

Research article

The dynamics of budget deficit, macroeconomic instability and economic growth in developing Asian countries: Evidence from heterogeneous panel methods

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Abstract: The objective of this study is to investigate the impact of budget deficit on macroeconomic instability and economic growth in the developing Asian region over the period 1973–2022. In the first-stage regression analysis, standard panel estimation techniques were used; in the second stage, the study employed mean group and pooled mean group estimation methods, as the slope heterogeneity test rejected the null hypothesis of homogeneous slope coefficients. The results show a positive impact of budget deficit on macroeconomic instability; this implies that, in the long run, an increase in budget deficit contributes to greater macroeconomic instability due to inflationary pressure, higher interest rates, and exchange rate volatility. Furthermore, the results show a negative impact of the budget deficit on economic growth in the long run, as a growing budget deficit may signal some fiscal challenges, such as increased government borrowing and reduced private sector investment, that ultimately hinder economic growth. The current study contributes to the existing empirical literature and offers important guidelines for policymakers seeking to better understand the dynamics of the budget deficit within the context of developing countries.

Keywords: macroeconomic instability; budget deficit; economic growth; heterogeneous panel method

JEL Codes: H6, O4, E6

1. Introduction

A country's budget, much like a planned financial blueprint, provides a comprehensive roadmap guiding its economic trajectory. The presence of a budget deficit indicates an imbalance between government expenditures and revenue collection. The budget reflects a country's overall economic well-being while fiscal and economic policies determine whether it results in a deficit or a surplus. The fundamental reason for a country's budget deficit is its economic priorities, fiscal policy decisions, and broader economic conditions.

The problem of budget deficit has become a crucial concern in the economic environment of today's world. Nowadays, developing countries (DCs) are especially concerned about the persistent government budget deficit and rising public debt. When a government's spending exceeds its total revenue, it may result in a budget deficit, creating a shortfall that often requires borrowing. Governments have historically struggled with budget deficits due to economic fluctuations, political instability, and wars. Basically, the budget is another name for financial planning.

Low levels of physical and human capital, unfavorable weather, political instability, and a deteriorating law and order situation in any country are key factors leading to unsustainable economic growth. Generally, public spending is considered a crucial policy instrument through which the government can stabilize the economy. Government spending in developing countries can be used to smooth demand fluctuations, finance infrastructure development, and stimulate long-term growth and development. However, in any country, the success and effectiveness of fiscal policy interventions mainly depend on the prevailing macroeconomic conditions and the quality of governance institutions. Persistent budget deficits, imprudent utilization of public funds, and inadequate institutional capability may deteriorate the stabilizing role of public spending; what is generally considered a stabilizing tool might actually add to rising macroeconomic volatility, especially in economies that are more vulnerable to external shocks and revenue volatility.

Although reasonable increases in public expenditure may usually result in macroeconomic stability, excessive spending predominantly supported by large deficits or structural fiscal restrictions can aggravate macroinstability. Policy intervention may indicate a destabilizing effect when the budget deficit increases considerably without corresponding revenue generation, leading to increased fluctuations in macroeconomic indicators such as inflation, exchange rates, and interest rates. In general, it is important to consider the magnitude as well as the context of fiscal interventions, as the stabilizing role of the government is conditional and may be reversed under certain economic conditions.

1.1. Macroeconomic instability and budget deficit

A budget deficit occurs when a government spends more money than it collects in taxes. In simple words, it parallels a situation where expenditures exceed income; when the government borrows a lot, it puts pressure on the overall economy, making it less predictable. This can lead to macroeconomic instability, as it may cause problems like high inflation and fluctuations in interest rates and exchange rates. Therefore, a persistently high budget deficit can cause fluctuations in the country's overall economic outlook. From a theoretical standpoint, there are different views on how a budget deficit might influence macroeconomic instability.

Ekren et al. (2017) argued that a persistent budget deficit can lead to higher levels of inflation and interest rates, contributing to economic instability. Others have suggested that well-targeted deficits during economic downturns can stabilize the economy by stimulating demand. Studies conducted by Cinar et al. (2014), Hussain and Haque (2017), and Nkrumah et al. (2016), among others, contribute to this body of literature. Furthermore, studies by Cinar et al. (2014), Hussain and Haque (2017), Nkrumah et al. (2016), Gatawa et al. (2017), Rehman et al. (2012), Iqbal and Zahid (1998), Ekren et al. (2017), and Saleh and Harvie (2005) argued that a one-to-one relationship exists between budget deficit and macroeconomic instability. Whenever the budget deficit increases, it automatically leads to higher macroeconomic instability. Specifically, the budget deficit can contribute to macroeconomic instability through higher interest rates, increasing public debt, inflationary pressure, exchange rate volatility, and crowding out of private investment.

1.2. Economic growth and budget deficit

A persistent budget deficit can place a strain on the economy by requiring more government borrowing, which will lead to higher interest rates while possibly limiting private sector investment and consumer spending, hampering overall economic growth. Some studies have explored causality, aiming to determine whether economic growth influences deficits or vice versa. Findings from these studies vary based on the time horizon considered and the economic context, providing policymakers with valuable insights for fiscal policies to stimulate economic activity while ensuring fiscal sustainability. Some reference studies contributing to this discourse include works by Alesina and Perotti (1995), Barro (1989), Blanchard and Perotti (2002), and Elmendorf and Mankiw (1998). Collectively, these studies contribute to a deeper understanding of the intricate interplay between economic growth and budget deficit in different contexts.

Romer and Romer (2010) explored the impact of different types of fiscal policies, distinguishing between tax cuts and increases in government spending. Furthermore, the literature highlights the importance of institutional factors, governance structures, and political considerations in shaping the outcomes of fiscal policies. Alesina and Tabellini (1990) emphasized the role of political institutions in influencing the effectiveness of fiscal policies on economic growth. Understanding the relationship between economic growth and budget deficit is crucial for policymakers seeking to design effective fiscal strategies. A persistent budget deficit can hinder economic growth through more government borrowing, higher interest rates, reduced private sector investment, reduced consumer spending, trade imbalance, and overall economic instability.

1.3. Objective of the study

Although several studies have explored the relationship between budget deficit, macroeconomic stability, and economic growth, a substantial portion of such literature has either focused on developed countries or conducted cross-country studies, resulting in developing countries being either not analyzed or underrepresented. Developing countries have different structural characteristics, such as relatively evolving fiscal institutions, shallow financial markets, higher macroeconomic volatility, and greater exposure to external shocks, which may affect the overall transmission mechanisms and the impact of fiscal interventions. Consequently, empirical findings from global samples or developed

regions may not be applicable to developing countries. This emphasizes the significance of conducting a targeted and region-specific study. Therefore, the objective of the current study is:

- To evaluate the impact of budget deficit on macroeconomic instability in developing Asian countries.
- To evaluate the impact of a budget deficit on economic growth in developing Asian countries.
- To analyze the impact of other factors involving broad money, trade openness, gross fixed capital, and urban population on macroeconomic instability.
- To analyze the impact of other factors involving broad money, trade openness, gross fixed capital, and urban population on economic growth.

1.4. Significance of the study

Addressing the issue of macroeconomic instability that arises due to budget deficit is crucial for developing Asian countries, as it directly influences factors like inflation, interest rates, and exchange rates. Further, understanding the relationship between budget deficit and macroeconomic instability is important as it may help to design effective fiscal policies to promote overall economic stability. Additionally, this study also examines the effects of budget deficit on economic growth, which can ultimately guide the formulation of effective fiscal strategies and foster sustainable development.

Several studies have explored the effect of the budget deficit on macroeconomic instability and economic growth in developed countries; however, studies that focus particularly on developing Asian countries are rare. The developing Asian economies present unique challenges, such as volatile revenue collection, limited fiscal space, and exposure to external shocks, which may affect the relationship between budget deficit, growth, and macroeconomic stability. Therefore, empirical findings from global samples or developed regions may not be applicable to developing countries. The current study attempts to fill this gap by examining the impact of a budget deficit on macroeconomic stability and growth in 24 developing Asian countries over the period 1973–2022. Moreover, existing literature has ignored the problem of slope coefficient heterogeneity for the cross-sectional unit; the current study tackles the issue of slope coefficient heterogeneity by employing pooled mean group (PMG) and mean group estimation techniques.

The use of a long-time series panel dataset along with heterogeneous panel techniques allows us to explore both long-run equilibrium relationships and short-run dynamics, which are often overlooked in existing literature. In the first-stage regression analysis, standard panel estimation techniques are used, while in the second-stage regression analysis, mean group and pooled mean group (PMG) estimation methods are employed. As the current study tackles the issue of cross-country heterogeneity, the estimated long-run dynamics may provide more reliable and policy-relevant insights as compared to existing studies. The current study fills an important gap in the literature by providing region-specific evidence along with a more integrated analysis of fiscal policy dynamics, which can better guide policymakers in the developing Asian region.

The remainder of the study is structured as follows: Section 2 presents a review of existing literature on budget deficit, macroeconomic stability, and economic growth. The conceptual framework is discussed in Section 3. Section 4 explains the methodology, data, and estimation techniques. Section 5 contains empirical findings and discussion. Finally, the last section concludes the study.

2. Literature review

2.1. Empirical evidence on the impact of budget deficit on macroeconomic instability

The relationship between budget deficit and macroeconomic performance is a well-debated issue among policymakers and practitioners. Fiscal deficits, according to traditional Keynesian theory, can increase aggregate demand and sustain output growth by supporting public investment and consumption, particularly during economic downturns. On the other hand, neoclassical opinions highlight the likely adverse impact of persistent deficits, due to higher interest rates, crowding out of private investment, and inflationary pressures. The deficit may have a neutral impact, as indicated by Ricardian theory, if individuals fully anticipate a future increase in taxes; however, this phenomenon is rarely observed in reality, and predominantly in underdeveloped countries, with underdeveloped financial markets and poor institutional structure, where persistent deficits often lead to macroeconomic imbalances (Aragaw, 2024; Catão and Terrones, 2003).

Several studies have shown that budget deficits lead to macroeconomic instability in emerging and underdeveloped economies. The findings of Aragaw (2024) highlighted that budget deficits result in high inflationary pressures, particularly in countries with a weak financial sector. Likewise, according to Catão and Terrones (2003), the deficit–inflation relationship is observed more strongly in high-inflation developing economies than in advanced economies, which highlights the context-specific nature of macroeconomic effects of budget deficits. Haan and Zelhorst (1990) found that budget deficits contribute to monetary expansion, which, in turn, leads to high inflationary pressures in developing countries. Saleh and Harvie (2005) highlighted that budget deficits are linked with key macroeconomic variables such as growth, interest rates, and inflation, supporting the Keynesian view that deficit financing—especially through monetization—can lead to inflation and external imbalances. Likewise, Easterly and Servén (2003) found a strong positive association between persistent fiscal deficit and macroeconomic instability in Latin America. This highlights that inefficient fiscal management amplifies volatility and undermines long-term development. In general, the aforementioned studies show that budget deficits often damage macroeconomic stability in developing countries.

Notably, existing literature has also attempted to explore the conditions under which fiscal interventions turn destabilizing. Egert (2015) and Alesina and Silvia (2010) found that when public debt and deficits exceed certain levels, they contribute to macroeconomic instability. Persistently larger budget deficits in emerging and developing economies may cause high inflation, exchange rate depreciation, and increased sovereign risk. Chudik et al. (2017) showed the presence of nonlinearities by demonstrating that moderate budget deficits can enhance economic growth and macroeconomic stability, whereas high deficits may destabilize the economy both by shrinking the fiscal space and increasing macroeconomic volatility.

In addition, deficit financing is critical in determining whether fiscal interventions remain stable. Usually, deficits supported by productive public investment can contribute to growth and macro stability, whereas deficits driven by recurring spending or useless subsidies may have adverse macroeconomic repercussions (Adam and Bevan, 2005). Nguyen (2015) used PMG estimation to show that fiscal deficits and broad money supply are significant determinants of inflation in a panel of Asian economies, indicating potential macroeconomic instability linked to fiscal imbalances. Similarly, deficits driven by external borrowing or monetary expansion most likely cause instability by triggering

inflationary pressures and exchange rate volatility (Aragaw, 2024). These risks are most likely magnified in developing nations with weak financial markets and varying institutional quality. This highlights the importance of examining the dynamic impact of budget deficit on macroeconomic instability and economic growth in developing Asian countries.

2.2. Empirical evidence on the impact of budget deficit and economic growth

Fiscal policy is generally considered a stabilizing tool, particularly with its countercyclical public spending; however, its effectiveness varies. According to Keynesian theory, expansionary fiscal policy may smooth business fluctuations and diminish output volatility. Auerbach and Gorodnichenko (2012) found that fiscal multipliers are large in recessions, implying that government interventions may stabilize aggregate demand. Likewise, Fatas and Mihov (2013) discovered that fiscal intervention has a strong impact on macroeconomic stability, and countercyclical fiscal intervention leads to macroeconomic stability in countries with a strong institutional structure. Conversely, fiscal indiscipline, limited policy credibility, and procyclical fiscal behavior in underdeveloped economies often decrease the effectiveness of fiscal interventions and raise fears about fiscal sustainability due to persistent budget deficits.

Rehman et al. (2012) investigated the impact of budget deficit on economic growth using time series data for Pakistan; the findings showed a negative relationship between budget deficit and economic growth, implying that controlling the deficit is essential for sustainable growth. Karki et al. (2024) used time series data for Nepal and indicated a negative relationship between budget deficit and economic growth, whereas trade deficit and FDI showed a positive relationship with growth. Nayab (2015) examined the Pakistani economy by employing cointegration, Granger causality, and Vector Error-Correction Models (VECM). The findings suggest that budget deficit does not significantly promote economic growth; rather, economic growth leads to investment, which in turn contributes to a high budget deficit. Cinar et al. (2014) used a Keynesian approach with panel Autoregressive Distributed Lag models (ARDL) for selected countries in Eurozone over the period of 2000–2011 and showed that deficit-based fiscal policy has a positive short-run impact on economic growth. Hussain and Haque (2017) analyzed the Bangladesh economy using VECM. The results indicated that fiscal deficits can promote economic growth when borrowed funds are used productively and repayment is ensured. Nkrumah et al. (2016) studied Ghana using the ARDL approach and found that budget deficit has a negative impact on economic growth; specifically, a rise in the deficit leads to a decline in real GDP.

The empirical evidence on the relationship between budget deficits and economic growth is inconclusive, as it indicates both positive short-term and negative long-term dynamics. Further, Hussain and Haque (2017) showed that budget deficits might initially enhance growth; however, it ultimately reduces growth when deficits lead to macroeconomic distortions. Generally, both macroeconomic stability and fiscal discipline are intertwined, which underscores the significance of considering sustainable fiscal positions while evaluating the effects of deficits (Zahid et al., 2024).

2.3. Empirical evidence on the impact of other control variables on macroeconomic instability and economic growth

The existing literature also highlights the significance of many control variables in influencing the dynamic relationship between budget deficit, macroeconomic instability, and economic growth. Trade openness, urbanization, foreign direct investment, and broad money are generally considered important determinants of macroeconomic stability and growth. Therefore, considering these control variables offers a more comprehensive understanding of the underlying economic linkages.

Chude and Chude (2016) examined the nexus between broad money supply and economic growth for Nigeria over the period 1987–2010 by using cointegration and vector autoregression (VAR) techniques, including the Granger causality test. The empirical investigation found a one-to-one significant relationship between broad money supply and economic growth, which implies that broad money supply has a significant influence on output and prices. Heady and Hodge (2009) investigated the impact of urban population growth on economic growth. They demonstrated that, in the early 1960s and 1970s, the population growth did not affect economic growth; after the 1980s, however, a tremendous shift occurred, and urban population gradually started affecting the economic growth of the countries. The literature suggests that increasing population growth may inversely affect economic growth in developing countries, while in developed countries, it may help to boost economic growth (Kelley and Schmidt, 1995; Bloom et al., 2003).

Gatawa et al. (2017) explored the impact of inflation, money supply, and interest rate on the economic growth in Nigeria over the period 1973–2013. The study used the VAR model and the Granger causality test. The results indicate that an increased money supply has a positive effect on GDP, while interest rates and inflation have a negative effect on GDP, particularly over the long run.

Combes and Saadi-Sedik (2006) investigated the impact of trade openness on the budget deficit in 66 developing countries over the period 1974–1998 by employing the GMM technique for empirical analysis. The findings of this study demonstrated that a nation's vulnerability to external shocks increases with trade openness. Furthermore, trade openness also affects budget balances indirectly through channels such as income inequality and corruption. Further, Raghutla (2020) examined the effect of trade openness on economic growth in five emerging economies for the period of 1994–2016 and demonstrated that greater trade openness positively affects economic growth through investment, promoting efficiency and technology transfer, suggesting that policies that encourage trade liberalization may enhance growth prospects in these economies.

In conclusion, this literature review shows that the effect of budget deficit on macroeconomic instability and economic growth has been studied in developed countries; however, studies that focus particularly on developing Asian countries are rare. As developing Asian economies present unique challenges, empirical findings from global samples or from developed regions may not be applicable here. This represents a literature gap: to investigate the dynamic relationship between budget deficit, macroeconomic stability, and economic growth in developing Asian countries. As such, the current study examines the impact of budget deficit on macroeconomic stability and growth in 24 developing Asian countries over the period 1973–2022. The current study provides region-specific evidence and a more integrated analysis of fiscal policy, which can better guide policymakers in the developing Asian region.

3. Conceptual framework

3.1. Keynesian perspective on budget deficit

Keynesian economics emphasizes the role of fiscal policy, including the budget deficit, as a tool to stabilize the economy during economic downturns. The theory suggests that deficits can stimulate aggregate demand, potentially mitigating economic instability and fostering growth. According to Keynes, during a recession, traditional market forces might not be sufficient to restore full employment. In such situations, fiscal policy interventions, including deficit spending, can play a crucial role in stimulating aggregate demand and boosting economic growth.

Keynesian theory advocates for countercyclical fiscal policy, meaning that during economic downturns, governments should increase spending or reduce taxes to stimulate demand and employment. The multiplier effect is crucial in understanding how deficit spending can potentially have a positive impact on economic growth. Keynesian theory suggests that government spending varies in its effectiveness in stimulating the economy. Furthermore, Keynesian policies may contribute to long-term economic growth when they support productive investments. The studies conducted by Keynes (1936), Blinder and Solow (1973), and Cinar et al. (2014) contributed to this body of literature.

3.2. Ricardian equivalence approach to budget deficit

The Ricardian equivalence hypothesis, proposed by Ricardo (1820), posits that individuals anticipate future tax liabilities associated with a budget deficit. According to this theory, changes in government spending, taxation, and budget deficits do not have a significant impact on overall consumption patterns and economic outcomes because individuals anticipate the future tax implications associated with these fiscal policies. According to Keynesian theory, deficit-financed government spending can increase overall spending and stimulate economic growth, especially when there is underemployment. Ricardian equivalence implies that changes in the composition of government financing, whether through taxation or deficits, do not alter the overall burden on future generations because consumers adjust their behavior accordingly.

3.3. Crowding-out effect of the budget deficit

Barro (1974), Blanchard and Johnson (2013), and Friedman (1968) discussed the crowding-out effect of budget deficits on private investment. This effect implies that increased government borrowing to finance a budget deficit can lead to higher interest rates in the financial markets. When the government borrows more to cover a budget deficit, it increases the demand for loanable funds in the financial markets. As a result, interest rates rise to equate the demand and supply of funds. Higher interest rates can make borrowing more expensive for businesses and individuals in the private sector. The crowding-out effect suggests that the higher interest rates resulting from increased government borrowing can lead to a reduction in private investment. Higher interest rates can also affect individual consumers. With increased costs of borrowing for mortgages, auto loans, and other forms of credit, consumers may reduce their spending on big-ticket items. This, in turn, could have implications for overall consumption patterns in the economy. If deficits are sustained over a long period and are

substantial, the crowding-out effect may become more pronounced, potentially dampening private sector activities.

3.4. Neoclassical perspective on the budget deficit

According to the neoclassical growth theory, long-term economic growth is determined by technological progress, labor force growth, and capital accumulation (Solow, 1956). Persistent budget deficits may affect growth indirectly via crowding out productive capital and influencing the availability of funds for private investment (Barro, 1974). However, if deficit spending is used for productive investments, then it may augment the capital stock and support sustainable growth over time (Blanchard and Johnson, 2013).

3.5. Model specification: budget deficit, macroeconomic instability, and economic growth

Based on the conceptual framework discussed above, the current study examines the impact of budget deficit on macroeconomic instability and economic growth. Equations (1) and (2) express the theoretical discussion about the impact of budget deficit on macroeconomic instability (MI) and economic growth (EG), respectively:

$$MI = F(BD, BM, TO, GFC, UP) \quad (1)$$

$$EG = F(BD, BM, TO, GFC, UP) \quad (2)$$

Equation (1) indicates that macroeconomic instability (MI) depends on budget deficit (BD), broad money (BM), trade openness (TO), gross fixed capital formation (GFC), and urban population (UP). Equation (2) indicates that economic growth (EG) depends on budget deficit (BD), broad money (BM), trade openness (TO), gross fixed capital formation (GFC), and urban population (UP). These equations imply that when any of these factors change, they affect the overall MI and EG of the economy.

Existing literature highlights the importance of many control variables in influencing the dynamic relationship between budget deficit, macroeconomic instability, and economic growth. This study considered the variables that are most frequently used in the literature. As discussed in Section 2, trade openness, urbanization, investment, and broad money are generally considered important determinants of macroeconomic stability and growth. Therefore, considering these variables offers a more comprehensive understanding of the underlying economic linkages.

4. Empirical model, data, and estimation procedure

4.1. Empirical model

Our conceptual framework puts forward two empirical hypotheses: (i) budget deficits affect macroeconomic instability, and (ii) budget deficits affect economic growth in developing Asian countries. This section investigates whether or not these hypotheses are accepted with empirical support. Equations (3) and (4) are regression equations of macroeconomic instability and economic growth, respectively, both based on the theoretical framework discussed in the previous section.

$$MI_{it} = \alpha_0 + \alpha_1 BD_{it} + \alpha_2 TO_{it} + \alpha_3 BM_{it} + \alpha_4 GFC_{it} + \alpha_5 \ln UP_{it} + \varepsilon_{it} \quad (3)$$

$$EG_{it} = \beta_0 + \beta_1 BD_{it} + \beta_2 TO_{it} + \beta_3 BM_{it} + \beta_4 GFC_{it} + \beta_5 \ln UP_{it} + \varepsilon_{it} \quad (4)$$

where i refers to country, t represents time, and $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ and $\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 are scalar parameters in Equations (3) and (4), respectively. Further, MI_{it} and EG_{it} refer to macroeconomic instability and economic growth, respectively, in country i at time t , whereas $BD_{it}, TO_{it}, BM_{it}, GFC_{it}$, and UP_{it} denote budget deficit, trade openness, broad money, gross fixed capital formation, and urban population, respectively, in country i and time t . Further, ε_{it} denotes the random error term.

4.2. Data

To empirically test the impact of a budget deficit on macroeconomic instability and economic growth, we use a panel dataset of developing Asian countries over the period 1973–2022. The study focuses on 24 developing Asian countries identified as developing economies by the Asian Development Bank. Moreover, UN classifications broadly categorize most Asian economies as developing, excluding only a few advanced economies (UNCTAD). The historical country classification by international institutions indicates that the selected countries were classified as developing economies at the start of the sample period. The 24 developing Asian countries include Afghanistan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, India, Indonesia, Kazakhstan, Kyrgyz Republic, Lao PDR, Malaysia, Maldives, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Tajikistan, Thailand, Timor-Leste, Turkmenistan, Uzbekistan, and Viet Nam.

This study employs a comprehensive set of variables, including budget deficit, urban population, trade openness, broad money, and gross fixed capital formation. Budget deficit is the focused variable of the study, while the remaining four variables (trade openness, broad money, gross fixed capital, and urban population) are the control variables. Further, macroeconomic instability and economic growth are dependent variables. For macroeconomic instability, a comprehensive index is constructed using principal component analysis (PCA) based on inflation rate, interest rate, and exchange rate. The study uses annual growth in gross domestic product (GDP) as a proxy for economic growth and the ratio of exports plus imports of the commodities to GDP as a proxy for trade openness. Data for these variables are sourced from the World Bank's World Development Indicators (WDI), ensuring reliability and consistency in the study's analysis.

4.3. Construction of the macroeconomic instability index

Principal component analysis (PCA) is a statistical technique used to reduce the dimensionality of a dataset, while preserving most of its information. It transforms correlated variables into a set of uncorrelated components that capture the maximum possible variation. PCA assumes that variables are standardized and exhibit linear relationships. Owing to these properties, it has been widely applied in existing literature (Arif and Ahmad, 2020; Dabbous, 2018).

For the current study, a composite index of macroeconomic instability is constructed using PCA, based on inflation rate, interest rate, and exchange rate. The three variables are standardized before estimation to ensure comparability. Eigenvalues and eigenvectors are then computed to identify the principal components. Based on the dominant component, a composite index of macroeconomic

instability is constructed using inflation, interest rate, and exchange rate. The corresponding eigenvectors are reported in Table 1.

The results show that the first principal component has an eigenvalue of 1.8 and explains 70% of the total variance, which implies that it captures the majority of the information contained in the three indicators. Therefore, the first component is retained as the macroeconomic instability index; the factor loadings show that inflation, interest rate, and exchange rate contribute positively and significantly to the index, indicating that increases in these variables are associated with higher macroeconomic instability. To enhance the interpretability of the index, we normalize the macroeconomic instability index by scaling the values within a range from 0 to 1.

Table 1. Principal components (eigenvectors).

| Variable | Component 1 | Component 2 | Component 3 |
|---------------|-------------|-------------|-------------|
| Inflation | 0.62 | 0.0383 | 0.56 |
| Interest rate | 0.58 | 0.7320 | 0.10 |
| Exchange rate | 0.53 | -0.6768 | -0.39 |

4.4. Estimation procedure

The most fundamental problem occurring in panel data is slope coefficient heterogeneity. The slope homogeneity test by Pesaran and Yamagata (2008) is conducted to examine whether the slope coefficients are the same across the panel. The test statistic was 33.45 with a p-value of 0.000 for the MI model and 23.21 with a p-value of 0.000 for the EG model, indicating significant heterogeneity among slope coefficients.

Table 2. Slope coefficients heterogeneity/homogeneity test.

| Test for slope heterogeneity | Test statistics |
|------------------------------|-----------------|
| MI model | 33.51*** |
| EG model | 23.21*** |

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

The Levin et al. (2002) test is used to test the stationarity of variables in panel data. The findings of this test show that BD, GFC, and TO are stationary at level $I(0)$, while the remaining four variables (macroeconomic instability, economic growth, BM, and UP) are stationary at the first difference, $I(1)$.

Table 3. Levin, Lin & Chu test.

| Variables | Order of integration |
|-----------|----------------------|
| MI | $I(1)$ |
| EG | $I(1)$ |
| BD | $I(0)$ |
| BM | $I(1)$ |
| GFC | $I(0)$ |
| TO | $I(0)$ |
| UP | $I(1)$ |

Further, the Pedroni cointegration test (2004) is used to examine long-run relationships (cointegration) among variables; the results are reported in Table 4. The test statistics for both models reveal that cointegration exists among all variables, as the test statistics reject the null hypothesis of no cointegration among the variables.

Table 4. Pedroni cointegration test.

| Pedroni panel cointegration test | MI model | EG model |
|----------------------------------|----------|-----------|
| Modified Phillips–Perron | −0.38*** | −7.39*** |
| Phillips–Perron t | −7.08*** | −16.95*** |
| Augmented Dickey–Fuller t | −7.07*** | −17.56*** |

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

In the first-stage regression analysis, the standard panel estimation techniques, fixed effect and random effect, are used to trace the impact of budget deficit on macroeconomic instability and economic growth. Fixed effects are particularly useful while dealing with panel data, offering a powerful means to account for individual-specific, time-invariant factors. The Equation of fixed effects for models (3) and (4) can be written as follows:

$$MI_{it} = \alpha_i + \alpha_1 BD_{it} + \alpha_2 TO_{it} + \alpha_3 BM_{it} + \alpha_4 GFC_{it} + \alpha_5 \ln UP_{it} + \varepsilon_{it} \quad (5)$$

$$EG_{it} = \beta_i + \beta_1 BD_{it} + \beta_2 TO_{it} + \beta_3 BM_{it} + \beta_4 GFC_{it} + \beta_5 \ln UP_{it} + \varepsilon_{it} \quad (6)$$

The equation of random effects for models(3) and (4) can be written as follows:

$$MI_{it} = \alpha_o + \alpha_1 BD_{it} + \alpha_2 TO_{it} + \alpha_3 BM_{it} + \alpha_4 GFC_{it} + \alpha_5 \ln UP_{it} + u_i + \varepsilon_{it} \quad (7)$$

$$EG_{it} = \beta_o + \beta_1 BD_{it} + \beta_2 TO_{it} + \beta_3 BM_{it} + \beta_4 GFC_{it} + \beta_5 \ln UP_{it} + u_i + \varepsilon_{it} \quad (8)$$

The REM provides a flexible framework that efficiently addresses unobserved heterogeneity by assuming that individual-specific effects are uncorrelated with the independent variables. As highlighted by Baltagi (2008), the random effects model offers a robust alternative when individual-specific attributes are not correlated with the observed variables. Further, the Hausman test is used to determine which of the two models—fixed effects or random effects—is preferable.

However, standard panel estimation methods provide single homogeneous slope coefficients for all cross-sectional units. So, we cannot perceive the variation in the dynamic relationship among the variables for individual countries. In the second stage, the mean group (MG) and pooled mean group (PMG) estimators are applied to the heterogeneous panel dataset (Pesaran and Smith, 1995) to estimate short-run and long-run coefficients along with the error correction term. The MG estimator allows full heterogeneity across cross-sectional units, whereas the PMG estimator permits variation in short-run dynamics but assumes homogeneous long-run coefficients. The Hausman test is used to choose between the MG and PMG (Pesaran et al. 1999) under the null hypothesis that the pooled mean group is better than the mean group estimator.

The simplified econometric model of macroeconomic instability and economic growth in the form of PMG is written below:

$$\Delta MI_{it} = \varphi_{1i}(MI_{i,t-1} - \beta'_1 X_{i,t-1}) + \sum_{j=1}^{p-1} \gamma_{ij} \Delta MI_{i,t-j} + \sum_{j=0}^{q-1} \delta'_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (9)$$

$$\Delta EG_{it} = \varphi_{2i}(EG_{i,t-1} - \beta'_2 X_{i,t-1}) + \sum_{j=1}^{p-1} \gamma_{ij} \Delta EG_{i,t-j} + \sum_{j=0}^{q-1} \delta'_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (10)$$

where ΔMI_{it} and ΔEG_{it} represent the first difference variable over time for each cross-sectional individual unit. $MI_{i,t-1}$ and $EG_{i,t-1}$ represent the lagged values of the dependent variables, $X_{i,t-1}$ is a vector representing all independent variables (budget deficit, trade openness, broad money, gross fixed capital, and urban population), and β'_1 and β'_2 are vector of long run coefficients. $\sum_{j=1}^{p-1} \gamma_{ij} \Delta MI_{i,t-j}$ and $\sum_{j=1}^{p-1} \gamma_{ij} \Delta EG_{i,t-j}$ are the sum of lagged differences of the macroeconomic instability and economic growth, respectively, which captures short-run dynamics, while $\sum_{j=0}^{q-1} \delta'_{ij} \Delta X_{i,t-j}$ captures the short-run dynamics of the independent variables. μ_i is a country-specific effect, φ_{1i} and φ_{2i} are the error correction terms, and ε_{it} is an error term.

5. Empirical results and discussion

This section analyzes our empirical question: how do budget deficits affect macroeconomic instability and economic growth in developing Asian countries? In the first-stage regression analysis, the standard panel estimation techniques, fixed effect and random effect, are used to trace the impact of budget deficit on macroeconomic instability and economic growth. The empirical findings of the first stage regression analysis are presented in Table 5 (budget deficit and macroeconomic instability) and Table 6 (budget deficit and economic growth). The Hausman test statistics proposed that the random effect model is preferred over the fixed effect model for both MI and EG regression equations.

Table 5. Budget deficit and macroeconomic instability (MI).

| Random effects model (dependent variable: macroeconomic instability) | | | |
|--|-------------|----------------|---------|
| | Coefficient | Standard error | P-value |
| BD | 0.0011 | 0.0005 | 0.00 |
| TO | -0.0006 | 0.0003 | 0.02 |
| BM | -0.0093 | 0.0004 | 0.00 |
| GFC | 0.0002 | 0.0003 | 0.50 |
| UP | -0.0406 | 0.0021 | 0.04 |
| Constant | 0.5166 | 0.0122 | 0.00 |
| Hausman test (p-value) = 0.55 | | | |

In the second stage, regression Equations (3) and (4) are estimated by applying the mean group (MG) and pooled mean group (PMG) estimation techniques on the heterogeneous panel dataset (Pesaran and Smith, 1995). The empirical findings of the second-stage regression analysis are

presented in Table 7 (budget deficit and macroeconomic instability) and Table 8 (budget deficit and economic growth). Hausman test statistics proposed that the PMG model is preferred to the MG model for both MI and EG regression equations.

The random effects estimation results presented in Table 5 trace the impact of budget deficit and other control variables on macroeconomic instability. Table 5 shows a Hausman test p-value greater than 0.05, which indicates that the random effects model is appropriate for investigating the impact of budget deficit on macroeconomic instability.

The result shows that the impact of a budget deficit on macroeconomic instability is positive and highly significant, which implies that an increase in the budget deficit leads to greater instability. This finding is consistent fiscal imbalance theories, which imply that a persistent budget deficit may lead to high inflationary pressures, thereby increasing the interest rate and worsening external imbalances, all of which contribute to greater macroeconomic instability.

Trade openness has a negative and significant impact on macroeconomic instability, implying that trade openness reduces macroeconomic instability. Trade integration improves resource allocation and enhances competitiveness and efficiency while providing access to larger markets and stabilizing external demand; thus, more open economies tend to be more stable.

Further, the results show that broad money has a negative and highly significant effect on instability. This is consistent with the financial development literature, as deeper financial systems stabilize economic fluctuations. Financial deepening may reduce instability by improving liquidity in the economy, enhancing financial intermediation, and facilitating smoother consumption and investment.

These results further show that the impact of gross fixed capital formation on macroeconomic instability is positive but insignificant, implying that its effect may be lagged, or investment volatility may offset its stabilizing role.

Moreover, Table 5 shows that urban population growth negatively and significantly affects instability, implying that urbanization reduces macroeconomic instability, as urbanization is generally associated with better infrastructure and productivity, labor market efficiency, and improved access to services and institutions. All these factors may collectively improve economic coordination and reduce volatility.

The random effects estimation results presented in Table 6 trace the impact of budget deficit and other control variables on economic growth. Table 6 shows a Hausman test p-value greater than 0.05, indicating that the random effects model is appropriate for investigating the impact of budget deficit on economic growth.

Table 6. Budget deficit and economic growth (EG).

| Random effects model (dependent variable: economic growth) | | | |
|--|-------------|----------------|---------|
| | Coefficient | Standard error | P-value |
| BD | -0.184 | 0.007 | 0.00 |
| TO | 0.031 | 0.004 | 0.00 |
| BM | 0.078 | 0.060 | 0.02 |
| GFC | 0.032 | 0.014 | 0.06 |
| UP | 1.15 | 0.268 | 0.00 |
| Constant | 0.516 | 0.012 | 0.00 |
| Hausman test (p-value) = 0.20 | | | |

The results show that the budget deficit has a statistically significant and negative impact on economic growth, as a unit increase in the budget deficit decreases economic growth by approximately 0.184 units on average. This empirical finding is supported by the neoclassical and crowding-out hypotheses, as an increase in government borrowing raises interest rates, private investment is reduced, and resource misallocation occurs. Furthermore, persistent deficits may create macroeconomic uncertainty, which reduces investors' confidence and adversely affects growth and the development of a country.

Trade openness has a positive and significant effect on economic growth, which implies that more open economies experience higher growth. This finding is supported by trade liberalization arguments and endogenous growth theory, suggesting that openness enhances technology transfer, expands market size, and improves efficiency through competition. The results further indicate that broad money positively and significantly affects economic growth, implying that monetary expansion enhances economic growth. This reflects the role of financial development in enhancing the growth process as increased liquidity supports investment, financial intermediation improves capital allocation, and credit availability encourages productive activities. All these factors eventually enhance economic growth and development.

Gross fixed capital formation, a measure of investment, has a positive and significant effect on growth. Investment is a main driver of growth as it increases productive capacity, enhances infrastructure, and promotes long-term economic expansion, which in turn boosts growth and development. Urban population also has a strong positive and significant impact on economic growth, implying that urbanization is also a key driver of growth in developing economies.

Table 7. Budget deficit and macroeconomic instability (MI).

| PMG model (dependent variable: macroeconomic instability) | | | |
|---|--------------|----------------|----------|
| PMG estimates for the impact of BD on MI in the long run | | | |
| MI | Coefficients | Standard error | P-values |
| BD | 0.0058 | 0.0002 | 0.00 |
| TO | -0.0221 | 0.0019 | 0.00 |
| BM | -0.0020 | 0.0010 | 0.05 |
| GFC | -0.0008 | 0.0002 | 0.01 |
| UP | 0.0182 | 0.0003 | 0.00 |
| PMG estimates for the impact of BD on MI in the short run | | | |
| BD | 0.0030 | 0.0010 | 0.00 |
| TO | -0.0008 | 0.0003 | 0.03 |
| BM | 0.0002 | 0.0002 | 0.32 |
| GFC | -0.0005 | 0.0008 | 0.21 |
| UP | -0.0511 | 0.0047 | 0.00 |
| Constant | 0.0446 | 0.0176 | 0.00 |
| ECT | -0.392 | 0.129 | 0.00 |
| Hausman test (p-value) = 0.127 | | | |

In the second stage, regression Equations (3) and (4) are re-estimated by applying the mean group (MG) and pooled mean group (PMG) estimation techniques, as the slope homogeneity test rejects the null hypothesis of homogenous slope coefficients for the cross-sectional units. The empirical findings of the second-stage regression analysis are presented in Table 7 (budget deficit and macroeconomic instability) and Table 8 (budget deficit and economic growth).

The PMG estimation results presented in Table 7 trace the impact of budget deficit and other control variables on macroeconomic instability. The table shows a Hausman test p-value greater than 0.05, which indicates that the PMG estimator is preferred over the MG estimator for investigating the impact of budget deficit on macroeconomic instability.

This shows that the impact of a budget deficit on macroeconomic instability is positive and highly significant in both the long and short runs, which implies that an increase in budget deficit leads to greater instability. Growing and persistent budget deficits may result in fiscal unsustainability. A persistent budget deficit may lead to high inflationary pressures, increase the interest rate, and worsen external imbalances, all of which contribute to greater macroeconomic instability. These deficits may be monetized (resulting in inflationary pressures), crowd out private investment through higher interest rates, and accumulate public debt, all of which amplify macroeconomic instability. The table shows that the long-run effect is relatively stronger and more significant than the short-run effect, as generally expected in an error-correction framework.

Table 7 shows that trade openness has a negative and significant impact on macroeconomic instability in both the long and short runs, implying that trade openness reduces macroeconomic instability. Open economies gain access to improved technology and foreign capital, diversify risks across global markets, and face external policy discipline; thus, more open economies tend to be more stable. Trade integration enhances competitiveness and efficiency and provides access to larger markets, stabilizing external demand.

Further, the results show that broad money has a negative and highly significant effect on macroeconomic instability in the long run; however, its effect is positive but insignificant in the short run. Financial deepening improves credit allocation, shock absorption, and monetary-policy transmission, as deeper financial systems stabilize economic fluctuations.

The impact of gross fixed capital formation on macroeconomic instability is negative and significant in the long run, implying that higher investment reduces macroeconomic instability. Higher investment enhances productive capacity, reduces supply-side constraints and inflationary pressures, and minimizes economic bottlenecks and volatility. The insignificant effect of gross fixed capital formation on macroeconomic instability in the short run reflects the fact that investment may take time to influence economic conditions, and the stabilizing or destabilizing effects of investment materialize only in the long run due to adjustment processes and implementation lags.

Table 7 depicts that urban population has a positive and significant effect on macroeconomic instability in the long run. It implies that urbanization increases macroeconomic instability, as rapid and unplanned urbanization may contribute to increased economic instability. Rapid urbanization may create urban congestion and infrastructure pressure, increasing housing shortages and fiscal burden, and weak urban planning can generate economic volatility. These factors can increase macroeconomic instability. The error correction term (ECT), which is the speed of adjustment from the short run to the long run equilibria, is reported in Table 7. The ECT is significant and correct in sign.

In general, the random effects model provides average estimates in a static framework, while the pooled mean group method provides deeper dynamics as it estimates both short-run and long-run

relationships. The PMG findings are more informative, showing that deficits and urbanization increase instability in the long run, whereas trade openness and financial development contribute to stability.

The PMG estimation results presented in Table 8 trace the impact of budget deficit and other control variables on economic growth. The table shows that the Hausman test p-value is greater than 0.05, indicating that the PMG estimator is preferred over the MG estimator for investigating the impact of budget deficit on economic growth. It implies that long-run homogeneity across countries is valid, and short-run dynamics can differ across countries.

Table 8. Budget deficit and economic growth (EG).

| PMG model (dependent variable: economic growth) | | | |
|---|--------------|----------------|---------|
| PMG estimates for the impact of BD on EG in the long run | | | |
| | Coefficients | Standard error | P-value |
| BD | -0.007 | 0.002 | 0.00 |
| TO | 0.021 | 0.004 | 0.00 |
| BM | -0.012 | 0.007 | 0.08 |
| GFC | 0.100 | 0.018 | 0.00 |
| UP | 0.075 | 0.032 | 0.00 |
| PMG estimates for the impact of BD on EG in the short run | | | |
| BD | -0.035 | 0.043 | 0.23 |
| TO | 0.023 | 0.015 | 0.09 |
| BM | -0.258 | 0.062 | 0.00 |
| GFC | 0.239 | 0.128 | 0.04 |
| UP | 1.998 | 0.981 | 0.06 |
| Constant | -2.067 | 0.775 | 0.00 |
| ECT | -0.431 | 0.173 | 0.00 |
| Hausman test (p-value) = 0.227 | | | |

The findings show that the budget deficit has a negative and significant impact on economic growth in the long run. This is supported by the crowding-out hypothesis, as government borrowing reduces private investment, leads to inefficient resource allocation, and creates macroeconomic uncertainty, which ultimately slows down economic growth. The results further show the negative impact of budget deficit on economic growth in the short run; however, the effect is insignificant, as fiscal effects take time to materialize.

Trade openness has a positive and significant effect on economic growth in both the short and long runs. Trade integration promotes technology transfer, expands markets, and enhances efficiency and competition, which lead to sustainable economic growth. Further, broad money has a negative and significant effect on growth in both the long and short runs. This may reflect excessive monetary expansion, which may cause inflationary pressures, financial inefficiencies in developing economies, and misallocation of credit, which ultimately weaken growth in the long run.

Investment has a strong positive and significant effect on growth in both the short and long runs, implying that investment is a key driver of economic growth. Higher investment enhances productive capacity, develops infrastructure, and stimulates long-term growth and development. Furthermore,

urbanization positively and significantly affects growth in both the long and short runs. This finding supports urbanization-led growth, as agglomeration economies increase productivity and labor market efficiency and enhance infrastructure and innovation, thus promoting overall growth and development. Further, the negative and significant ECT confirms long-run cointegration, showing that 43.1% of the disequilibrium is corrected each year, indicating a moderate speed of adjustment toward a long-run equilibrium.

Random effect estimates provide only average (static) effects, while the PMG reveals long-run equilibrium relationships and short-run dynamics, which provide a deeper understanding that growth in developing Asian economies is driven by investment, openness, and urbanization but is hindered by persistent fiscal deficits.

In general, both random effects and pooled mean group estimates provide consistent results for key variables; however, the PMG model is more reliable, as it allows for cross-country heterogeneity in the short run, captures long-run equilibrium relationships, and incorporates the error correction mechanism, which makes it more suitable for panel time-series data.

6. Conclusions

The objective of this study is to investigate the impact of a budget deficit on macroeconomic instability and economic growth in the developing Asian region over the period 1973–2022. In the first-stage regression analysis, standard panel estimation techniques are used, while in the second-stage regression analysis, mean group and pooled mean group estimation methods are employed, as the slope heterogeneity test rejects the null hypothesis of homogeneous slope coefficients.

The results show that the impact of budget deficit on macroeconomic instability is positive and highly significant in both the long run and short run. Growing and persistent budget deficits may result in fiscal unsustainability. A persistent budget deficit may lead to high inflationary pressures, increase the interest rate, and worsen external imbalances, all of which contribute to greater macroeconomic instability. These deficits may be monetized (resulting in inflationary pressures), crowd out private investment through higher interest rates, and accumulate public debt, all of which amplify macroeconomic instability. The results show that deficits and urbanization increase instability in the long run, whereas trade openness, financial development, and investment contribute to stability.

Further, the analysis indicates that a budget deficit has a negative and significant impact on economic growth in the long run. This is supported by the crowding-out hypothesis, as government borrowing reduces private investment, leads to inefficient resource allocation, and creates macroeconomic uncertainty, which ultimately slows down economic growth. The results also show the negative impact of budget deficit on economic growth in the short run; however, this effect is insignificant as fiscal effects take time to materialize. Further, broad money has a negative and significant effect on growth in the long run, whereas trade openness, investment, and urbanization have a positive and significant effect on growth in the long run.

Some policy guidelines based on the findings of this study are presented below:

- There is a crucial need in developing countries for prudent fiscal policies to maintain macroeconomic stability. Developing countries should focus on adopting accountable budgetary practices, reducing fiscal imbalances, and enhancing fiscal discipline.
- Developing countries require strategies for reducing public debt to ensure long-term fiscal sustainability.

- The governments of these countries should establish clear guidelines for borrowing, while focusing on investments that contribute to economic growth.
- Governments should consider reforms in tax policies to ensure fairness and discourage tax evasion.
- Developing countries should implement policies that stimulate private investment, especially in situations where a country experiences interest rate shocks, as this can help reduce reliance on government borrowing, ease inflationary pressures, and mitigate the crowding-out effect.

Despite providing valuable empirical insight, there are various limitations to this study. First, due to data availability, the analysis is limited to 24 developing Asian countries, which may limit how broadly the findings may be generalized. Second, structural breaks such as global financial crises may have an impact on the results, despite the fact that the long time period (1973–2022) allows for an in-depth analysis. Third, even after accounting for cross-country differences, the heterogeneous panel technique may fail to capture all nonlinearities and country-specific shocks. Future research may expand on this analysis by including more countries, utilizing alternative techniques, and using a better-defined macroeconomic instability index.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Author contributions

Umaima Arif: Conceptualization, methodology, formal analysis, writing—original draft, and review and editing. Maliaka Komal: Data Collection, software, formal analysis, results interpretation, and writing—original draft. Asma Arif: Conceptualization, results interpretation, writing—review and editing. All authors have read and approved the final version of the manuscript.

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Data Availability

Data is available on request.

Conflict of interest

All authors declare no conflicts of interest in this paper.

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