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Investigating the asymmetrical influence of foreign direct investment, remittances, reserves, and information and communication technology on Pakistan's economic development

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ABSTRACT

The study used an asymmetric ARDL model to analyse the asymmetric (positive and negative shocks) impact of foreign direct investment, personal remittances, total reserves, gross savings, and information and communication technology on economic growth in Pakistan from 1976 to 2019. The short-run and long-run results of the asymmetric autoregressive distributed lag approach show that total reserves have a negative and non-significant influence on Pakistan's economic growth. Similarly, the results of asymmetric ARDL show that positive shocks in personal remittances have a positive and significant influence on Pakistan's economic growth, but negative shocks have a negative and non-significant impact in both the long-run and short-run. The findings of the gross savings show that a positive shock has a favourable and non-significant impact on economic growth in both the long-run and short-run. The investigated outcomes of foreign direct investment show that positive shocks have a detrimental and considerable impact on the economy of Pakistan in both the long-run and short-run. Furthermore, information and communication technology has a negative impact on economic growth in both the long-run and short-run. The government of Pakistan may adopt better policies to build the country's infrastructure by employing foreign investment more effectively.

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1. Introduction

The rapid increase of debt in emerging economies poses a difficulty to boosting economic growth. Despite extensive research, a clear and realistic debt threshold beyond which economic progress in some developing countries is endangered has yet to be determined. There is significant evidence that the debt trajectory influences the pace of economic growth. Foreign direct investment (FDI), remittances, and government development assistance financial flows may all be important drivers of economic growth. The developing economies may enhance their short-term and long-term economic growth prospects by building an enabling environment for infrastructure, investment, and human development. Economic policies at the national and international levels must be integrated to monitor long-term economic growth and urgent measures for productive investments in the context of sustainable development. Increased economic growth encourages additional international investment and remittances, as well as the continuance of government development assistance to emerging economies (Bird & Choi, 2020; Comes et al., 2018; Zardoub & Sboui, 2021). The significance of foreign investment for both developed and developing countries' economic progress cannot be emphasized. Foreign direct investment refers to financial funds sent from one country to another over the internet. This kind of investment is not the same as regular stock market investing. Individuals, corporations, and governments may all become foreign investors. There is compelling evidence that FDI is a significant driver of economic growth in developing countries. As a consequence of globalization, developing countries have benefited from foreign money and finance, as well as technical skills and technology. The economy of a country is impacted in numerous ways by FDI, gross domestic product, exchange rates, and government policies; nevertheless, foreign investment has the biggest effect on economic growth while government policies have the least. When foreign investment enters an economy, it implies that the country's firms are thriving because they are producing more goods and services, hence increasing gross domestic product (Falki, 2009; Hayat, 2018; Saqib et al., 2013; Zekarias, 2016).

The role of information technology in economic and social progress has long been recognized. The most often accepted explanation for the standstill of social, economic, and cultural progress in developed countries is that they are unable to invent, develop, and deploy cutting-edge technology. The coverage and effectiveness of this technology is one of the world's most urgent issues today (Cheng et al., 2021; Lu, 2018). Science and technology are responsible for the creation of innovative techniques. To increase the manufacturer's output, a new combination of existing resources is required. Modernizing and diversifying the nation's economy necessitates changes in industrial methods and procedures, as well as the use of new technologies. When it comes to economic integration in developed countries, digitization of the national economy is essential. In today's modern economy, digital networks and communications infrastructure offer a global platform for corporate and organizational development ambitions. They also make it simpler for individuals to collaborate, communicate cheaply, and exchange information, all of which contribute to increased production. Currently, information technology is being implemented (Irtyshcheva et al., 2021; Jurayevich & Bulturbayevich, 2020).

Foreign direct investments are critical sources of funding for economies like Pakistan, where financial resources are limited. FDI can affect the equilibrium real

exchange rate, or the appreciation or depreciation of the local currency, in both positive and negative ways. If foreign direct investments are used to finance imports, they have no effect on the equilibrium real exchange rate; however, if they are used for non-trade purposes, they determine the appreciation of the local currency. Increased FDI inflows into non-tradable industries have increased Pakistan's current account deficit by reducing the amount of earnings that can be reinvested in the country. It further increases the income and strain on the country's current account balance. Pakistan's banking industry has a long history of high profitability, attracting both domestic and international investment. The high profitability in this sector has been preserved by paying depositors a negative real interest rate (Iqbal et al., 2013; Rehman et al., 2020; Zheng & Sheng, 2017). For example, when domestic capital investment falls short of what is needed for long-term development, foreign direct investment has historically served as a growth engine for the countries involved. The host economy's impact on FDI can be measured in terms of job creation, managerial talent transfer, technical know-how transfer, and financial lending. This demonstrates that foreign investment is an important source of capital that supplements private savings. It has little effect on migration of people with only a primary education, but it tends to reduce secondary and higher education employees (Bhavan et al., 2011; Tiwari, 2011; Wang & Wong, 2011).

Economic inflows are intended to assist many countries, especially developing ones, by financing long-term development. Because of a scarcity of local resources, capital flows may assist economies, especially emerging ones, in growing sustainably. Globalization has resulted in increasing mobility of people, money, and commodities in recent decades. Foreign investment has the potential to boost financial stability, support long-term prosperity, and safeguard society as a whole. They aid emerging countries in resolving economic activity and financial challenges while taking into account the limitation of local resources. This study adds to the existing literature on the effect of foreign investments, remittances, and reserves on fostering Pakistan's economic progress, and our primary objective was to determine the influence of total reserves, personal remittances, foreign direct investment, gross savings, and information and communication technology on Pakistan's economic growth using annual data series. The asymmetric ARDL model was used to assess the influence of positive and negative shocks to total reserves, personal remittances, gross saving, foreign direct investment, and information technology on Pakistan's economic development.

Except from the introduction part, the rest of the paper is organized as follows: Section 2 focuses into previously published studies on the central concept. Section 3 is concerned with research methodologies and data, as well as a model presentation. Section 4 digs into the study's results and discussions. Finally, the investigation is summarized in Section 5 with a conclusion and recommendations.

2. Literature review

2.1. Foreign direct investment and economic growth nexus

The entire development of emerging economies is dependent on foreign investment and remittances from developed countries. Local counterparts gain from

multinational enterprises' managerial expertise, entrepreneurial abilities, and skills, which are taught to them and then applied via the learning-by-doing technique. Economic growth is hastened as a result of this good spillover effect (Das & Sethi, 2020; Diaconu, 2014; Pradhan & Phuyal, 2020). Foreign direct investment (FDI) is vital for economic development for a variety of reasons. FDIs make it simpler to transfer advanced technologies from developed to developing countries. Foreign direct investments help a country's human resources and institutions, which in turn stimulate domestic investments. Increased employment and trade are two advantages of foreign direct investment, which establishes backward and forward links across sectors while also introducing new production processes. Furthermore, some may believe that high-tech information, technology, and management skills may be transferred from foreign enterprises to local firms in order to enhance economic efficiency. In addition, the impact of foreign investment on economic growth differs per country. It varies from country to country. The ability of a region to attract and utilise foreign money, technology, management skills, and backward and forward links all influence how much foreign direct investment affects economic growth. This indicates that policy suggestions for developing countries may be obtained from national-level study led under specific conditions (Agrawal, 2015; Belloumi, 2014; Iamsiraroj & Ulubaşoğlu, 2015; Silajdzic & Mehic, 2016).

In today's global economy, investment is seen as a stimulant for economic growth. One way FDI aids development is through increasing productivity via new investments, improved technology, and the power of host governments to make choices. Thus, foreign direct investment (FDI) benefits the host country's economy by increasing the quantity of investable capital and allowing technology transfer. Foreign direct investment (FDI) is considered as a collection of both physical and intangible capital that travels across borders and flows into local economies, generating growth. Foreign direct investment is an important component of global economic integration since it establishes long-term and direct economic linkages between economies (Economou, 2019; Ketteni & Kottaridi, 2019; Mahembe & Odhiambo, 2016). As a consequence of the global financial crisis, the roles of the host and home countries in FDI have evolved. The effect of foreign direct investment varies according on the features of multinational activities. The distinct reactions of global corporations and small firms may be ascribed to their manufacturing and financial links. Self-selection tendencies may be the most common reason of FDI's favourable benefits on corporate operations. Foreign direct investment (FDI) played a different role in different countries during the financial crisis. The impact of foreign direct investment is influenced by a company's reliance on foreign capital. The benefits of FDI were more profound in host economies that were hard hit by the crisis. The impact of FDI decreases as the host economy's overall performance improves, and it increases as the crisis worsens (Alfaro & Chen, 2012; Bayar & Gavriletea, 2018; Popescu, 2014).

2.2. Remittances, information technology, and investment

For many developing countries that receive remittances, financial markets, investment initiatives, and government funding for development all fall short. There is a

remittances flow since payments are big. Understanding how remittances affect economic development might help policymakers create effective remittance policies. In addition to alleviating poverty, boosting human capital and labor supply, lowering inequality, and buffering local shocks, the full global impact of remittances remains largely unclear. Transfers from outside sources aid financial development, economic growth, and reduce production volatility (Aggarwal et al., 2011; Bettin & Zazzaro, 2012; Combes & Ebeke, 2011; Karikari et al., 2016). Remittances are workers' earnings from border, seasonal, or other short-term agreements. Even while remittances are a substantial source of income for immigrant families, there are problems and costs connected with them. As a consequence, the impact on GDP may be ambiguous depending on whether remittances are used for consumption or investment, which is logical. The net amount of this revenue is heavily determined by the remittance's transaction charges. Foreign remittances are the second greatest source of cash inflows to developing countries after foreign direct investment. Remittances, on the other hand, have a multiplier effect on consumption, the creation of financial intermediaries, and the use of foreign currency, all of which contribute to the country's economic growth. When the conditions are different, remittances may have a negative influence on productivity and may lead the real exchange rate of recipient countries to rise, reducing the possibility for economic progress in such countries (Meyer & Shera, 2017; Sobiech, 2019; World Bank, 2016).

Traditional sources of growth include excess labour, physical capital investment, technological improvements, foreign assistance, trade openness, and resource availability. While contemporary sources include remittances, financial development, and technological developments, they are not the only ones. Financial development and remittances have lately gained more attention due to their potential impact on economic growth and inequality via job creation and poverty reduction (Bang et al., 2015; 2016; Peprah et al., 2019). A solid financial system influences both improved investment options and higher long-term growth rates. The expansion of the financial industry has been shown to be advantageous. In addition to receiving remittances, every economy needs funds to support its own development initiatives. If the country's savings are insufficient, attracting foreign direct investment may be one option for obtaining a capital infusion. Foreign direct investment is the investment of the foreign private sector in a country, typically through multinational branches, multinational subsidiaries, partnerships, joint ventures, or other forms of participation. Increased investment is thought to go hand in hand with increased economic productivity. Capital accumulation, such as physical equipment, land, capital, and human resources, is a critical component of economic development. Foreign direct investment (FDI) promotes job creation, increases government revenue, and facilitates technology transfer. In contrast to loans, development finance, and export credits, which are all considered national debt, FDI is typically more lucrative and does not represent a burden to the national economy (Anwar, 2016; Athukorala & Waglé, 2011; Setyari et al., 2016; Ukhtiyani & Indartono, 2020).

During the previous three decades, international remittances have risen in relevance and stability as a source of financial inflows and economic promotion for many developing countries. In some countries, remittances account for the bulk of

international capital flows; these flows exceed foreign direct investment, export earnings, and foreign assistance, and they are growing faster than any of these sources of capital. One of the most visible results of global migration is money brought home from abroad. People move to offer a better life for their families. Remittances are goods or financial instruments that immigrants working and living abroad send back to their home country (Adarkwa, 2015; Ahmed & Martinez-Zarzoso, 2013; Nyeadi et al., 2014). Many individuals, especially in developing countries, are split about foreign direct investment and economic progress. The extent to which a nation draws foreign investment is determined by the strength of its financial system and its capacity to do so. Foreign investment may boost the overall economic efficiency of the economy throughout the financial crisis. Domestic savings may help to sustain consumption by stabilizing consumption patterns, boosting production capacity via new technologies, creating employment opportunities, and rising per capita income. Instead, research indicates that depending more heavily on foreign direct investment in developing countries may impede local sector development since abroad competitors have snatched up market share, pushing domestic enterprises to close down (Hassen & Anis, 2012; Hermes & Lensink, 2003; Mohamed et al., 2017).

An economy's long-term rise in production is influenced by a number of different variables. Human capital development, institutional frameworks, natural resource development, labour productivity, physical capital, and information technology are a few examples of these characteristics, although they are by no means exclusive ones (Adeleye & Eboagu, 2019). Through the transfer of money, technology, and expertise, foreign investment has a beneficial effect on the economic development of the emerging economies. It has a multiplier effect beyond the businesses that get FDI revenues. Because of spillovers in technology, people and capital creation, and increased competitiveness, this effect may extend to other firms in the nation or sector, thus boosting overall productivity (Ibrahim & Dahie, 2016). By transferring advanced technologies and discoveries from advanced economies and by attracting a variety of inflows of foreign money, developing countries may speed up their own economic development. The majority of economists agree that increased inflows of foreign money led to an increased economic growth. Foreign capital inflows have varying impacts on different countries and regions, since the economic climate and government policies vary from one nation or region to another. Foreign investment occurs when the investor state of the foreign investor controls the acquired business and makes an investment into the enterprise. Non-residents send remittances to their relatives back home in the form of money they earn while working abroad (Abu & Karim, 2016; Emmanuel, 2014; Nwaogu & Ryan, 2015).

3. Study methods and data

The primary goal of this analysis is to explore the association between foreign direct investment, personal remittances, total reserves, gross savings, information and communication technology, and Pakistan's economic growth from 1976 to 2019, using annual data series from the World Development Indicators (https://data.worldbank.org/country/pakistan). Figure 1 illustrated the variable trends clearly.

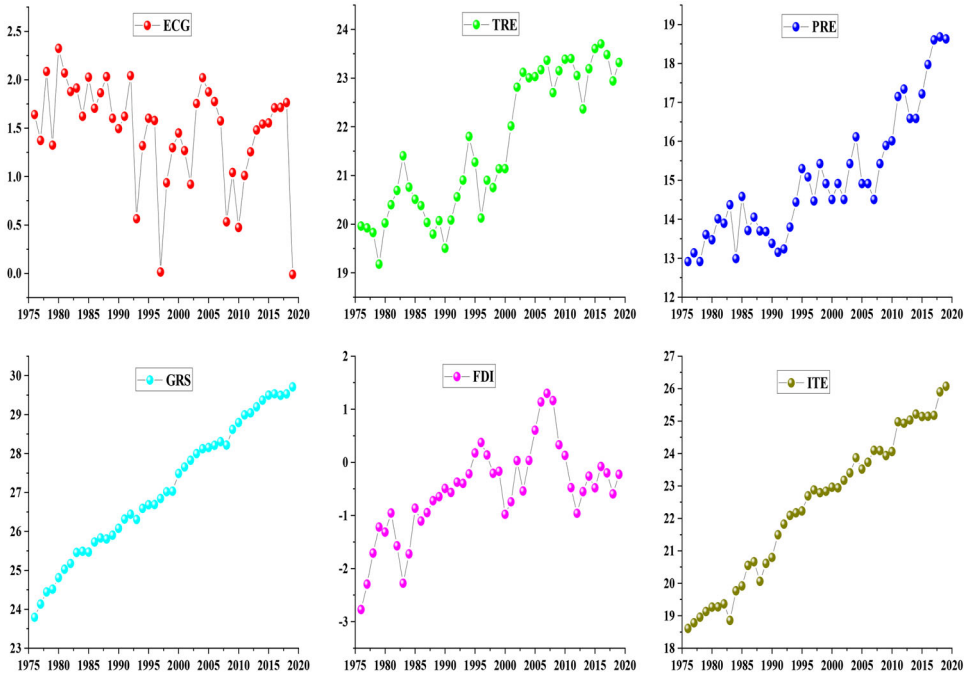

Figure 1. Variables utilized in the study.
Source: Elaborated by Authors based on data from World Bank database for Pakistan.

3.1. Model specification

We have utilized the asymmetric technique to examine the interaction among the variables. In order to check the interaction amid foreign direct investment, personal remittances, total reserves, gross savings, and information and communication technology on economic growth, following model can be stated as:

$$ECG_t = f(TRE_t, PRE_t, GRS_t, FDI_t, ITE_t) \quad (1)$$

The equation (1) can further be extended as:

$$ECG_t = \alpha_0 + \alpha_1 TRE_t + \alpha_2 PRE_t + \alpha_3 GRS_t + \alpha_4 FDI_t + \alpha_5 ITE_t + \varepsilon_t \quad (2)$$

The explanation of all variables in the equation (2) demonstrated that, ECG_t measures the economic growth, TRE_t specifies total reserves, PRE_t show the personal remittances, GRS_t indicates gross savings, FDI_t designates the foreign direct investment, and ITE_t indicates the information and communication technology. Where t specifies the time dimension and ε_t indicates the error term. Further, the coefficients of the model stated as α_1-α_5.

3.2. Asymmetric model demonstration

In order to check the interaction amid variables, this study followed the ARDL method of Pesaran et al. (2001) with short-run and long-run analysis. The specification of ARDL (Autoregressive Distributed Lag) technique can be written as:

$$\Delta ECG_t = \eta_0 + \sum_{v=1}^{v} \pi_v \Delta ECG_{t-v} + \sum_{v=0}^{v} \alpha_v \Delta TRE_{t-v} + \sum_{v=0}^{v} \vartheta_v \Delta PRE_{t-v} + \sum_{v=0}^{v} \theta_v \Delta GRS_{t-v} + \sum_{v=0}^{v} \lambda_v \Delta FDI_{t-v} + \sum_{v=0}^{v} \beta_v \Delta ITE_{t-v} + \tau_1 ECG_{t-1} + \tau_2 TRE_{t-1} + \tau_3 PRE_{t-1} + \tau_4 GRS_{t-1} + \tau_5 FDI_{t-1} + \tau_6 ITE_{t-1} + \varepsilon_t \quad (3)$$

The ARDL method is applied to express the short-run and long-term dynamic associations between variables in the form of equations (3). It is more appropriate than most conventional methods for specifying key parameters in a small sample, and as a result, it has certain advantages. However, by following Pesaran et al. (2001), the F-test can be used to confirm long-term predictions if special effects of long-term parameter combinations are assumed, and this is supported by the literature. As quickly as integration is achieved, τ_2- τ_6 assesses long-term resilience, and the process is then controlled by τ_1.

The asymmetric (Non-linear Autoregressive Distributed Lag) technique of Shin et al. (2014) can be specified by decaying the variables with having positive $(TRE^+_q; PRE^+_q; GRS^+_q; FDI^+_q)$ and negative $(TRE^-_q; PRE^-_q; GRS^-_q; FDI^-_q)$ shocks and can be demonstrated as:

$$TRE^+_q = \sum_{r=1}^{q} \Delta TRE^+_q = \sum_{r=1}^{q} \max\ (\Delta TRE^+_q,\ 0) \quad (4)$$

$$TRE^-_q = \sum_{r=1}^{q} \Delta TRE^-_q = \sum_{r=1}^{q} \min\ (\Delta TRE^-_q,\ 0) \quad (5)$$

$$PRE^+_q = \sum_{r=1}^{q} \Delta PRE^+_q = \sum_{r=1}^{q} \max\ (\Delta PRE^+_q,\ 0) \quad (6)$$

$$PRE^-_q = \sum_{r=1}^{q} \Delta PRE^-_q = \sum_{r=1}^{q} \min\ (\Delta PRE^-_q,\ 0) \quad (7)$$

$$GRS^+_q = \sum_{r=1}^{q} \Delta GRS^+_q = \sum_{r=1}^{q} \max\ (\Delta GRS^+_q,\ 0) \quad (8)$$

$$GRS^-_q = \sum_{r=1}^{q} \Delta GRS^-_q = \sum_{r=1}^{q} \min\ (\Delta GRS^-_q,\ 0) \quad (9)$$

$$FDI^+_q = \sum_{r=1}^{q} \Delta FDI^+_q = \sum_{r=1}^{q} \max\ (\Delta FDI^+_q,\ 0) \quad (10)$$

$$FDI^{-}{}_{q} = \sum_{r=1}^{q} \Delta FDI^{-}{}_{q} = \sum_{r=1}^{q} \min\ (\Delta FDI^{-}{}_{q},\ 0) \tag{11}$$

The specification of NARDL model can be stated accordingly by following the equations (4)-(11) in order to explore the positive and negative shocks amid the study variables as:

$$\begin{aligned}\Delta ECG_{\ t} = {} & \varphi_0 + \sum_{e=1}^{l} \theta_e \Delta ECG_{\ t-e} + \sum_{e=0}^{l} \beta_e \Delta TRE^{+}{}_{t-e} + \sum_{e=0}^{l} \tau_e \Delta TRE^{-}{}_{t-e} \\ & + \sum_{e=0}^{l} \alpha_e \Delta PRE^{+}{}_{t-e} + \sum_{e=0}^{l} \pi_e \Delta PRE^{-}{}_{t-e} + \sum_{e=0}^{l} \eta_e \Delta GRS^{+}{}_{t-e} \\ & + \sum_{e=0}^{l} \gamma_e \Delta GRS^{-}{}_{t-e} + \sum_{e=0}^{l} \psi_e \Delta FDI^{+}{}_{t-e} + \sum_{e=0}^{l} \rho_e \Delta FDI^{-}{}_{t-e} \\ & + \sum_{e=0}^{l} \omega_e \Delta ITE_{t-e} + \lambda_1 ECG_{\ w-1} + \lambda_2 TRE^{+}{}_{w-1} + \lambda_3 TRE^{-}{}_{w-1} \\ & + \lambda_4 PRE^{+}{}_{w-1} + \lambda_5 PRE^{-}{}_{w-1} + \lambda_6 GRS^{+}{}_{w-1} + \lambda_7 GRS^{-}{}_{w-1} + \lambda_8 FDI^{+}{}_{w-1} \\ & + \lambda_9 FDI^{-}{}_{x-1} + \lambda_{10} ITE_{w-1} + \varepsilon_t \end{aligned} \tag{12}$$

The asymmetrical paradigm presented in equation (12) illustrates the link between the short and long-term. As a result, ECM (Error Correction Model) can be written as follows:

$$\begin{aligned}\Delta ECG_{\ t} = {} & \theta_0 + \sum_{k=1}^{k} \theta_k \Delta ECG_{\ t-k} + \sum_{k=0}^{k} \theta_k \Delta TRE^{+}{}_{t-k} + \sum_{k=0}^{k} \theta_k \Delta TRE^{-}{}_{t-k} \\ & + \sum_{k=0}^{k} \theta_k \Delta PRE^{+}{}_{t-k} + \sum_{k=0}^{k} \theta_k \Delta PRE^{-}{}_{t-k} + \sum_{k=0}^{k} \theta_k \Delta GRS^{+}{}_{t-k} \\ & + \sum_{k=0}^{k} \theta_k \Delta GRS^{-}{}_{t-k} + \sum_{k=0}^{k} \theta_k \Delta FDI^{+}{}_{t-k} + \sum_{k=0}^{k} \theta_k \Delta FDI^{-}{}_{t-k} \\ & + \sum_{e=0}^{l} \omega_e \Delta ITE_{t-e} + \theta ECM_{t-1} + \varepsilon_t \end{aligned} \tag{13}$$

It's necessary to observe the multiplier response of economic growth to other parameters in the non-linear ARDL technique as follows:

$$\left[\begin{array}{llll} z_v^{+} = \sum_{v=0}^{v} \frac{\tau ECG_{t+l}}{\tau TRE_l^{+}}; & z_v^{-} = \sum_{v=0}^{v} \frac{\tau ECG_{t+l}}{\tau TRE_l^{-}}; & z_v^{+} = \sum_{v=0}^{v} \frac{\tau ECG_{t+l}}{\tau PRE_l^{-}}; & z_v^{-} = \sum_{v=0}^{v} \frac{\tau ECG_{t+l}}{\tau PRE_l^{-}}; \\ z_v^{+} = \sum_{v=0}^{v} \frac{\tau ECG_{t+l}}{\tau GRS_l^{+}}; & z_v^{-} = \sum_{v=0}^{v} \frac{\tau ECG_{t+l}}{\tau GRS_l^{-}}; & z_v^{+} = \sum_{v=0}^{v} \frac{\tau ECG_{t+l}}{\tau FDI_l^{+}}; & z_v^{-} = \sum_{v=0}^{v} \frac{\tau ECG_{t+l}}{\tau FDI_l^{-}}; \end{array}\right]$$

Where for $v = 1, 2, 3 \ldots$ .and $z_v^{+} \rightarrow L_{zi^{+}}$ as $v \rightarrow \infty$, and $z_v^{-} \rightarrow L_{zi^{-}}$

Table 1. Summary analysis for the variables.

	ECG	TRE	PRE	GRS	FDI	ITE
Mean	1.468	21.588	15.003	27.075	−0.527	22.340
Median	1.589	21.205	14.545	26.930	−0.485	22.812
Maximum	2.323	23.701	18.683	29.710	1.299	26.072
Minimum	−0.011	19.176	12.913	23.792	−2.773	18.609
Std. Dev.	0.531	1.434	1.624	1.703	0.865	2.254
Skewness	−1.125	0.063	0.807	−0.075	−0.297	−0.175
Kurtosis	3.972	1.444	2.773	1.868	3.456	1.784
Jarque-Bera	11.024	4.464	4.870	2.388	1.030	2.933
Probability	0.004	0.107	0.087	0.302	0.597	0.230

Source: Authors' own estimations in E-views.

Table 2. Correlation of variables.

	ECG	TRE	PRE	GRS	FDI	ITE
ECG	1.000	−0.273	−0.276	−0.349	−0.325	−0.418
TRE	−0.273	1.000	0.803	0.907	0.550	0.864
PRE	−0.276	0.803	1.000	0.880	0.386	0.862
GRS	−0.349	0.907	0.880	1.000	0.643	0.981
FDI	−0.325	0.550	0.386	0.643	1.000	0.679
ITE	−0.418	0.864	0.862	0.981	0.679	1.000

Source: Authors' own estimations in E-views.

It explores the positive and negative shocks of the economic growth to total reserves, personal remittances, gross savings and foreign direct investment to uncover the multiplier effects.

4. Results and discussion

4.1. Summary analysis and variable's correlation

Table 1 is incorporating the consequences of the summary analysis of the variables including foreign direct investment, total reserves, personal remittances, gross savings, information and communication technology and economic growth with having probability, Skewness and Kurtosis statistics. Furthermore, Table 2 is demonstrating the correlation analysis amid the variables and concluded that all variables are correlated to each other.

4.2. Stationarity of variables

The Phillips-Perron (P-P) (Phillips & Perron, 1988) and KPSS (Kwiatkowski et al., 1992) tests at I(0) and I(1) revealed the stationarity between variables, but not at I(2) and the outcomes are presented in the Table 3. If a series is stationary, the test statistics and variable probability values show that the variables in the model are initially non-stationary; however they become stationary with a single step change in the integration order from I(0) to I(1).

4.3. Asymmetric bounds test to cointegration

Table 4 is exposing the outcomes of the asymmetric bounds testing for the validation of cointegration in order to explore the Non-linear Autoregressive Distributed Lag

Table 3. Unit root test.

	ECG	TRE	PRE	GRS	FDI	ITE
PP Unit root test						
At level T-Stat (P-Values)	−4.073*** (0.000)	−1.115 (0.271)	−0.612 (0.543)	−1.722* (0.092)	−2.863** (0.006)	−0.455 (0.651)
At first difference T-Stat(P-Values)	−8.795 (0.000)	−6.547*** (0.000)	−8.812*** (0.000)	−7.020*** (0.000)	−5.728*** (0.000)	−7.959*** (0.000)
KPSS Unit root test						
At level T-Stat (P-Values)	0.457*** (0.000)	0.758*** (0.000)	0.774*** (0.000)	0.845*** (0.000)	−4.043*** (0.000)	0.835*** (0.000)
At first difference T-Stat(P-Values)	−0.414 (0.680)	0.075 (0.317)	0.271 (0.175)	0.243*** (0.000)	0.886 (0.380)	0.500*** (0.000)

Note: *,**,*** Indicates the significance level at 1%, 5% and 10%.
Source: Authors' own estimations in E-views.

Table 4. Bounds testing to cointegration results.

F-B Test		N-Hypo.: No levels relationship		
Test Statistic	Value	Signif. Level	I(0)	I(1)
F-stat.	[5.609]	10%	[1.8]	[2.8]
K	9	5%	[2.04]	[2.08]
		2.5%	[2.24]	[3.35]
		1%	[2.5]	[3.68]

Source: Authors' own estimations in E-views.

Table 5. J-cointegration results.

Trace test statistics				Maxi-eigen statistics			
Hypo-No. of CE(s)	T-Statistic	C-Value (0.05%)	Prob.**	Hypo-No. of CE(s)	Max-Eigen Statistic	C-Value (0.05%)	Prob.**
None *	84.127	95.753	0.240	None	27.959	40.077	0.564
Max. at 1	56.167	69.818	0.371	Max. at 1	25.916	33.876	0.325
Max. at 2	30.250	47.856	0.706	Max. at 2	18.767	27.584	0.432
Max. at 3	11.483	29.797	0.948	Max. at 3	7.159	21.131	0.947
Max. at 4	4.323	15.494	0.875	Max. at 4	4.207	14.264	0.836
Max. at 5	0.116	3.841	0.732	Max. at 5	0.116	3.841	0.732

Note: *Signifies the rejection of hypothesis at the 0.05 level; **show the p-values of MacKinnon-Haug-Michelis.
Source: Authors' own estimations in E-views.

Bounds Testing technique. The statistical value of F-test is (5.609) and significance level at 10%, 5%, 2.5% and 1% at I(0) and I(1) difference.

In addition, the Johansen cointegration technique (Johansen & Juselius, 2009) was utilised to explore cointegration in modelled variables. The outcomes of this technique are shown in Table 5. Integration establishes long-term links between study variables. As a result, some variable pairs may be combined. Because the majority of variables suggest that the null hypothesis may be rejected, and the variables have a long-term connection.

4.4. Asymmetric short- and long-run

Short-run and long-run consequences are reported in Table 6 shows the positive and negative shocks.

The results of the short-run analysis reveal that the positive and negative shocks of total reserves and foreign direct investment have coefficients (-0.147), (0.530), (-0.593), (0.749) with probability values (0.529), (0.034), (0.079), (0.021) which exposed an adversative and constructive relation to the economic growth in Pakistan. The variable personal remittances show a positive and negative linkage to the Pakistan's economic growth. Gross savings also indicates a constructive linkage with positive and negative measurement. Further, the variable information and communication technology has a negative influence on the economic progress in Pakistan. Similarly, the results of the long-run estimations uncover that total reserves and foreign direct investment explored a negative and constructive linkage to the economic growth with probability values (0.537), (0.055), (0.127), (0.044). Negative and positive shock of personal remittances exposed a negative and productive linkage to the economic growth. The variable gross savings also demonstrate a productive association to the economic growth of Pakistan with probability values (0.108), (0.000).

Table 6. Short- and long-run results.

Panel A: Short-run (Error Correction Regression)				
Variables	Coefficients	S-error	test-Statistic	Prob.
C	1.949	4.391	0.444	0.660
ECG(-1)	−0.969***	0.168	−5.749	0.000
TRE_POS	−0.147	0.232	−0.635	0.529
TRE_NEG(-1)	0.530*	0.238	2.219	0.034
PRE_POS	0.655**	0.234	2.794	0.009
PRE_NEG	−0.118	0.235	−0.504	0.617
GRS_POS	1.545*	0.858	1.801	0.081
GRS_NEG	11.662***	2.841	4.104	0.000
FDI_POS	−0.593*	0.327	−1.813	0.079
FDI_NEG	0.749**	0.307	2.433	0.021
ITE	−0.048	0.244	−0.197	0.844
D(TRE_NEG)	0.012	0.298	0.042	0.966
CointEq(-1)	−0.969***	0.106	−9.070	0.000
Panel B: Long-run Analysis				
Variables	Coefficients	S-error	test-Statistic	Prob.
TRE_POS	−0.152	0.243	−0.623	0.537
TRE_NEG	0.546*	0.274	1.994	0.055
PRE_POS	0.675**	0.288	2.343	0.025
PRE_NEG	−0.122	0.248	−0.491	0.626
GRS_POS	1.593	0.962	1.655	0.108
GRS_NEG	12.026***	3.147	3.820	0.000
FDI_POS	−0.612	0.390	−1.566	0.127
FDI_NEG	0.772**	0.367	2.102	0.044
ITE	−0.049	0.252	−0.197	0.844
C	2.010	4.538	0.442	0.660
R^2 (0.583) Mean-D var (1.467)				
Adjusted R^2 (0.430) S.D. dependent var (0.543)				
SE of regression (0.410) AIC (1.289)				
Sum-S resid (5.043) S-criterion (1.786)				
Log-likelihood (-15.082) H-Quinn criter. (1.471)				
F-stat. (3.819) Durbin-Watson stat (2.035)				
Prob(F-statistic) (0.001)				

Note: *,**,*** Indicates the significance level at 1%, 5% and 10%.
Source: Authors' own estimations in E-views.

Furthermore, the information and communication technology exposed an adversative association to the economic progress of Pakistan. Because of the rise in the real exchange rate, large remittance inflows may reduce international competitiveness, harming the manufacturing sector and the creation of marketable goods. To put it another way, remittances have a multifaceted and passive impact on the economies of the countries where they are received. It might be advantageous to the family as a whole. A rise in remittance inflows may have a negative influence on the work enthusiasm of recipient families, particularly in developing countries, and hence have a negative impact on economic growth in general. More research is required to better understand how the flows of remittances might be linked to global economic development. Foreign direct investment (FDI) inflows and their consequences on economic growth are not new issues of investigation or debate. Foreign investment serves to supplement domestic investment and grow domestic capital (Chorn & Siek, 2017; Kumar, 2013; Tahir et al., 2019; Tiwari & Mutascu, 2011). Workers' remittances are a large source of money entering impoverished countries (defined here as economies with low and medium income), frequently dwarfing several well sources such as private capital and government assistance. The use of remittances helps to enhance

national savings, reduce foreign currency and balance of payments limitations, and aids the government in developing budgetary plans. To maximize these inflows, remittances should be transferred via formal channels such as bank draughts and remittance firms. In casual contact, illegal sources such as business colleagues, family members, and intimate friends should be avoided (Barajas et al., 2009; Minasyan & Nunnenkamp, 2016).

Trade and foreign direct investment are two economic activities that rely heavily on contemporary Internet infrastructure. The Internet is now playing a critical role in social and economic development, financial international collaboration, GDP, foreign direct investment (FDI), productivity and organizational infrastructure, new job creation, and poverty alleviation. Furthermore, it has benefited the country's populace in developing as citizens and bringing about democratic stability in the country (Latif et al., 2018; Lu, 2018). In many developing countries, foreign direct investment is also a key source of capital inflows, national savings, and economic activity. Authorities have recognized the crucial importance of foreign investment, particularly in economic growth. Foreign direct investments (FDIs) may assist developing countries in dealing with liquidity issues since they provide an alternative to local investment. To assist emerging economies in attracting more foreign direct investments, one must actively engage in the flow of equity in the economy. Increasing productivity via knowledge transfer, training, and access to new markets benefits recipient countries' growth (Jude & Levieuge, 2017; Williams, 2017).

For many years, the emphasis of the migration discussion has been on the nations to which people migrate. However, the emphasis has shifted to the conditions in the home country, with particular attention paid to the way migration affects the development in that country. Cash and other financial and non-financial goods are the most common types of remittances sent back by immigrants. There are non-monetary remittances, such as essential aid and shelter. Even while remittances are still far behind foreign direct investment, they've emerged as a valuable source of funding for poor nations due to their large size. Due to the fact that remittances to many countries surpass foreign private capital and government development aid, they constitute a significant source of foreign currency for the emerging economies Remittances have become a significant source of private financial resources for families in the home country (Cazachevici et al., 2020; Driffield & Jones, 2013; Oladipo, 2020). Non-residents contribute significant remittances to families back home (who are also residents). To put it another way, remittances are the one-way money transfers from an immigrant to his or her family or friends, community, and country. Personal remittances are three times as large as official development assistance in poor countries, and they offer an extra source of income for millions of underprivileged families worldwide. Official development aid (ODA) refers to financial resources given to developing countries by donor governments and international organizations. The purpose of official development assistance is to assist developing countries in growing economically and improving their quality of life (Majumder & Donghui, 2016; Musaad et al., 2017). In order to develop appropriate policy measures and organizational frameworks to ensure product price stability, one needs to have a comprehensive understanding of the policies that are currently in place as well as the impact those policies have on the viability of production,

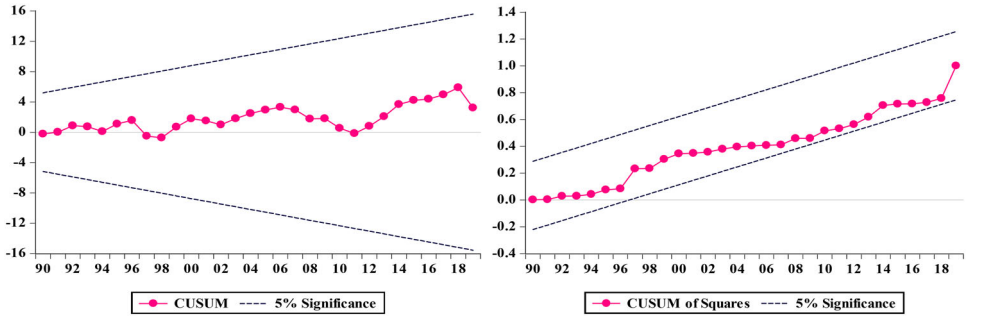

Figure 2. Asymmetric CUSUM and its squares plot.
Source: Authors' own estimations in E-views.

supply, trade, and domestic goods security (Wen et al., 2021). The statistical values of $R,^2$ Adjusted $R,^2$ F-stat, AIC, HQC and Durbin-Watson stat are (0.583), (0.430), (3.819), (1.289), (1.471) and (2.035) correspondingly. The plots of the asymmetric CUSUM and its squares are illustrated in Figure 2.

Furthermore, the multiplier influence of total reserves, personal remittances, gross savings, and foreign direct investment are presented in Figure 3.

5. Conclusion and recommendations

This study has determined the asymmetric impact of total reserves, personal remittances, gross savings, population growth and foreign direct investment on the Pakistan's economic growth using the annual time sequence data from 1976 to 2019. A Non-linear Autoregressive Distributed Lag model was utilized to expose the positive and negative shocks of the variables via short-run and long-run. Outcomes of short-run show that the positive and negative shocks of total reserves and foreign direct investment exposed adversative and productive connection, respectively, to the economic growth in Pakistan. Personal remittances shocks established a constructive and negative relation to the economic growth. The variable gross savings display the positive influence to the economic growth, and information and communication technology demonstrates a diverse association to the economic growth in Pakistan. Similarly, the findings via long-run uncover that total reserves and foreign direct investment explored a negative and constructive linkage to the economic growth. Negative and positive shock of personal remittances exposed a negative and productive influence to the economic growth. The variable gross savings also demonstrate a productive association to the economic growth in Pakistan. Furthermore, the information and communication technology exposed an adversative association to the economic progress in Pakistan.

Foreign direct investment is regarded as a primary source of economic growth in emerging countries across the globe, particularly in Pakistan's financial and strategic development. A considerable quantity of foreign direct investment inflow from developed economies of the globe is required to achieve socioeconomic goals by pushing them to spend in infrastructure and education sectors. Pakistan is one of the world's emerging economies with a serious dearth of physical capital, and foreign companies may assist Pakistan raise its standard of living. Foreign direct investment has assisted inhabitants of emerging countries including the people of Pakistan in finding jobs,

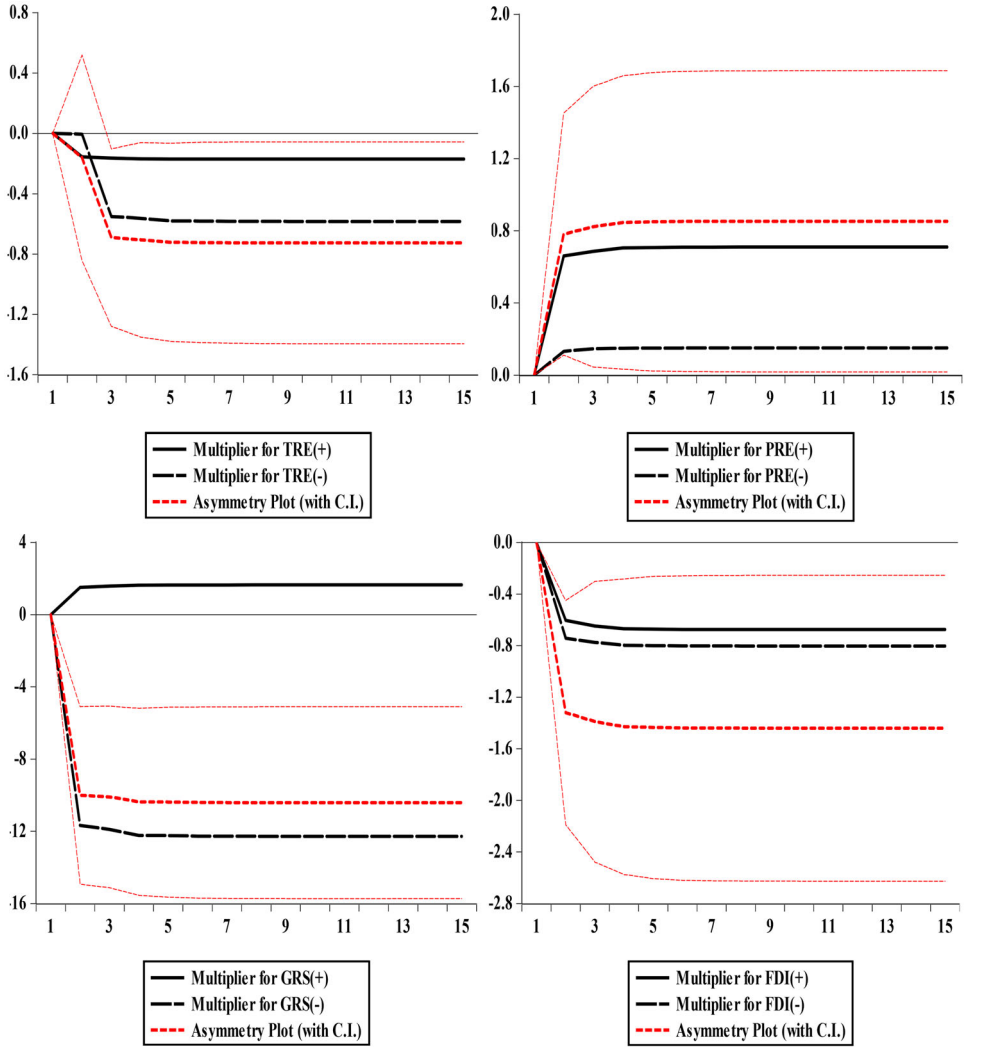

Figure 3. Multiplier influence asymmetric plots.
Source: Authors' own estimations in E-views.

increasing their skills, and integrating their economy with the global economy via the transfer of technology and strategic management abilities. Export costs, technical resources, market size, low-wage skilled labour, and currency exchange rates are all factors that influence foreign investment into emerging countries like Pakistan. Pakistan has attracted numerous international investors due to its stability, competent labour, and flexibility in government policy. Furthermore, the implementation of some policies demonstrates that the Pakistani government is willing to open the local market to foreign investors for the sake of the country's prosperity and well-being. And yet again, Pakistan's political environment supported FDI inflows by passing a number of incentives, such as tax cuts, fiscal incentives, and risk-aversion measures. FDIs have contributed significantly to Pakistan's socioeconomic growth. The government is pursuing privatization, deregulation, and liberalization of Pakistan's

telecommunications industry, making it particularly appealing to international investors. This analysis is not limited; more research may be undertaken to examine the relationship between other economic sectors and Pakistan's economic progress.

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