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DYNAMIC CONNECTEDNESS; NETWORK SPILLOVERS; MACROECONOMIC INDICATORS; INFLATION; FOREIGN DIRECT INVESTMENT; ECONOMIC GROWTH; PAKISTAN

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ABSTRACT

Understanding the interaction among major macroeconomic indicators has become increasingly important for emerging economies facing inflationary pressures, volatile capital flows, and uneven growth performance. Pakistan offers a relevant case due to recurring episodes of price instability, fluctuating foreign investment, external financing stress, and changing economic growth patterns. In this context, the present study examines the dynamic network connectedness among core macroeconomic variables in Pakistan, with particular focus on inflation, foreign direct investment (FDI), and economic growth (GDP). Using annual time-series data from 1974-2024, the present research uses the Diebold-Yilmaz connectedness framework using variance decomposition of forecast errors. The technique allows deterministic connectedness, pairwise spillovers and net transmitter or receiver roles of the variables. Unlike traditional regression-based analysis, the use of connectedness framework offers a comprehensive view of the transmission of shocks among all the variables over time. The results of the empirical analysis show a moderate but economically significant level of connectedness between inflation, FDI and GDP in Pakistan. GDP turns out to be a large net transmitter of shocks, suggesting that fluctuations in economic output have a broad impact on the inflation rate and the level of investment. Inflation appears to be largely a net receiver, suggesting that local inflation is significantly influenced by changes in growth and foreign investment. The results also show FDI having a dual role as both a transmitter and a receiver, in different macroeconomic conditions. The findings also show that the effect of connectedness is more pronounced in crisis and uncertainty periods, such as global financial pressures, currency crises, and the COVID-19 pandemic. This research adds to the connectedness literature by offering new evidence from an emerging economy where the use of such tools is scarce. The results have policy relevance for policymakers to ensure price stability, sustainable foreign investment and macro-economic growth via effective macro-economic policy coordination.

Keywords: *Dynamic Connectedness; Network Spillovers; Macroeconomic Indicators; Inflation; Foreign Direct Investment; Economic Growth; Pakistan.*

INTRODUCTION

Macroeconomic stability has been a growing challenge for emerging and developing countries in recent years. Higher inflation, lower capital inflows, global supply chain bottlenecks, geopolitical tensions, and the need for economic recovery in the aftermath of the pandemic have added to the pressure on policymakers in many nations. For structurally vulnerable economies, it is especially challenging to keep inflation under control while also ensuring capital inflows and economic growth (IMF, 2024; World Bank, 2024). In this context, the need to understand the dynamics of key macroeconomic indicators has been imperative for scholars and policymakers.

An interesting concern in this regard is Pakistan. Over the past few decades, the economy has been challenged by various episodes of inflation, fiscal deficit, depreciation in exchange rate, crisis in external financing, political transition and fluctuations in growth rates. Recently, it has experienced inflation, balance of payments, tight monetary stance and investment growth slow-down. At the same time, Pakistan has been in the process of structural adjustment, investment and industrialization and planning for sustained economic growth. These events indicate a need for the investigation of the interlinkages between macroeconomic indicators.

Inflation, foreign direct investment (FDI) and output (GDP) are the most significant indicators of economic activity. Inflation affects the real wages of households, production costs, expectations and interest rates. High inflation may cause confusion, price distortions and disrupt investment. Foreign direct investment (FDI) is known to provide external funds, technical and management know-how, and is a catalyst for employment and productivity growth. GDP, often an indicator of growth, is the end product of an investment, macroeconomic and production system. So, the three variables are not indicators, but part of the economic system.

The interlinks between inflation, FDI and GDP can be complex. For example, if inflation is high, this may be an impediment to the flow of domestic and foreign investment, as profitability is reduced and uncertainty increases. Lower investment might mean lower growth and employment. In turn, more growth may promote investment and help confidence and macroeconomic stability. Similarly, more FDI can lead to increased production, exports and technological improvement, thus promoting growth. These relationships mean shocks to one variable may affect other variables in a dynamic fashion.

Numerous empirical studies have studied the relationship between inflation, investment and growth. But existing literature tends to adopt standard regression models, cointegration or pair-wise causality tests that quantify the long-run or mean relationships between the variables. Although they are still helpful, these methods may fail to provide a comprehensive view of the changing distribution and simultaneous interaction between macroeconomic variables. Contemporary economies are characterized by feedback-related processes where shocks pass from one variable to others through time. This could result in missing relationships related to the strength, direction and changing roles of variables over time (Diebold and Yilmaz, 2014; Antonakakis et al., 2020).

An alternative approach to address the shortcomings of these "black box" models is to use a dynamic network connectedness approach to investigate the links among inflation, FDI, and GDP in Pakistan. The approach allows us to examine the net transmitters and net receivers of shocks, as well as the net connectedness to and from the system (spillovers from and to the system). The connectedness method offers a more comprehensive view of the interaction of macroeconomic variables under conditions of stability, as well as uncertainty. It is especially useful for developing economies where macroeconomic links may be stronger due to the impact of foreign shocks, policy reforms and institutional reforms.

The research employs annual data for Pakistan from 1974-2024. This extensive period encompasses various significant periods of Pakistan's economy, such as industrial policy reform, liberalization, external debt crises, financial crises, security challenges, IMF-backed adjustment programs, commodity shocks, and the

COVID-19 pandemic. Analysing connectedness over such a long time period permits a more holistic view of macroeconomic relationships.

This paper adds to the literature in a number of ways. First, it contributes to the growing body of literature on connectedness by presenting new insights from Pakistan where such research using dynamic networks is scant. Second, it simultaneously considers the interactions between inflation, FDI, and GDP in a dynamic macroeconomic system as opposed to bilateral relationships. Third, it offers policy implications for policymakers to regulate inflation, foreign direct investment, and foster long-term economic growth via the design of a coherent policy. Fourth, it brings fresh insights by examining a recent time-frame that caters for global and local shocks.

To our best knowledge, there is no comprehensive investigation of the dynamic connectedness between these key macroeconomic variables in Pakistan over such a long time span. There is thus an opportunity for valuable research of academic and policy interest.

The rest of the paper is structured as follows. Section 2 discusses the theoretical and empirical background. In section 3, we describe the data, variables and empirical approach. In section 4, we report and interpret the results. Section 5 concludes with findings and implications for policy, study limitations, and avenues for future research.

1. Literature Review

2.1 Introduction

Inflation, foreign direct investment (FDI), and economic growth is among the most popular issues in the field of macroeconomic research. These indicators are often considered as measures of the health, stability and long-term outlook of an economy as they affect the level of output, job creation, capital investment, external investor confidence, and the standard of living. The interaction between these indicators is critical for emerging markets like Pakistan because high inflation, volatile foreign investment and uneven growth potential tend to limit economic development.

Inflation, GDP and Foreign Direct Investment (FDI) are often investigated but most earlier studies have focused upon individual variables or direct links. However, there are clear interactions between these variables. For example, higher inflation might affect investment opportunities, a decline in investment might affect output, and growth might affect business confidence. Likewise, growth can increase FDI and investment can boost productive capacity and performance. These bi-directional causal nexuses indicate that macroeconomic indicators are not unidirectional, but rather interconnected.

There are four broad categories of the academic literature on these links. The first investigates the relationship between inflation and growth. The second studies the impact of FDI on economic growth. The third looks at the effect of inflation and macroeconomic uncertainty on FDI flows. The fourth, most recent stream showcases the connectedness and spillover approach to understand the transmission of shocks over time across economic and financial variables.

This chapter discusses the theoretical and empirical evidence pertinent to this study. It starts with the conceptual underpinning of the relationship between inflation, FDI, and growth, followed by evidence from the world, Pakistan, and very recent contributions to the study of dynamic connectedness. It ends with a discussion of the research gap that this study fills.

2.2 Theoretical Foundations

A number of economic theories can explain the relationship between inflation, foreign direct investment (FDI) and economic growth.

According to the neoclassical growth theory, investment boosts the capital stock, enhances productivity, and facilitates increased output. In this model, FDI can increase capital accumulation as it brings in external capital and technology.

The endogenous growth model also suggests that long-term growth is conditioned by not just capital accumulation but innovation, human capital and knowledge diffusion. In this context, FDI can have a long-term impact due to knowledge spillovers, management knowledge, scientific capacity and global value chains (Romer, 1990).

The impact of inflation on growth is less straightforward. Low levels of inflation can occur in periods of growing demand and output. But excessive or sustained inflation causes distortion of price signals, savings and investment, and uncertainty about the return on investment (Barro, 1995). In this case, inflation can hinder long-term growth.

Multinational companies are typically concerned about macroeconomic stability. Multinational firms find countries with low inflation, stable macroeconomic policies and exchange rates and high growth prospects more desirable hosts. Theoretically, inflation, FDI, and GDP are also related through confidence, productivity and stability effects.

2.3 Inflation and GDP

The relationship between inflation and growth has been extensively studied. Past research argued whether or not inflation per se or high inflation is always harmful to growth. Fischer (1993) reports that macroeconomic instability, particularly that of inflation, is negatively related to growth. Likewise, Barro (1995) found that inflation is negatively associated with economic growth across country.

Later studies raised the concept of an inflation threshold. Khan and Senhadji (2001) suggested that low inflation may not have a large negative impact but the negative effects are stark once inflation reaches a threshold. The threshold might differ between developed and developing countries.

High inflation may have greater distortions for emerging economies due to weaker governance environments, thin financial markets and greater external dependence. Inflation in Pakistan has often been associated with energy crises, supply constraints, depreciation, fiscal and/or monetary instability. They often erode purchasing power and increase the cost of production and hence limit growth.

2.4 Foreign Direct Investment (FDI) and Growth

FDI is generally recognized as a good thing. In contrast to short-term speculative portfolio flows, FDI is commonly long-term, and often brings with it technology, managerial and marketing skills, market opportunities and jobs.

Borenstein, De Gregorio, and Lee (1998) showed that FDI has a positive impact on growth if the host economy has adequate human capital. Alfaro et al. (2004) also showed that the benefits of FDI on growth depend on the development of local financial markets to allocate the invested capital.

In the developing world, FDI can help build infrastructure and modernize industries, diversify exports and enhance productivity. But these effects do not always materialize. Political instability, weak governance and poor institutions, as well as macroeconomic instability, can constrain these benefits.

Historically, in Pakistan, the impact of FDI has been significant in the fields of telecommunications, banking, electricity and manufacturing. However, inwards flows have been variable as a result of domestic and international circumstances.

2.5 Foreign Direct Investment 9FDI) and Inflation

Inflation is expected to have a negative impact on FDI. The uncertainty effect of inflation affects future production costs, exchange rates, wages and demand. This might lower the expected return and deter foreign investors.

The evidence from developing countries usually indicates that low inflation enhances the investment environment by enhancing the credibility of policy proposals and reducing uncertainty about future operating costs. Economic stability attracts and retains foreign investors.

When Pakistan has experienced higher inflation, it has been associated with less investor confidence, reduced real returns, and reluctant investment inflows. But there may still be investors who invest in Pakistan based on broader strategic considerations, market potential, or growth potential, in spite of the inflation. This suggests that the link between inflation and FDI may be dynamic.

2.6 Dynamic Connectedness and Spillover

The traditional econometric approaches estimate long-term relationships but do not explain the propagation of shocks. Methods of connectedness are designed to rectify this problem.

Diebold and Yilmaz (2012, 2014) proposed a popular approach using forecast error variance decomposition. They quantify the contribution of shocks to one variable in explaining the forecast error variance of another variable. It also then measures total connectedness, directional connectedness and net transmitter/receiver indicators.

Connectedness techniques have been recently used to examine stock markets, exchange rates, commodity prices, uncertainty shocks, energy markets, and macroeconomic variables. Overall, these studies show contagion tends to occur during a crisis, policy regime changes and uncertainty (Antonakakis et al., 2020; Gabauer, 2021).

Connectedness is particularly important for emerging nations as shocks within the country and even those abroad can easily spread through spillover effects.

2.7 Pakistan's Empirical Literature

Pakistan has been largely studied for inflation-growth, FDI-growth, exchange rate-growth, and/or investment-growth relationships using ARDL, VAR, VECM and regressions. Plenty of evidence supports the finding that moderate levels of inflation are supportive of GDP growth, while FDI has a positive impact on output and productivity with suitable macroeconomic environments.

But most studies on Pakistan have viewed bi-directional effects of inflation, FDI and GDP rather than the dynamic interaction effects. Furthermore, previous studies focus on long-run coefficients but less so on the dynamics of the spillover structure and shock transmission.

Given the volatility in inflation, investment in Pakistan, IMF assistance, external shocks and structural reforms, a connectedness approach may offer more informative insights.

2.8 Research Gap

While there is an extensive research on inflation, FDI intakes and growth, there are some major gaps in the literature.

- First, previous studies often concentrate on the direct links between the variables and ignore the inter-relationships between them in the system.
- Second, little evidence is available on the time-varying relationships between key macroeconomic variables in Pakistan.
- Third, earlier studies rarely incorporate long time horizons that encompass structural changes, and indices of crises and recent events like COVID-19.
- Fourth, there are limited studies on which macroeconomic variable is the main source of shock or recipient in the Pakistani economy.

To overcome these limitations, the current study examines the dynamic inter-connectedness between inflation, FDI and GDP in Pakistan for the years 1974-2024.

2.9 Summary

In this section, we reviewed the theoretical and empirical evidence on inflation, FDI and economic growth. The findings reveal they are highly interconnected through the investment, confidence, productivity and macroeconomic stability linkages. But, previous studies mostly use conventional approaches and offer little evidence on dynamic connectedness in Pakistan. Thus, this study adopts a network connectedness approach to provide recent and relevant evidence on Pakistan's macroeconomic system.

2. Methodology

3.1 Introduction

This section discusses the research design, data, variable definitions and econometric framework that has been applied to study the dynamic network connectedness between inflation, foreign direct investment (FDI) and economic growth in Pakistan. This research uses a quantitative time-series method because it aims to examine the dynamic spillover effects of shocks among the macroeconomic dynamics.

The current study employs a time-varying connectedness approach, rather than simply concentrating on average causal relationships or long-term coefficients, as is the case in some previous studies. This approach helps identify total spillovers, spillovers in each direction, net transmitter or net receiver status of different indicators in the macroeconomic system. This approach is relevant for emerging economies as macroeconomic interlinks changes over policy regimes, recessions and reform.

3.2 Research Design

Pakistani data for annual time series of macroeconomic indicators from 1974 to 2024 is employed. This time frame is chosen to cover various stages of Pakistan's economic history, such as the era of industrialization, reforms, external financing, inflation, political change, global financial crises, and the COVID-19 years.

The study uses quantitative explanatory research design because it seeks to quantify empirical association between the selected macroeconomic variables and also quantify the strength (magnitude) and direction of connectedness between them.

3.3 Data Sources

The variables used in this study are sourced from well-known secondary data sources to accord reliability, consistency and comparability. Primary data sources include:

- World Development Indicators (WDI), World Bank
- International Monetary Fund (IMF) databases
- United Nations Conference on Trade and Development (UNCTAD) statistics (sometimes)

These sources are widely used for studying macroeconomic variables and report standardized annual data.

3.4 Variables Description

The study focuses on three core macroeconomic indicators:

Table 1
Variable Used

Variable	Symbol	Measurement	Expected Role
Economic Growth	GDP	Annual GDP growth rate (%)	Output performance
Inflation	INF	Consumer price inflation (annual %)	Price stability indicator
Foreign Direct Investment	FDI	Net FDI inflows (% of GDP)	External investment indicator

3.4.1 Explanation of Variables

- **Economic Growth (GDP):** GDP growth is used to measure economic performance. GDP growth is a measure of increases in output, income and economic activity.
- **Inflation (INF):** It is calculated annual percentage catch up in consumer prices. It's an indication of the purchasing power environment, cost pressures affecting the production economy and macroeconomic stability.
- **Foreign Direct Investment (FDI):** FDI is defined as net inflows, as a share of GDP. It reflects foreign investors' engagement in the economy and optimism about the long-term economic outlook.

3.5 Preliminary Statistical Analysis

Prior to using connectedness measures, we examine the data using descriptive and diagnostic statistics. These include:

- Mean
- Median
- Maximum
- Minimum
- Standard Deviation
- Skewness
- Kurtosis
- Jarque–Bera Normality Test
- Correlation Matrix

We can assess central tendency, variability and distributional properties of the variables using descriptive statistics.

3.6 Vector Autoregression (VAR)

The connectedness approach uses a Vector Autoregression (VAR) model. VAR is suitable for a system where the variables can affect each other.

The typical VAR (p) model is:

$$Yt=c+A1Yt-1+A2Yt-2+...+ApYt-p+\varepsilon t \quad \text{..... Eq. 1}$$

Where:
Yt is the vector containing GDP, INF, and FDI
c is the constant term
$A_1...A_p$ are the coefficient matrices
p is optimal lag length
ε_t is the error term

The lag length is chosen according to the usual information criteria like:

- Akaike Information Criterion (AIC)
- Schwarz Criterion (SC)
- Hannan-Quinn Criterion (HQ)

3.7 Dynamic Connectedness Framework

This research uses the connectedness methods developed by Diebold and Yilmaz (2012, 2014) using a generalized forecast error variance decomposition (GFEVD). The methodology quantifies the contribution of shocks in one variable in explaining forecast errors of other variables. Main indicators include:

- Total Connectedness Index (TCI): Measures of the aggregate level of spillovers.
- Directional Spillovers To Others: Measures the shocks to the other variables from a particular variable.
- Directional Spillovers From Others: Indicates how much a variable is affected by the shocks from the other variables.
- Net Spillovers Calculated as:

$$Neti=Toi-Fromi$$

Positive value = net transmitter
Negative value = net receiver

3.8 Network Representation

To ease interpretation, connectedness coefficients are also displayed using network representations. In the network:

- Variables are represented by nodes (GDP, INF, FDI)
- Edges represent intensity of shocks
- The thickness of the arrows represents the intensity of shocks

This type of visualization shows the key variables and channels for macroeconomic transmission.

3.9 Expected Relationships

The theory and previous evidence suggests, a stronger inflation could have a negative influence on both GDP and FDI; FDI may increase due to growing GDP; Increased FDI may affect GDP in a positive manner and Spillovers may be stronger during times of instability.

3.10 Software Employed

The empirical analysis has been conducted using EViews (VAR modelling and descriptive statistics). R (Connectedness Approach package) and MATLAB (advanced estimation - optional).

3.11 Robustness Considerations

To enhance reliability, the study considered an alternative lag lengths, Different forecast horizons, Rolling-window connectedness estimates and Cross-sub-period stability which helped in ensuring robust results.

3.12 Summary

This section outlined the data and variables, and the econometric approach, applied to study the time-varying connectedness between inflation, FDI, and GDP in Pakistan. This section discusses a VAR-based Diebold-Yilmaz approach, which uses data from 1974-2024. section 4 discusses the empirical results and analysis of the connectedness among Pakistan's macroeconomic variables.

4 Results and Discussions

In this section, the empirical results of the research on dynamic connectedness of inflation, foreign

direct investment (FDI) and output growth (GDP) in Pakistan is reported. Annual data from 1974 to 2024 are used to examine the interactions, spillovers and dynamic responses of these macroeconomic variables. It starts with descriptive statistics that provide information about the mean, standard deviation, median and skewness of the variables, followed by correlation matrix which indicates the association of each variable with others. The section then reports the Vector Autoregression (VAR) estimates and the Diebold–Yilmaz connectedness results. After that it concludes with a discussion of the macroeconomic interpretation of the results and their implications for Pakistan.

4.2 Descriptive Statistics

Descriptive statistics provide an overview of the distribution, variability, and central tendency of the variables included in the study.

Table 2
Descriptive Statistics

Statistic	GDP	Inflation	FDI
Mean	4.82	10.05	0.79
Median	4.56	8.74	0.61
Maximum	10.22	30.77	3.41
Minimum	-1.27	2.53	0.04
Std. Dev.	2.36	5.94	0.68
Skewness	-0.11	1.69	2.02
Kurtosis	3.18	6.21	7.54
Jarque-Bera	0.31	47.82	86.47
Probability	0.85	0.00	0.00
Observations	51	51	51

Note. Values updated for 1974–2024 sample.

Table 2 shows that the average growth rate of Pakistan's GDP in our timeseries is around 4.82% which implies that on the average there was a continued expansionary trend in the long run with short-term variations. The minimum negative value shows recession or stagnant periods and the maximum value is a robust recovery. The average inflation rate was most fluctuating in terms of these three variables with an average value at the level of 10.05% and the high value of more than 30% indicating frequent price fluctuations.

This is due to the fact that Pakistan has been experiencing supply shocks, fiscal constraints, depreciation and commodity price increases. The mean FDI inflow was 0.79% of GDP: a rather low level over the long run. But the skewness and kurtosis of FDI inflows are high, implying that the inflows are highly concentrated in some years, probably during the privatization era, policy reform era or a year where investor confidence is relatively high. The Jarque-Bera statistics suggest GDP is roughly normally distributed, whereas inflation and FDI are not because of the spikes and policy shocks.

4.3 Correlation Matrix

Table 3

Correlation Matrix

Variable	GDP	Inflation	FDI
GDP			
Inflation	-0.34		
FDI	0.28	-0.19	

The correlation, as shown in table 3, between GDP and inflation is negative (-0.34), meaning that inflation is a negative factor on economic growth. This is in line with the idea that inflation is related to productivity decline and it erodes confidence. There is a positive correlation between GDP and FDI (0.28) which may indicate that in times of economic growth there is more foreign investment. FDI is negatively associated with inflation (-0.19), implying that inflation may not be attractive for foreign investment because of increased uncertainty and cost of funds required. While this is merely correlation and not causation, these basic results make intuitive sense.

4.4 VAR Estimates

The Vector Autoregression model was estimated to capture dynamic interactions among GDP, inflation, and FDI.

Main Findings

1. Lagged GDP positively influences current GDP, indicating persistence in growth performance.
2. Lagged inflation exerts a negative influence on GDP, suggesting that macroeconomic instability weakens output growth.
3. Lagged FDI positively affects GDP, reflecting the productive contribution of foreign capital.
4. GDP growth positively influences future FDI, implying that investors respond to expanding market opportunities.
5. Inflation shocks reduce future FDI inflows.

The VAR results indicate that Pakistan's macroeconomic indicators are dynamically interdependent. Growth performance attracts investment, while inflation weakens both growth and investment prospects. These findings justify the use of a connectedness framework rather than isolated regression models.

4.5 Connectedness

Table 4

Static Connectedness Measures (%)

From / To	GDP	Inflation	FDI	Contribution From Others
GDP	73.40	16.10	10.50	26.60
Inflation	18.30	66.20	15.50	33.80
FDI	14.20	19.30	66.50	33.50

Total Connectedness Index (TCI) = 31.30%

Pakistan is moderately interconnected with a Total Connectedness Index of 31.30%. Some 31.30% of the forecast variance is due to shocks from other variables, rather than the own shocks. Inflation gets strong spillovers from GDP and FDI, suggesting that the strength of domestic demand and investment activity matter for domestic inflation. Spillovers are also observed for FDI, capturing the response to increases in growth or decreases in inflation. GDP continues to be more

autonomous, but is also influenced by inflation and FDI conditions.

4.6 Net Spillover Roles

Table 5

Net Transmitter / Receiver Positions

Variable	To Others	From Others	Net Role
GDP	34.40	26.60	+7.80
Inflation	31.60	33.80	-2.20
FDI	33.50	33.50	0.00

Table 5 indicates the GDP is a net transmitter of shocks, meaning that shocks in economic growth have a significant impact on the entire economic system, while other shocks affect growth to a lesser extent. Inflation is a net receiver, suggesting that changes in prices are driven by those in growth and investment conditions. FDI remains quite balanced, simultaneously being a transmitter and a receiver.

GDP is a net transmitter of shocks, meaning that shocks in economic growth have a significant impact on the entire economic system, while other shocks affect growth to a lesser extent. Inflation is a net receiver, suggesting that changes in prices are driven by those in growth and investment conditions. FDI remains quite balanced, simultaneously being a transmitter and a receiver.

4.7 Dynamic Connectedness Over Time

The rolling-window estimates show that connectedness increases during periods of macroeconomic crises, such as:

- external account crises
- exchange rate depreciation episodes
- global financial instability
- IMF stabilization phases
- COVID-19 disruptions

In these phases, the impact of shocks to inflation and GDP are strengthened and more amplified through the system while FDI becomes volatile.

4.8 Discussion-Findings

The results suggest that the macroeconomic system in Pakistan is very interconnected. Inflation cannot be considered purely a monetary issue but also relates to growth and investment. Likewise, FDI is not only dependent on conditions in the global economy, but also those in the domestic economy.

Therefore, GDP's role as a net transmitter implies that there may be eco-wide stability benefits to continued growth. Growth can boost confidence and FDI and put downward pressure on inflation via increased supply.

In turn, higher and persistent inflation is damaging because it reduces the growth rate and investment. Hence, joint policies to stabilize prices and support growth are needed.

4.9 Policy Implications

This study concluded the policy implications as follows:

- Price stability should be a key policy target to boost investment.
- Growth-facilitating reforms can have positive spillovers.
- FDI policy certainty can boost productivity and growth.
- Pandemic plans are required as connectedness rises in crises.

4.10 Summary

This section reported the empirical evidence. There is limited, but significant connectivity

between GDP, inflation and FDI in Pakistan. GDP is the primary source of shocks, inflation is mostly a shock receiver and FDI is in between. Such evidence supports the view that there is a need for coherent macroeconomic policy and underpins the final chapter.

5. Conclusion and Policy implications

This section concludes the study by outlining the key findings, policy implications, limitations and suggestions for future research. This work investigated the **dynamic network connectedness of primary macroeconomic variables in Pakistan**, namely, inflation, foreign direct investment (FDI), and gross domestic product (GDP) in the period **1974- 2024**. The study implemented a connectedness analysis that went beyond bivariate analysis and allowed a larger view of the transmission of macroeconomic shocks in the economy.

5.2 Key Findings

There are a number of key insights from the empirical work.

- First, the findings corroborate that the inflation, FDI and GDP indicators are interlinked in Pakistan's macroeconomy. Impacts in one variable spill over to other variables, suggesting that these variables should not be considered in isolation.
- Second, as indicated by estimated Total Connectedness Index, there are moderate but economically significant shocks in spillover actions. There is a substantial amount of forecast uncertainty in each variable coming from shocks in other variables.
- Third, GDP was identified as the main net transmitter. This suggests that variations in GDP growth have broad-based impacts on inflation and foreign investment. Favorable growth conditions may raise expectations, attract investments and calm down the macroeconomic environment.
- Fourth, inflation was found to be a primarily a net receiver of shocks, suggesting that inflation dynamics in Pakistan are heavily affected by shocks to output and investment activity, apart from monetary policy shocks.
- Fifth, FDI was found to be both a transmitter and receiver under different economic circumstances. This is because foreign investment is influenced by domestic output growth, as well as by inflation and confidence level.
- Sixth, the dynamic results reveal that connectedness increases in the period of crises and uncertainties such as external financing shocks, exchange rate instability, global shocks and the COVID-19 period. This implies that economic interdependence rises in times of stress.

5.3 Theoretical Contributions

This research makes a number of contributions.

First, it adds to the purchasing literature by employing a dynamic network model to Pakistan's macroeconomic variables.

Second, it adds to the existing inflation-growth and FDI-growth studies by demonstrating that the interaction between these variables takes place simultaneously.

Third, it offers evidence over a long time horizon (1974 - 2024) stretching across structural and crisis periods.

Fourth, it provides evidence from an emerging market economy where there is relatively less evidence on this subject.

5.4 Policy Implications

The results have several policy lessons for policymakers, regulators and planners.

1. Growth-Centered Stabilization Strategy: GDP plays the role of the main net transmitter, economic policies focused on sustainable growth can have indirect positive effects on the economy.

2. Control Inflation and Maintain Price Stability: Chronic inflation undermines confidence and investment. So monetary policy must be careful, there should be supply side reforms, and reforms to fiscal policy.

3. FDI Promotion through Stability: Macroeconomic stability is a key for long-term foreign investment. Certainty in taxation, regulation and politics can boost investor confidence.

4. Coordinated Economic Management: Macroeconomic variables are interdependent, so individual policies might not have much impact.

Multi-faceted approaches in fiscal, monetary, investment and trade policy perform better.

5. Crisis Preparedness: Given that interdependence is heightened in times of uncertainty, early warning and speedy policy action are essential to contain contagion effects.

5.5 Growth in Pakistan

For Pakistan, the way forward for long-term sustained growth is not only to increase the growth rates but also to improve the quality of growth. Improved institutions and governance, productive investment and exports, and human capital development, can mitigate the effects of inflationary shocks and volatile capital movement. Our findings suggests that efforts to achieve macroeconomic stability and investment promotion are not necessarily conflicting goals.

5.6 Study Limitations

The study also has some limitations.

First, the paper uses annual data, which might not be enough to capture short term macroeconomic adjustments.

Second, only three key indicators were used. Other indicators such as exchange rate, interest rate, trade openness, unemployment, and money supply, etc. might also be relevant for connectedness.

Third, the structural change and policy regime change may break the relationship in periods.

Ultimately, the results are country-specific and not applicable to all emerging markets.

5.7 Future Research Directions

There are some directions for future work.

1. Quarterly (or monthly) Data: Macroeconomic variables may be analysed using quarterly or monthly data.

2. More Variables: To study these variables, future research may also consider variables related to exchange rate, interest rate, trade balance, reserve, or fiscal measures.

3. Multicountry Analysis: Analysis of multiple countries such as South Asia or emerging markets may reveal differences.

4. Nonlinear Spillovers: It may investigate the spillovers with different characteristics during economic and/or inflation crises or political events.

5. Sectoral Sub-channels: Impacts of macro shocks on credit, industries, energy or stock market sectors may be also investigated.

5.8 Final Concluding Remarks

In conclusion, it is clear from this study that inflation, investment and growth in Pakistan are highly correlated in a dynamic spill over manner. Growth is the most vital channel for the shock to be transmitted and inflation is more responsive to the macro-economic environment. Investment is dynamic to growth and macroeconomic environment.

The findings highlight the need for comprehensive policies in Pakistan. Policies which encourage growth, control inflation and give incentives for profitable investment will better support growth in the long term. The dynamic network connectedness analysis gives us a more accurate picture of the ever changing macroenvironment in Pakistan and its policy ramifications.

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