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Estimation of Threshold Level of Interest Rate and Analysis of Determinants of GDP For Pakistan

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Abstract
Objective: This study aims to calculate the threshold level of interest rate for Gross Domestic Product (GDP), moreover this study also intended to explore the major determinants of the GDP which are inflation, money supply, interest rate, and investment.
Research Gap: Very few studies in Pakistan have estimated the threshold level of interest rate for GDP in Pakistan so this the research gap for this study.
Methodology: This study employed time series data starting from 1991- 2024. The study employed the Augmented Dickey Fuller Test, Non-linear Threshold model and Autoregressive Distributive Lag model for the analysis of the data.
The Main Findings: Results from the non-linear regression model found the threshold level interest rate of 11% is the threshold level of interest for Pakistan. Which means that up to 11 % the interest rate will have a positive impact on the GDP while after 11 % interest rate has inverse impact on the GDP. Results from the ARDL model revealed positive long run effect of inflation, money supply, and investment on GDP, while interest rate has a negatively affect to GDP.
Practical implication of the Findings: This study recommends that we gradually bring down the interest rate at 9-10 % because a 9% interest rate is beneficial for the economy. Increase money supply that reduce interest rate which increase investment and consumption expenditure thereby increasing national income and employment.
Key Words: GDP, Interest Rate, Non-linear Threshold model, ARD

Introduction

Background of the Study

Investment plays an important role in accelerating the pace of economic growth, which will increase the Gross Domestic Product (GDP), per capita income, and economic prosperity. The increase in the GDP will increase the per capita income and purchasing power of the masses and hence decrease poverty and stimulate prosperity. The increase in the GDP and investment will also increase employment and productivity. The interest rate plays an important role in the promotion of investment and GDP. An increase in interest rate initially at a low level will promote the investment and GDP, while after a level of interest rate, the interest rate will harm and decrease the investment and GDP. The point from where the interest rate has an inverse impact on the investment and GDP is called a threshold interest rate. Before the threshold, the interest rate is positive while after the threshold the interest rate harms the GDP and Investment, Olaniyi (2019).

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Elevated interest rates increase the cost of borrowing, decrease disposable income, and therefore curtail consumer spending growth. According to Azam and Khan (2022), the elevated interest rate level can lead to uncertainty about the future benefits of investment projects and thus decrease aggregate output. Higher interest rates tend to decrease inflationary pressures and cause an appreciation in exchange rates. On the other hand, lower interest rates indicate more money available in the pockets of consumers and investors. On the part of the consumers, lower interest rates will discourage them from saving, making them have more money in their pockets to increase their consumption level which has a positive relationship with economic growth. Also, households may borrow more when interest rates are lower because they will have smaller repayment obligations. Similarly, reduced interest rates can encourage business expansion by boosting investment spending.

Specifically, inflation, which entails price increases, affects the overall economy. Its effect on the economy could be both negative and positive. If the inflation rate is managed and kept at a reasonable level, the economy may boom. If the inflation rate becomes too high, the economy may deteriorate. The cost of borrowing will rise with rising prices, which will lower investment, cost of living, and cost of doing business (Azam & Khan, 2022). On the other hand, if inflation is controlled and maintained at a lower level, employment rises, leading to an increase in demand for goods and services that will propel economic growth. In other words, high rates of inflation force businesses and consumers to shift funds away from profitable ventures and into endeavors that might not promote economic growth.

The yoke between money supply and output has been getting increasing attention in recent times for the important role it plays in economic growth in emerging and industrialized economies (Hussan and Haque, 2017). Some Keynesians think that “money does not matter”, hence irrelevant to influence economic growth, while on the other hand, some monetarists believe that “money does matter”. However, the new Keynesians argue that in the short run, changes in the money supply seem to affect real variables like GDP and employment levels because of price-rigidity (Price-stickiness) and imperfect information flow in the market. This study intends to calculate the threshold level of interest rate for Pakistan economy and also intends to quantify the impact of the various determinants including interest rate on the GDP.

Analysis of the nexus between the Gross Domestic Product (GDP) and its Determinants

Idris (2019) proved that there was a negative relationship between interest rates and economic growth. Semuel and Nurina (2015) proved that there was a significant positive relationship between interest rates and GDP. Ihsan and Anjum (2013) showed that interest rate has a significant impact on GDP. Habanabakize and Meyer (2018) analyzed that there was a negative relationship between interest rates and GDP. Udoka and Roland (2012) reveal a direct relationship existed between interest rate and GDP.

Nandeeswara and Yesigat (2015) analyzed the negative relationship between the inflation and economic growth. Malenkovic (2023) proved that an increase in inflation has a negative and statistically significant impact on GDP. Eka and Seno (2025) showed that inflation negatively affects GDP. Semuel and Nurina (2015)

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proved that there was a significant positive relationship between inflation and GDP.
Umaru and Abdulrahman (2012) showed that there was a positive impact of inflation on economic growth. Eka and Seno (2025) declared that the money supply positively affects GDP. Bajrami et al. (2025) indicate that the money supply has a positive and significant impact on economic growth.
Eka and Seno (2025) proved that investment positively affects GDP. Bajrami et al. (2025) showed that Foreign Direct Investment positively influences growth. Ingilab et al. (2020) showed that İnvestment has a significant positive effect on economic growth. Habanabakize and Meyer (2018) reveal a significant positive relationship between Foreign Direct Investment and GDP.

Objectives of the study

To estimate the threshold level of the interest rate for GDP
To evaluate the impact of various important variables on the GDP

Significance of the study

Estimating the threshold level of interest rate and analyzing the determinants of GDP is vital for Pakistan's economic stability and growth. The threshold level of interest rate determines the optimal level for monetary policy, balancing inflation and growth, while GDP determinants confess the drivers of economic expansion. By identifying these factors, policymakers can make informed decisions to promote sustainable growth, break poverty and inequality, and increase economic competitiveness. Judicious estimation and analysis can help to address Pakistan's challenges, including low economic growth, high inflation, and trade deficits. Moreover, identifying the key drivers of GDP growth can help Pakistan optimize its resource allocation, attract foreign direct investment, and expand its economy. By addressing these critical issues, Pakistan can acquire sustainable economic growth, improve living standards, and become an antagonist player in the global economy.

Literature Reviews

Waqas et al. (2015) the main objective of this study is to investigate the effect of major economic variables including the interest rate, exchange rate, and inflation rate on the economic growth of Pakistan. The results showed that both the interest rate and inflation rate harm Pakistan's economic growth while the exchange rate is found positive impact on the economy of Pakistan.
Evans (2017) used a non-linear threshold model to shed light on the impact of interest rates on financial inclusion in Nigeria. The estimated interest rate threshold was 16.9% and the threshold is significant at the 0.05 level. This revealed that interest rates were harmful to financial inclusion when interest rates were too high. Nigeria and other developing countries should aim to attain interest rate levels that do not deter financial inclusion by adopting policies that drive down interest rates.
Habanabakize and Meyer (2018) explored the relationship between Foreign Direct Investment, GDP, and interest rate in South Africa. The results reveal that FDI and GDP are positively correlated while GDP and interest rate are negatively correlated. They suggest that South African macroeconomists and policymakers should mostly focus on creating opportunities that attract foreign investors in

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order to improve the country's economy.

Idris (2019) investigated the effect of interest rates on the economic growth of Nigeria. The result shows the negative relationship between interest rates and economic growth in Nigeria. To achieve the desired growth level in Nigeria, monetary authorities and policymakers should adopt policy measures that are growth-oriented and have the potential to accelerate the economy to higher productivity and sustainable economic growth.

Olaniyi (2019) examined the threshold effects of interest rates on growth and investment in Nigeria. They used a threshold estimation approach for Nigeria. The estimated values of the interest rate threshold are 21.1% for GDP growth and 22.6% for investment growth that is the interest rate contributes positively to economic growth. Nigeria and other developing countries as well should aim to achieve interest rate levels that do not inhibit growth and investment by adopting policies that put interest rates on the right trajectory below the estimated threshold.

Krupasindhu et al. (2020) investigated the impact of unemployment, inflation rate, and interest rate on GDP in ASEAN-5 countries (Indonesia, Thailand, Malaysia, Philippines, and Singapore). The results show a strong long-run relationship between inflation and economic growth, but the relationship between the unemployment rate and economic growth is insignificant. They suggest that policymakers should be aware of this linkage when making decisions to facilitate economic growth and stability.

Njie and badjie (2021) examined the effect of interest rates on economic growth in Gambia. They employed a vector error correction model. The results indicate that interest rates harm the performance of Gambia's economy in the long run but in the short run there is no relationship between interest rates and economic growth in the context of Gambia.

Berko et al. (2022) checked the effect of interest rate spread on economic growth in Ghana. The long-run and short-run results indicate a negative impact of interest rate spread on economic growth. Policy actions to ensure macroeconomic stability should be embarked upon to achieve stability and sustainable growth of the economy.

Adenomon and Oduwole (2022) examined the interrelationship among inflation, exchange rate, and interest rate with the impact of money supply and GDP in Nigeria. The results show that the effect of GDP on the exchange rate and inflation rate is negative and positive for the interest rate while the money supply effect on the exchange rate and inflation rate is positive and negative for the interest rate.

Joon (2024) investigated the threshold impact of interest rates on economic growth. They used the panel threshold model to properly determine the threshold value of the interest rate and its impact on economic growth. The threshold effect identified in this study is much smaller than the 21.1%. In the future, further research is likely to clarify the actual relationship between the exchange rate and the growth of the economy.

Bawono et al. (2024) examined the dynamic interplay of interest rate (usury), investment, economic development, and labor force participation in Indonesia. The threshold interest rate is around 2.772. Above this threshold, changes in interest rates can stimulate or inhibit economic expansion. Careful management of interest rates is important to maintain the balance between stimulating growth

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and avoiding a downturn.
Abdullahi (2024) analyzed that the macroeconomic variables affect African economies such as Nigeria, South Africa, Egypt, Algeria, and Morocco. The results show that interest rate, exchange rate, inflation, and FDI can influence the selected African economies. FDI has been identified as an important factor in improving industrial prosperity and living standards in developing economies after stabilizing inflation, currency exchange rate, and interest rate.
Oyadeyia et al. (2025) investigated the optimum threshold effects of interest rates, inflation rates, and exchange rates in stimulating economic growth in Nigeria. They employed the threshold auto-regression technique. Results show that interest rate-economic growth thresholds suggest targeting an average monetary policy rate of 16.5%, a prime lending rate of 20%, and a maximum lending rate of 30%.

Theoretical Framework and Econometric Methodology
Investment plays a vital role in increasing production capacity and driving economic growth. Investment is a key factor in economic growth. High levels of investment can expand production capacity, increase output, and create jobs, which contributes to GDP growth. In this theory, increased investment leads to a higher capital stock, driving long-term economic growth, reflected in an increase in GDP (Domar, 1946). Rizky et al. (2022) show that increased investment, both public and private, can boost GDP through the creation of new infrastructure, technological innovations, and production efficiency. Mashita (2023) identified that foreign direct investment (FDI) significantly enhances national productivity and economic growth Eka and Seno (2025).
The money supply plays a crucial role in determining aggregate demand within an economy. Increasing the amount of money in circulation can drive GDP growth through increased consumption and investment. Increasing people's purchasing power due to increasing money in circulation will drive aggregate demand. Devinda et al. (2023) show that the amount of money in circulation has a positive effect on economic growth. However, excessive growth in the money supply can lead to inflation, which may harm the economy. Eka and Seno (2025).
Mundell (1963) and Tobin (1965) have explained the effect of inflation on economic growth based on neo-classical growth theory. They depict a positive relationship between inflation and economic growth by assuming that real money balance and investment are substitutes. Thus when inflation is high, it will decrease the return on real money balances but the return on investment will increase and people substitute the real money balance by investing in other assets. This increases capital accumulation and economic growth and it will show a positive relationship between inflation and economic growth. Rao and Yesigat (2015).
A negative relationship between interest rates and GDP because lower interest rates can lead to higher GDP. Keynesian economics suggests that lowering interest rates can encourage investment, which can lead to higher GDP.

Variables of the study
This study aim to quantify the threshold level of interest rate for Gross Domestic Product (GDP), moreover this study also intended to explore the major

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determinants of the GDP are arranged below.

Table 1: Variables of the Study

S. No	Variables	Code	Nature	Sign	Measurement
01	Gross Domestic Product	GDP	Dependent		Growth rate
02	Interest rate	INTR	Independent	Negative	Percentage
03	Money supply	MS	Independent	Positive	Growth rate
04	Inflation	INF	Independent	Positive	Percentage
05	Investment	INVT	Independent	Positive	Per capita GDP

Econometric Technique and Research Methodology:
The analysis was done in two steps, in first step this research has estimated the threshold level of interest rate for GDP while in second step this study has quantified the major determinants of the GDP which are inflation, money supply, interest rate, and investment. The threshold level of interest rate is calculated by using Non-Linear Threshold Regression. For regression all variables must be stationary at level. Threshold level of interest rate is based on the following equations.

$GDP = \beta_0 + \beta_1 (INTR_t) + \beta_2 * D_t (INTR_t - k) + \beta_3(INF_t) + \beta_4(MS_t) + \mu_t$

The second step of this research study has quantified the major determinants of the GDP. This study employed the ARDL co-integration to quantify the long run impact of the handles on the GDP. When the variables are integrated of mixed order, some variables are integrated I (0) and other integrated I (1), then the model that is used in this situation can be Autoregressive Distributive Lag model (ARDL). Interest rate, and inflation were integrated at level *I (0)* while other variables were stationary at first difference, *I (1)*. The existence of ARDL type co-integration is further verified by using ARDL bound test.

$GDP = \beta_0 + \beta_1 INVT + \beta_2 INTR + \beta_3 MS + \beta_4 INF + \mu$

Data type and sources
This research study used the Time Series Data from 1991-2024 and retrieved from World Bank, the data will consist of the following variables Gross Domestic Product, Interest Rate. Inflation, Money Supply, and Investment.

Data Analysis and Interpretation
Granger Causality Test:
The granger causality test is to evaluate the direction of the causation among the various economic variables. In this research study the granger causality is used to check the direction of causality among the variables included in the model the variables are Gross Domestic Product and interest rate.

Table 2: Granger Causality test between the Interest rate and gross

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domestic product:

Null Hypothesis	No of Observations	F-statistics	Probability
Interest rate does not Granger cause GDP	32	7.34668	0.0028
GDP does not Granger cause interest rate	32	1.62071	0.2164

Above table present the results of granger causality, where the null hypothesis of interest rate is (Interest rate does not Granger cause GDP) and the null hypothesis of GDP is (GDP does not Granger cause interest rate). As present in table 01 the first null hypothesis is rejected which means that interest rate granger cause the gross domestic product. However, the second null hypothesis is accepted implying the gross domestic product does not granger cause the interest rate. The results verify the existence of unidirectional causality from interest rate to gross domestic product. Keynesian Theory of Interest Rate

Augumented Dickey Fuller Test

Table 3: Results of ADF tests

S.No	Names	ADF	Test Values	Critical value at 5%	P value	Results
01	GDP	Level	-4.425166	-3.552973	0.0067	*I(0)*
		1st difference	-7.033785	-3.562882	0.0000	
02	Interest Rate	Level	-5.284345	-3.580623	0.0010	*I(0)*
		1st difference	-2.718900	-3.587527	0.2373	
03	Inflation	Level	-5.187678	-3.552973	0.0010	*I(0)*
		1st difference	-4.766946	-3.568379	0.0033	
04	Money Supply	Level	-4.801601	-3.552973	0.0026	*I(0)*
		1st difference	-7.000931	-3.562882	0.0000	

The ADF test results showed that variables were integrated at level *I(0)* The results were according to the threshold non-linear regression.

The Analysis of the relationship between Interest rate and Gross Domestic Product and calculation of threshold level of interest rate:

Table 4: Regression analysis outcomes

K	Variables	Coefficient	Std. Error	t-Statistic	Prob.	RSS
	Money supply	0.067521	0.048286	1.398348	0.1726	105.7270
	Inflation	-0.013505	0.030306	-	0.6592	

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8%	Interest rate	-0.374175	0.137051	-2.730179	0.0107	
	i-k(i-8)	0.185660	1.265566	0.146701	0.8844	
	C	6.951857	1.750342	3.971713	0.0004	
Heteroskedasticity Test	nR^2	0.953697	P-value	0.9167		
Autocorrelation test	nR^2	3.492013	P-value	0.1745		
Normality Test	JB=5.763697	P-value	0.056031			
F-statistic	3.099921	Prob(F-statistic)	0.030626			
9%	Money supply	0.083826	0.049887	1.680314	0.1036	101.9547
	Inflation	-0.018954	0.030171	-0.628216	0.5348	
	Interest rate	-0.242276	0.173184	-1.398954	0.1724	
	i-k(i-9)	-1.041166	0.994831	-1.046576	0.3039	
	C	6.238012	1.767720	3.528847	0.0014	
Hetroskedasticity Test	nR^2	2.418492	P-value	0.6593		
Autocorrelation test	nR^2	3.233712	P-value	0.1985		
Normality Test	JB=3.974207	P=value	0.137092			
F-statistic	3.482869	Prob(F-statistic)	0.019311			
10%	Money supply	0.071684	0.050419	1.421764	0.1658	105.4441
	Inflation	-0.014618	0.030525	-0.478901	0.6356	
	Interest rate	-0.319901	0.196557	-1.627518	0.1144	
	i-k(i-10)	-0.327505	1.038774	-0.315281	0.7548	
	C	6.673621	2.008554	3.322599	0.0024	
Heteroskedasticity Test	nR^2	1.166505	P-value	0.8836		
Autocorrelation test	nR^2	3.424119	P-value	0.1805		
Normality Test	JB=5.393411	P-value	0.067427			

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F-statistic	3.127695	Prob(F-statistic)	0.029609			
11%	Money supply	0.071859	0.045628	1.574877	0.1261	95.11347
	Inflation	-0.007763	0.028794	-0.269597	0.7894	
	Interest rate	-0.635360	0.191909	-3.310734	0.0025	
	i-k(i-11)	1.822503	1.009394	1.805542	0.0814	
	C	9.078225	1.901449	4.774371	0.0000	
Hetroskedasticity Test	nR^2	5.469617	P-value	0.2424		
Autocorrelation test	nR^2	3.400082	P-value	0.1827		
Normality Test	JB=1.737327	P-value	0.419512			
F-statistic	4.254850	Prob(F-statistic)	0.007866			
12%	Money supply	0.059820	0.048551	1.232114	0.2278	103.9109
	Inflation	-0.013798	0.029950	-0.460698	0.6485	
	Interest rate	-0.248884	0.206097	-1.207611	0.2370	
	i-k(i-12)	-0.932587	1.282539	-0.727141	0.4730	
	C	6.098698	2.069507	2.946933	0.0063	
Heteroskedasticity Test	nR^2	1.930870	P-value	0.7485		
Autocorrelation test	nR^2	3.581954	P-value	0.1668		
Normality Test	JB=8.862739	P-value	0.011898			
F-statistic	3.280808	Prob(F-statistic)	0.024600			
13%	Money supply	0.066766	0.047950	1.392414	0.1744	105.4417
	Inflation	-0.012542	0.030212	-0.415133	0.6811	
	Interest rate	-0.318270	0.200131	-1.590304	0.1226	
	i-k(i-13)	-0.436688	1.380607	-0.316302	0.7540	

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	C	6.591020	2.171341	3.035460	0.0050	
Hetroskedasticity Test	nR^2	1.290771	P-value	0.8629		
Autocorrelation test	nR^2	3.610726	P-value	0.1644		
Normality Test	JB=6.378766	P=value	0.041197			
F-statistic	3.127925	Prob(F-statistic)	0.029600			
14%	Money supply	0.066099	0.048018	1.376544	0.1792	105.4974
	Inflation	-0.012176	0.030340	-0.401297	0.6911	
	Interest rate	-0.325768	0.190785	-1.707518	0.0984	
	i-k(i-14)	-0.416008	1.429484	-0.291020	0.7731	
	C	6.662546	2.093560	3.182400	0.0035	
Heteroskedasticity Test	nR^2	1.047904	P-value	0.9024		
Autocorrelation test	nR^2	3.376450	P-value	0.1848		
Normality Test	JB=6.067455	P-value	0.048136			
F-statistic	3.122449	Prob(F-statistic)	0.029798			
15%	Money supply	0.065503	0.048168	1.359877	0.1843	105.5065
	Inflation	-0.011158	0.030937	-0.360682	0.7210	
	Interest rate	-0.337882	0.163246	-2.069775	0.0475	
	i-k(i-15)	-0.541709	1.889678	-0.286667	0.7764	
	C	6.762307	1.902073	3.555230	0.0013	
Hetroskedasticity Test	nR^2	1.374067	P-value	0.8487		
Autocorrelation test	nR^2	3.223112	P-value	0.1996		
Normality Test	JB=5.521087	P=value	0.063257			
F-statistic	3.121553	Prob(F-statistic)	0.029831			

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The study used 08 Non-Linear threshold regressions for the estimation of threshold level of interest rate. The results of Non-Linear threshold regressions revealed that the residuals increase when the interest increases from 8 percent and continuously decreases upto 11 percent at 11 % of the interest rate the residuals are minimum (96.1134) and after 11 % the residuals the residuals are increasing. So the analysis concluded that the threshold level of interest rate is 11% (95.11347), which means that up to 11 % the interest rate will have positive impact on the GDP while after 11 % interest rate has inverse impact on the GDP.

Augmented Dickey Fuller Test
Table 5: Results of ADF Test

S.No	Variables	ADF	Test value	Critical value at 5%	P value	Results
01	GDP	Level	-2.456542	-3.557759	0.3458	*I(1)*
		1st difference	-6.426402	-3.562882	0.0000	
02	Interest Rate	Level	-5.284345	-3.580623	0.0010	*I(0)*
		1st difference	-2.718000	-3.587527	0.2373	
03	Inflation	Level	-5.187678	-3.552973	0.0010	*I(0)*
		1st difference	-4.766046	-3.568379	0.0033	
04	Money Supply	Level	-2.565618	-3.557759	0.2972	*I(1)*
		1st difference	-4.541122	-3.557759	0.0052	
05	Investment	Level	-2.756062	-3.557759	0.4809	*I(1)*
		1st difference	-4.279666	-3.562882	0.0000	

The ADF test results showed that variables were integrated of mixed order, some variables were integrated at level *I* (0) and some variables were integrated at first difference, *I* (1). Interest rate, inflation were integrated at level *I (0)*. While other variables were non-stationary at level and stationary at first difference, *I (1)*. The results were indicating the use of Autoregressive Distributive Lag Model (ARDL

Bound Test of Co- Integration
Table 6: Results of Bound Test

Test Statistics	Statistics Value	Level of Significance	Lower Bound	Upper Bound	Results
F-statistics	7.543192	5%	2.56	3.49	ARDL co-integration exist

The results of bound test has confirmed the presence of Auto-regressive Distributed Lag type of co-integration between the variables. The F-statistics value was greater than the upper bound reject the null hypothesis of the non-existence of Auto-regressive Distributed lag co-integration.

Long Run Analysis of Gross Domestic Product Handles
Table 7: Results of ARDL Co-Integration

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S. No	Variables	Co-efficient	t-statistics	P-value
01	Per Capita GDP(-	0.879832	17.59051	0.0000
02	Inflation	1.950417	1.862258	0.0749
03	Inflation(-1)	4.520849	2.821138	0.0095
04	Interest rate	-3.775586	-0.845235	0.4063
05	Money Supply	22.87176	4.746086	0.0001
06	Money Supply (-	-17.18636	-3.778215	0.0009
07	Investment	43.74297	3.867918	0.0007
08	Investment (-1)	-76.48028	-5.685633	0.0000
09	C	351.8914	2.625774	0.0148

Inflation has a positive and significant relationship with GDP which states that a 1% increase in inflation will increase the GDP per capita by 2 dollars. Bashir and Rashid (2019) and Laulak et al. (2024) confirm that inflation exhibits a positive but statistically insignificant relationship with GDP per capita. Nandeeswara and Yesigat (2015) and Malenkovic (2023) disprove the results and show a negative relationship between inflation and GDP. Results validate the Neo-classical and endogenous growth theories.

Money supply has a positive relationship with per capita GDP which indicates that a 1% increase in money supply as a percentage of GDP will change 23 dollars in per capita GDP. Dingela et al. (2017) reveal that there is a statistically significant positive relationship between money supply and economic growth both in the short run and long run. Razia and Omarya (2022) showed that money supply positively affects economic growth per capita. These findings support the Keynesian money transmission mechanism theory.

The interest rate has a negative relationship with GDP which state that a one percent increase in interest rate will lead to a decrease in GDP per capita by 4 dollars. Semuel and Nurina (2015) disprove the results and show a significant positive relationship between interest rate and GDP. Habanabakize and Meyer (2018) results confirm that there is a negative relationship between interest rate and GDP. This observation aligns with Keynesian Theory.

Investment has a positive relationship with GDP when investment increases by one percent GDP will lead to 44 dollars increase in GDP per capita. Ingilab et al. (2020) and Eka and Seno (2025) prove that İnvestment has a significant positive effect on economic growth. This outcome confirms the validity of the Harrod-Domar Theory.

Diagnostic Test

Table 8: Results of Diagnostic Test

The total 98 % of the variations were explained as shown by R-squared. The F-statistic exposed that model was overall significant. Breusch-Pagan-Godfrey calculated test indicate that there was no heteroscedasticity in the model and no autocorrelation in the model.

S.No	Test Types	Null Hypothesis	Test Statistics	P-Values	Results
01	R-Squared		0.987124		Best fit model
02	F-Test	Model is overall insignificant	229.9940	0.000000	Model is overall significant

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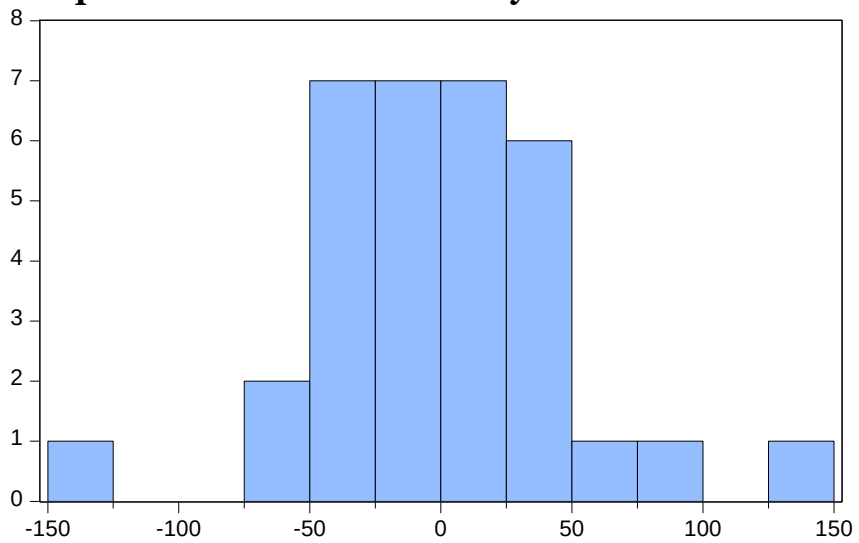
03	Breush-Pagan Godfrey	No Heteroskedasticity	8.015287	0.4320	No Heteroskedasticity
04	Breush-Godfrey	No Autocorrelation	9.67191	0.0948	No Autocorrelation

Jarque-Bera Test for Normality



Series: Residuals
Sample 1992 2024
Observations 33

Mean	1.40e-13
Median	-2.965433
Maximum	125.1484
Minimum	-125.4143
Std. Dev.	46.41470
Skewness	0.057550
Kurtosis	4.242566
Jarque-Bera	2.141175
Probability	0.342807

The Jarque-Bera test was used to confirm the model specification errors. It followed the $\chi 2$ distribution. The Jarque-Bera statistics p-value was 0.34, which showed that residual were normally distributed because p-value is greater than 0.05, so we reject null hypothesis.

Conclusion and Recommendations

This study aimed to explore two objectives to estimate the threshold level of interest rate for Pakistan's GDP and identify its major determinants. This study employs the techniques of threshold non-linear regression models to analyze the estimation of the threshold level of interest rates and the auto-regressive distributed lag model to analyze the major determinants of the GDP. The analysis is conducted in two phases.

In the first phase, a threshold non-linear regression model was used. In the first step use various tests such as the ADF test, granger causality, and the analysis of the relationship between Interest rate and Gross Domestic Product and the calculation of the threshold level of interest rate. The results of Granger causality show that it is the interest rate that affects GDP, and GDP does not affect the interest rate. The Augmented Dickey-Fuller Test confirms that all variables are stationary at the level. Non-linear threshold regression results indicate that the residual sum of square values at 11% is 95.11347. The residuals are minimized at 11% which is the threshold level of interest rate. This analysis concluded that the threshold level of interest rate is at 11 % from where onward the interest rate ceases to affect the gross domestic product positively and after the threshold level the interest rate has a negative and significant impact on gross domestic product.

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In the second phase, an Auto-regressive Distributed Lag model was used to analyze the major determinants of the GDP. The ADF test results showed that the variables were integrated in mixed order, some at the level *I* (0) and others at the first difference, *I* (1). The appropriate technique is ARDL for analysis. The bound test also confirmed the presence of Auto-regressive Distributed Lag type of co-integration between the variables. Then conduct the long-run ARDL analysis of the major determinants of GDP. The determinants are inflation, interest rate, money supply, and investment.

Inflation has a positive and significant relationship with GDP which shows that when 1% increase in inflation will increase the GDP per capita by 2 dollars. Results validate the Neo-classical and endogenous growth theories.

There is a direct relationship between money supply and per capita GDP which indicates that a 1% increase in money supply as a percentage of GDP corresponds to a 23-dollar change in per capita GDP. These findings support the Keynesian money transmission mechanism Theory.

Interest rate has a negative relationship with GDP implying that a one percent increase in interest rate results in a 4 dollars decrease in per capita GDP. This observation aligns with Keynesian Theory.

A positive relationship exists between investment and GDP indicating that a one percent increase in investment leads to a 44 dollars increase in per capita GDP. This outcome confirms the validity of the Harrod-Domar Theory.

Recommendation for a threshold level of interest rate

Our threshold level of interest rate is 11% which is higher than the developed countries. In this study, data was collected from 1991-2024. The interest rate is 22% in the last two years had a huge negative impact on our economy. In the last two years, our GDP growth has been near zero % due to the high interest rate. Now we need to gradually bring down the interest rate, although it's come down to 12% we should bring it down to 9 or 10% because a 9 or 10 % interest rate is beneficial for the economy this is our recommendation to the government. The government should not make drastic changes in interest rates every month or every two months, they should make small changes not more than 0.5% increase or decrease because it creates a panic situation. From 0 to 11 % it's has a positive relationship with GDP because a lower interest rate can stimulate the overall economy. Businesses are more likely to borrow and invest when the cost of borrowing is lower. This increased investment leads to job creation, higher productivity, and ultimately economic growth. The interest rate should not be maintained at excessively low levels can discourage savings and investment with reduced savings and investment the overall economic growth of the country may slow. The optimal interest rate should attract both domestic and foreign investment while encouraging savings and overall economic growth.

Recommendations for ARDL Type Co-integration

The positive relationship between money supply and GDP. Expanding the money supply can reduce interest rates thereby enhancing investment and consumer spending which in turn drives up national income and employment. To implement this effectively we should increase the money supply gradually not drastically the criteria should be to increase the money supply by 0.5 percent more than GDP growth, for example, if GDP growth is 4% increase the money

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supply by 5-6 % gradually this is appropriate and has a positive impact on economy.

Inflation has a positive relationship with GDP up to a certain level but after the threshold level, the rise in the inflation rate will cause a decrease in the GDP. For Pakistan threshold level of inflation is around 12-14 %. We need to keep inflation below 10 -12%. Central banks should utilize instruments like increasing policy interest rates (e.g., the repo rate/discount rate), raising reserve requirements for commercial banks, and conducting open market operations (selling government securities) to reduce the money supply in the economy. Governments should reduce their aggregate spending, particularly on non-developmental activities, and/or increase taxes (e.g., income tax, sales tax) to decrease disposable income and curb overall demand.

The government should appliance policies that strongly incentivize both domestic and foreign investment. Implement policies that encourage economic stability, such as reducing interest rates and offering tax incentives for investors. Invest in infrastructure development to attract foreign investment and stimulate domestic investment. Streamline regulatory processes and reduce bureaucratic hurdles to encourage investment.

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