge mediation, and is

an impediment to economic development (Roubin & Sala-i-Martin 1992).

There are different opinions about how the interest rate affects inflation and output. The most famous is called Monetary Transmission Mechanism (MTM). According to the demand side channel of MTM, increase an interest rate, therefore the aggregate demand will decrease and finally, the price level will decrease. However, the supply side channel of MTM states that the rise of interest rate will increase the cost of production, shifting up the aggregate supply curve. This will create a rise in the general price level (Rehman 2014; Uddin 2021). According to monetarism, which suggests that inflation is a major factor that influences growth, However, if inflation is more than the rate of economic growth rate, while the price has to go up consequently (Bhuinia, 2016; Gokal and Hanif 2004; Tanwer, 2014; Ijaz, 2021). But Phillips' curve concept suggests that high inflation with confidence and positively impacts economic growth by lowering the unemployment rate. Subsequently, a few dynamic studies by Dorrance (1966), Jayathilake & Rathnayake (2013) and Saad and Uddin (2021) concluded that there was no positive or negative link between economic development and inflation. In addition, architects argue that inflation is important for economic growth at the same time as financial managers think inflation is not safe for economic development (Doguwa and Sani, 2012). The link between economic development and interest rates remains one of the most controversial issues in the last decade worldwide. When loan charges are increased, customers typically have less money to save. However, amid less expenditure, the budget goes down, which leads to a lower inflation rate. Afterwards, when rates are low, users prefer to get more cash to spend,

the economy slows, and money rises. According to McKinnon (1973) and Shaw (1973), high real interest rates generate successive levels of savings that promote economic growth. That is why it is critical to ensure that asset prices and economic expansion go hand in hand. However, Barro and Becker (1989) considered a discount on their model and confirmed the negative correlation between real interest rates and economic growth.

The link between inflation, loan rate, and economic growth has been one of the most important and controversial economic topics between policymakers and economists. Economic growth reflects the country's ability to increase productivity. Inflation and interest rates are two important macroeconomic variables as the behavior of these two factors has an important contact on economic development. (Mensah and Okyere 2015). Gülşen & Özmen (2020) argued that domestic interest rates respond to inflation and inflation, especially, under short-term inflation (IT). ABhoff et al. (2020) investigated the effects of unfavorable monetary policy (UMP) on price rises expectations that have a positive impact of UMP on price rise potential tends to fade over the medium term while reflecting real GDP growth over the medium-term growth produced by UMP measures. However, some researchers have emphasized that high inflation expectations had a healthy upshot on financial activity during fixed loan taxes (Coibion et al., 2018).

## Literature Review

### Theoretical review:

Every country wishes to lower inflation while maintaining price stability in order to attain a better rate of economic growth. Mundell (1963) and Tobin (1965) discovered

a positive relationship between inflation and economic growth, but Stockman (1981) discovered a negative relationship between inflation and economic growth. Fischer (1983), discovered the nonlinear relationship where low inflation has a beneficial influence on economic growth. Furthermore, as the rate of inflation rises, there is a detrimental influence on economic growth. When the rate of inflation is excessive, there is a negative association between inflation and economic growth; however, when the rate of inflation is too low, there is no solid evidence of a correlation between inflation and economic growth (Bruno and Easterly, 1998). The intricate relationship between inflation, interest rates, and economic growth was also investigated by Friedman's (1961) monetarist school of thought. According to monetarist theory, an expanding money supply is the primary cause of inflation or deflation in an economy, and this issue has an impact on economic growth. Friedman downplayed the relevance of interest rates and interest rate uncertainty as variables influencing money demand, while emphasizing inflation expectations as a key effect on fluctuations in velocity (Bibow 2002). According to Taderera et al. (2021), while inflation targeting provides rationality to the financial sector, it may slow development because the desired inflation level is higher than the targeted inflation level. Furthermore, Kumar et al. (2020) proposed that a successful banking sector is critical for economic growth, and interest rate fluctuations have the capacity to alter bank profitability.

### Empirical Review:

However, they all used time domain analysis to examine the growth-inflation relationship. Barro (1995) identified a negative

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association between growth and inflation using data from more than 100 nations from 1960 to 1990, but Anidiobu et al. (2018) discovered a positive but non-significant relationship between growth and inflation in Nigeria using data from 1986 to 2015. In the case of Pakistan, Shahid (2014) investigated the long-run relationship between inflation, unemployment, and economic development. The ARDL estimate findings showed a negative and negligible link. Ihsan and Anjum (2013) examine the Impact of Money Supply (M2) on the GDP of Pakistan by using the Regression Model. The finding showed that CPI and interest rate have a significant impact on GDP and inflation rate has an insignificant impact on GDP. Fazlani et al. (2012) used regression analysis and found that long-run inflation is not only related to interest rate but also with supply of money. Hence, interest rate has a greater impact on the inflation in Pakistan. Ijaz (2021) worked on the impact of inflation on economic growth in Pakistan by using the Engel Granger Co-integration test. The finding showed that in Pakistan there is a strong positive and significant association between GDP growth and inflation. This means that a one-unit increase in GDP will result in a 0.27-unit increase in the inflation rate. Ijaz (2020) reported that interest rates have a positive relationship with the exchange rate and industrial input costs, but a negative relationship with the price of equity and investment. As a result, the exchange rate, import and export prices, and consumption have a positive link with inflation, but investment, loan, and production have a negative association with inflation. While Saad and Uddin (2021) reported that the effect of inflation on real GDP per capita is significant but negative. Azam and Khan (2020) evaluated the threshold influence of

inflation on economic growth in 27 countries. It is made up of 16 developing nations and 11 rich countries, and they utilized the fixed effect approach and the feasible generalized least square method to estimate the threshold impact of inflation on economic growth. According to the empirical findings, the link between inflation and economic growth over the threshold level is negative and substantial. The outcome also suggests that inflation harms economic growth.

Ali et al. (2015) worked on the impact of interest rate, inflation and money supply on exchange rate volatility in Pakistan by using the Johansen Co integration test. The short and long run relation between inflation and exchange rate volatility. High money supply and increase in interest rate raises the price level (inflation) which leads to an increase in exchange rate volatility. Uddin and Khalil (2022) worked on the impact of corruption, unemployment and inflation on economic growth: evidence from developing countries for 79 developing countries of the world for the period from 2002 to 2018. According to the calculations, corruption, unemployment, and political stability have a negative impact on GDP per capita, but inflation, governance effectiveness, and rule of law have a favorable impact. Taderera et al. (2021) conducted an empirical research study on the Southern African Customs Union (SACU) and concluded that policymakers should allow for a high sustainable inflation rate to promote economic growth, while interest rates can be used as a monetary policy tool to achieve the desired inflation rate, which will positively affect economic growth. Harswari et al. (2017) examined the impact of interest rates on economic growth in Asian nations from 2006 to 2015 and determined that interest rates had a significant negative impact on GDP and

inflation while having a negligible negative impact on foreign direct investments.

## Methodology and Data

### Model Specification

To observe the nexus amongst the interest rate, inflation and economic growth in Pakistan, evidence from Simultaneous Equation Modeling was taken. The model used (from equation 1, 2, 3) in this study has emerged from the previous research done by Akin et al., (2014), Ali et al., (2015), Azam & Khan (2022), Hayat et al. (2021), Saad and Uddin (2021), Uddin and Rehman (2022).

$$\ln GDPPC_t = \beta_{10} + \beta_{11} \ln IR_t + \beta_{12} \ln INF_t + \beta_{13} \ln UM_t + \beta_{14} \ln MS_t + \beta_{15} \ln ER_t + \beta_{16} \ln TI_t + \beta_{17} \ln BD_t + \beta_{18} \ln FDI_t + \varepsilon_{t1} \quad (1)$$

$$\ln IR_t = \beta_{20} + \beta_{21} \ln INF_t + \beta_{22} \ln MS_t + \beta_{23} \ln ER_t + \beta_{24} \ln FDI_t + \beta_{25} \ln BD_t + \varepsilon_{t2} \quad (2)$$

$$\ln INF_t = \beta_{30} + \beta_{31} \ln IR_t + \beta_{32} \ln MS_t + \beta_{33} \ln UM_t + \varepsilon_{t3} \quad (3)$$

Where,  $GDPPC_t$  = Gross Domestic Product Per Capita,  $INF$  = Inflation,  $MS$  = Money Supply,  $ER$  = Exchange Rate,  $FDI$  = Foreign Direct Investment,  $IR$  = Interest Rate,  $UM$  = Unemployment,  $TI$  = Total Investment  $BD$  = Budget Deficit  $\varepsilon_t$  = Error term, subscript ( $t = 1, \dots, t$ ) indicates the time period. And  $\ln$  represents a natural logarithmic form. Equation 1, estimates the impact of interest rate, inflation, unemployment, money supply, exchange rate, total investment, budget deficit, and FDI on GDP per capita. Equation 2 estimates the impact of inflation, money supply, exchange rate, foreign direct investment, and budget deficit on interest rate. While equation 3 represents the impact of interest rate, money supply and unemployment on inflation. In the given equation 1, the GDP per capita

is the dependent variable, while interest rate, inflation, unemployment, money supply, exchange rate, total investment, budget deficit, and FDI are explanatory variables. The  $\beta_{10}$  is intercept and  $\beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15}, \beta_{16}, \beta_{17}$  and  $\beta_{18}$  are slope coefficients of the respective variables and  $\varepsilon_{t1}$  is the residual term. In the given equation 2 the interest rate is the dependent variable, while inflation, money supply, exchange rate, foreign direct investment, and budget deficit are explanatory variables, the  $\beta_{20}$  is intercept and  $\beta_{21}, \beta_{22}, \beta_{23}, \beta_{24}$ , and  $\beta_{25}$  are slope coefficients of the respective variables, and  $\varepsilon_{t2}$  is the residual term. In equation 3 the inflation is the response variable while interest rate, money supply and unemployment are the explanatory variables, the  $\beta_{30}$  is intercept and  $\beta_{31}, \beta_{32}, \beta_{33}$  are the slopes of the respective variables.

### Augmented Dicky fuller test (ADF)

Before running the formal test, the stationarity checking is very important to avoid spurious estimates. The Augmented Dickey Fuller (ADF) is used to test, whether is stationary or not. The null hypothesis of the ADF test is that series are a unit root, while the alternative hypothesis reveals that the series has no unit root.

$$\Delta Y_t = +\alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^k d_j \Delta Y_{t-j} + \varepsilon_t \quad (4)$$

In the given equation 4 the  $\Delta X$  is the dependent variable represents first difference of the data series. The  $\alpha_0$  the intercept,  $\alpha_1$  is the slope of previous lags of the dependent variable,  $d_j$  represents the coefficient of  $k$  lags of the  $Y_t$  series (Azam et al., 2022).

### Johanson cointegration test

To determine if the model has any long-term relationships between the variables, the Johanson cointegration test is utilised. The

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number of cointegration equations in the model was verified by the trace and Eigen value tests. The alternative hypothesis of a “cointegration” link between the variables is compared to the null hypothesis of “no cointegration (Shaheen et al., 2017).

**Robust least square regression**

The robust least square regression is an extension of the simple least square regression that takes into account three dimensions of the variables. First, it helps to reduce potential outliers from the dependent variable using “S-estimation,” then it reduces potential outliers from the exogenous variable using “M-estimation,” and finally it deals with both the endogenous and exogenous

variables to remove potential outliers from the given models (Shaheen et al., 2017).

**Data measurement and Source**

The data has been obtained from the World development Indicator (WDI, 2022) and the State Bank of Pakistan. The data measurement and source are given in table 1.

**Results and Discussion**

**Descriptive statistics**

Table 2 shows the descriptive statistics of the variables. The mean value of GDP per capita, interest rate, inflation, money supply, total investment, unemployment, foreign direct investment, exchange rate, and budget deficit

**Table 1.** Data measurement and Source

Symbols	Abbreviations	Unit of Measurement	
GDPPC	Gross Domestic product per capita	Constant 2015 US \$	WDI (2022)
IR	Interest rate	Overnight Repo Rate	SBP (2022)
INF	inflation	Annual %	WDI (2022)
UM	unemployment	% of total labor fore	WDI (2022)
MS	Money supply	Annual %	WDI (2022)
ER	Exchange rate	Rupee/\$	SBP (2022)
TI	Total investment	% of GDP	WDI (2022)
BD	Budget deficit	%GDP	SBP (2022)
FDI	Foreign direct investment	net inflows (% of GDP)	WDI (2022)

**Table 2.** Result of Descriptive statistics

	GDPPC	IR	INF	MS	TI	UM	FDI	ER	BD
Mean	6.60145	10.4561	2.01506	3.79996	2.76766	1.05362	-0.78444	3.34217	1.52651
Median	6.66909	9.2341	2.017733	3.77803	2.80308	1.35950	-0.55962	3.37796	1.63129
Maximum	7.14142	13.2456	3.28327	4.122380	3.06697	2.05796	1.29973	4.96759	2.42952
Minimum	6.11008	4.4561	0.92795	3.526238	2.35421	-0.91629	-4.66963	1.56064	-0.75849
Std. Dev.	0.28560	0.3451	0.53276	0.144353	0.144729	0.79460	1.12542	0.94249	0.66014
Observation	44	44	44	44	44	44	44	44	44



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are, 6.60145, 10.4561, 2.01506, 3.79996, 2.76766, 1.05362, -0.78444, 3.34217, and 1.52651 respectively. The standard deviation of the GDP per capita, interest rate, inflation, money supply, total investment, unemployment, foreign direct investment, exchange rate, and budget deficit are 0.28560, 0.3451, 0.53276, 0.14435, 0.144729, 0.79460, 1.12542, 0.94249 and 0.66014 respectively.

### Unit root and Johnson Cointegration test

Table 3 shows the results of the ADF test. The null hypothesis of the ADF test, the series is unit root. In the given table the GDP per capita and exchange rate are not stationary at level, when all variables are converted to first difference, then all variables become stationary after the first difference. Table 4 presents the estimates of the Johnson Cointegration test, it reveals the rejection of the null hypothesis of no cointegration.

### Robust Least Square Regression Estimates

Table 5 shows the estimates of the Robust Least Square Regression Estimates (RLR)

for equation 1, 2 & 3 respectively. Where in the estimates of equation 1, the coefficient of interest rate and unemployment have a negative sign indicating that a 1% surge in the interest rate and unemployment will cause the reduction of GDP per capita by 0.011% and 0.004% respectively. When the interest rate is high the investment level will decrease and it turn diverse effect on aggregate demand (Ijaz, 2020). Unemployed people tend to spend less, may accrue more debt, it will lead to reduction of the GDP per capita. This finding agrees with the finding of Imran et al. 2015; Uddin and Khalil 2022. The coefficient of inflation, money supply, exchange rate, total investment, budget deficit and foreign direct investment have a positive sign indicating that 1% rise of the inflation, money supply, exchange rate, total investment, budget deficit and foreign direct investment will cause a surge in GDP per capita by 0.004%, 0.250%, 0.279%, 0.141%, 0.002% and 0.003% respectively. When inflation grows, so do consumer spending and investment, since individuals are incentivized to make purchases sooner

**Table 3.** Results of ADF Test

At Level			1st Difference		
Variable	Constant	Constant + Trend	Variable	Constant	Constant + Trend
GDPPC	-0.610777	-1.995403	ΔGDPPC	-5.679002 <sup>a</sup>	-5.61000 <sup>a</sup>
IR	-5.949491 <sup>c</sup>	-5.422341 <sup>c</sup>	ΔIR	-7.545656 <sup>b</sup>	-7.545561 <sup>a</sup>
BD	-5.063091 <sup>c</sup>	-5.287102 <sup>c</sup>	ΔBD	-8.009014 <sup>b</sup>	-6.069905 <sup>a</sup>
ER	-1.368425	-2.813690	ΔER	-6.299583 <sup>a</sup>	-7.499114 <sup>a</sup>
FDI	-3.327314 <sup>c</sup>	-4.312425 <sup>c</sup>	ΔFDI	-12.64972 <sup>c</sup>	-12.69651 <sup>a</sup>
INF	-3.233091 <sup>b</sup>	-3.416264 <sup>a</sup>	ΔINF	-7.377869 <sup>c</sup>	-7.328926 <sup>b</sup>
MS	-1.470389	-4.292740 <sup>c</sup>	ΔMS	-5.695925 <sup>b</sup>	-5.727196 <sup>b</sup>
TI	-3.849007 <sup>c</sup>	-3.813989 <sup>b</sup>	ΔTI	-4.522248 <sup>a</sup>	-4.500464 <sup>a</sup>
UM	-5.613077 <sup>c</sup>	-1.760695	ΔUM	-5.613077 <sup>a</sup>	-5.499335 <sup>a</sup>

Note a,b, & c represent 1% , 5%, & 10% level of significance.

Table 4. Johansen Cointegration test

Hypothesized No of CE	Equation 1		Equation 2		Equation 3	
	Eigen Value	Trace Statistics	Eigen Value	Trace Statistics	Eigen Value	Trace Statistics
None	0.936	379.010 <sup>c</sup>	0.623 <sup>a</sup>	122.307 <sup>a</sup>	0.672 <sup>a</sup>	81.312 <sup>a</sup>
At most 1	0.903 <sup>a</sup>	285.372 <sup>c</sup>	0.604 <sup>c</sup>	80.339 <sup>b</sup>	0.551 <sup>a</sup>	43.410 <sup>a</sup>
At most 2	0.835 <sup>b</sup>	205.929 <sup>a</sup>	0.446 <sup>a</sup>	40.424 <sup>a</sup>	0.279 <sup>a</sup>	16.182 <sup>a</sup>
At most 3	0.770	144.615 <sup>c</sup>	0.188 <sup>b</sup>	15.014 <sup>c</sup>	0.137 <sup>a</sup>	5.041 <sup>a</sup>
At most 4	0.623 <sup>a</sup>	94.603 <sup>c</sup>	0.129 <sup>a</sup>	6.059 <sup>a</sup>		
At most 5	0.530 <sup>a</sup>	61.405 <sup>a</sup>	0.002 <sup>a</sup>	0.094 <sup>a</sup>		
At most 6	0.396 <sup>a</sup>	35.670 <sup>a</sup>				
At most 7	0.327 <sup>a</sup>	18.507 <sup>a</sup>				
At most 8	0.137 <sup>a</sup>	5.022 <sup>a</sup>				

Note a,b, & c represent 1% , 5%, & 10% level of significance.

rather than later. Consumers rationally want to buy now rather than wait until the product becomes more expensive next year. It causes an increase in aggregate demand, which leads to an increase in economic growth. This finding agrees with the finding of Uddin 2021; Uddin and Khalil 2022.

In table 5, where in the estimates of equation 2, the coefficient of inflation and exchange rate have a positive sign indicating that 1% rise the inflation and exchange rate will lead to a surge in interest rate by 0.176% and 1.544% respectively. Inflation will also have an impact on interest rate levels. The higher the inflation rate, the more likely interest rates will rise. This happens because lenders will want higher interest rates to compensate for the future reduction in the buying value of the money they are paid. When the exchange rate is high, the price of imported items is comparatively cheap. Furthermore, the price of imported raw materials and components will cut enterprises' manufacturing costs, perhaps leading to reduced consumer pricing. While the coefficient of money supply, budget

deficit and foreign direct investment have a negative sign indicating that a 1% surge in the money supply, budget deficit and foreign direct investment will cause the reduction of the interest rate by 4.546%, 0.007% and 0.868% respectively. A bigger money supply reduces market interest rates, making consumer borrowing less expensive. Smaller money supply, on the other hand, tends to boost market interest rates, making it more expensive for customers to get a loan. Long-term interest rates rise in response to the government deficit. Any action to reduce the predicted level of future national savings raises expected short-term interest rates.

In table 5, where in the estimates of equation 3, the coefficient of interest rate and money supply is a positive sign, indicating that 1% rise in the interest rate and money supply will cause a rise in inflation by 0.405% and 4.885% respectively. The price level would rise if interest rates increased. For example, the cost channel argues that an increase in interest rates will raise the cost of manufacturing, pushing the aggregate supply



curve upward. The general price level will rise as a result of this. Monetary tightening will lower aggregate supply and raise inflation further. As a result, the evidence that monetary tightening caused inflation dates back to 1923, when Gibson (1923) stated that the link between inflation and interest rates is positive. According to Rehman (2014) and Ijaz (2020), rising interest rates lead to greater inflation,

which has an influence on the cost side of the economy. The coefficient of unemployment has a negative sign indicating that a 1% surge in the unemployment will cause a reduction in inflation by 0.611% in Pakistan. Historically, inflation has been inversely related to unemployment. This means that when inflation grows, so does unemployment. Lower inflation is associated with higher

**Table 5. Robust Least Square Regression Estimates**

Variable	Equation 1	Equation 2	Equation 3
Interest rate	-0.011 (0.399) <sup>a</sup> [0.004]		0.405 (0.233) <sup>c</sup> [0.082]
Inflation	0.004 (0.002) <sup>b</sup> [0.065]	0.176 (0.081) <sup>b</sup> [0.031]	
Unemployment	-0.004 (0.005) [0.446]		-0.611 (0.326) <sup>c</sup> [0.061]
Money supply	0.250 (0.117) <sup>b</sup> [0.033]	-4.546 (3.368) [0.177]	-4.885 (5.125) [0.340]
Exchange rate	0.279 (0.017) <sup>a</sup> [0.000]	1.544 (0.522) <sup>a</sup> [0.003]	
Total investment	0.141 (0.082) <sup>c</sup> [0.086]		
Budget deficit	0.002 (0.003) [0.547]	-0.007 (0.159) [0.962]	
Foreign Direct investment	0.003 (0.014) [0.882]	-0.868 (0.561) [0.122]	
C	5.148 (0.537) <sup>a</sup> [0.000]	19.762 (12.035) [0.100]	25.178 (20.387) [0.216]
R <sup>2</sup>	0.841	0.186	0.113
Rw-squared	0.972	0.286	0.197
S.E. of regression	0.069 <sup>a</sup>	2.354 <sup>a</sup>	4.597 <sup>a</sup>

Note a,b, & c represent 1% , 5%, & 10% level of significance.

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unemployment. The finding is consistent with the finding of Arshad and Ali 2016. Moreover, the coefficient of determination (R square) for GDP per capita, interest rate and inflation equation is 0.841, 0.186 and 0.113, indicating that 84.1% variation occurs in GDP per capita, 18.6% variation occurs in interest rate and 11.3% variation occurs in inflation equation is due to their explanatory variables.

**Granger causality estimates**

Table 6 presents that the estimates of granger causality, the finding reveals that there is bio directional exist between the GDP per capita and FDI, interest rate and inflation, money supply and exchange rate. While unidirectional exist between the interest rate and budget deficit, budget deficit and money supply, budget deficit and total investment, interest rate and FDI, unemployment and FDI, exchange rate and inflation, inflation and GDP per capita, inflation and total investment, interest rate and GDP per capita, GDP per capita and exchange rate, total investment and exchange rate, GDP per capita and money supply. Moreover, no causality exists between FDI and budget deficit, inflation and budget deficit, interest rate and budget

deficit, GDP per capita and budget deficit, unemployment and budget deficit, inflation and FDI, exchange rate and FDI, money supply and FDI, total investment and FDI, money supply and inflation, unemployment and inflation, exchange rate and interest rate, money supply and interest rate, total investment and interest rate, interest rate and unemployment, unemployment and exchange rate, total investment and GDP per capita, unemployment and GDP per capita, total investment and money supply, unemployment and money supply, unemployment and total investment.

**Conclusion**

The central objective of the empirical study is to examine the simultaneous equations modeling for interest rate, inflation and economic growth, for the period from 1970 to 2019. This empirical study used ADF, Johansen Cointegration, robust least square (RLS), and Granger causality. This ADF test shows that budget deficit, FDI, inflation, total investment and unemployment are stationary at level, while GDP per capita, exchange rate and money supply are stationary after first difference. The Johansen Cointegration test

**Table 6.** Estimates of granger causality

	GDPPC	IR	INF	UM	MS	ER	TI	BD	FDI
LnGDPPC		0.291	1.097	0.828	6.249 <sup>b</sup>	11.528 <sup>a</sup>	0.760	2.368	3.626 <sup>a</sup>
IR	3.562 <sup>b</sup>		7.869 <sup>a</sup>	4.968	2.046	0.203	0.293	12.14 <sup>a</sup>	6.999 <sup>b</sup>
INF	2.926 <sup>c</sup>	12.909 <sup>c</sup>		0.586	2.395	1.015	2.921 <sup>b</sup>	0.024	0.665
UM	1.359	3.109	2.011		0.224	0.121	0.385	0.376	4.093 <sup>b</sup>
lnMS	0.252	0.598	1.142	1.233		3.258 <sup>c</sup>	0.139	1.504	0.139
lnER	0.305	1.096	6.342 <sup>a</sup>	0.301	5.183 <sup>b</sup>		1.527	2.686	1.717
LTI	0.147	0.961	0.008	0.642	0.317	5.295 <sup>b</sup>		0.137	1.236
BD	0.615	0.431	1.880	1.167	3.234 <sup>c</sup>	0.910	3.273 <sup>c</sup>		0.906
FDI	3.239 <sup>b</sup>	1.830	0.290	0.286	0.135	1.864	0.733	2.103	

Note a,b, & c represent 1% , 5%, & 10% level of significance.

results show that there is a long-run nexus among the variables. The estimates of RLS for equation 1, the coefficient of interest rate and unemployment have a negative effect on GDP per capita while inflation, money supply, exchange rate, total investment, budget deficit and foreign direct investment have a positive effect on GDP per capita. Since the estimates of RLS for equation 2, the coefficient of inflation and exchange rate have a positive effect on interest rate, while money supply, budget deficit and foreign direct investment have a negative effect on interest rate. Moreover the estimates of RLS for equation 3, the coefficient of interest rate have a positive effect on inflation, while unemployment and money supply have a negative effect on inflation in Pakistan. The estimates of granger causality reveals that there is bio directional causality between GDP per capita and FDI, interest rate and inflation, while uni-directional causality exists between interest rate and FDI, inflation and GDP per capita, inflation and total investment, interest rate and GDP per capita, GDP per capita and exchange rate, GDP per capita and money supply.

This empirical study has several policy recommendations which are based on the research findings:

1. The government should allocate more budgets on productive projects.
2. The government should improve the debt service to support economic growth and control inflation.
3. The policymakers should adopt a sound macroeconomic policy to enhance the economic growth and control the interest rate and inflation.
4. Inflationary pressures stifle economic growth, thus policymakers must devise appropriate measures to regulate and lower inflation to single digits.
5. Political stability, security, and safety for foreign investors in Pakistan are more crucial factors in attracting FDI to our country.
6. Pakistan's central bank should also pursue an expansionary monetary policy in order to reduce the borrowing costs and support growth.

This study has several limitations which will provide us opportunity for future research. This empirical study is based on Pakistan's economy only, a further study use this variables for developing and developed countries. This empirical study only used the Robust Least Square, and ignored the GMM, FMOLS, DOLS and ARDL and more advanced econometric techniques.

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