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The effect of monetary policy on income inequality: Empirical evidence from Asian and African developing economies

Journal of Central Banking Theory and Practice

Provided in Cooperation with:
Central Bank of Montenegro, Podgorica

Suggested Citation: Khan, Zulfiqar; Khan, Muhammad Azam (2023) : The effect of monetary policy on income inequality: Empirical evidence from Asian and African developing economies, Journal of Central Banking Theory and Practice, ISSN 2336-9205, Sciendo, Warsaw, Vol. 12, Iss. 3, pp. 133-158, https://doi.org/10.2478/jcbtp-2023-0028

This Version is available at:
https://hdl.handle.net/10419/299086

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sciendo

UDK: 336.74:338.23(5:6)
DOI: 10.2478/jcbtp-2023-0028

Journal of Central Banking Theory and Practice, 2023, 3, pp. 133-158
Received: 17 August 2022; accepted: 23 February 2023

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The Effect of Monetary Policy on Income Inequality: Empirical Evidence from Asian and African Developing Economies

Abstract: Inequality is a challenging issue for all developing countries across the globe. Evaluating the role of monetary policy in mitigating inequality is imperative for researchers and policy makers. The central objective of the present study is to empirically evaluate the impact of monetary policy on income inequality for ten Asian and African developing economies from 1990–2020. The methods of pooled mean group (PMG)/panel autoregressive distributed lag (ARDL), and fully modified least square (FMOLS) are implemented. The empirical results indicate that money supply has negative, and inflation has a positive and significant influence on income inequality. It has also been found that GDP per capita income and inward foreign direct investment (FDI) have a negative impact on inequality. The findings of the present study recommend that money supply, per capita income, and inward FDI should be enhanced, while inflation must be controlled using coordinated fiscal and monetary policies.

Keywords: Monetary policy; income inequality; panel ARDL; Asian and African countries

JEL Classification: E00; E25; C33

1. Introduction

The most critical issue of the developing world is income inequality. It has also been recognized by the United Nation under Sustainable Development Goals (Goal 10)

which clearly focuses on reducing the inequality within and among countries. Despite this, distributive justice is also an important issue. It is a common problem of both developing and the developed economies of the world (Wan, Zhang & Zhao, 2022). Growing inequality is the most serious problem of the world (Park, 2021). Income inequality in most developing countries has raised the interest of policy makers and researchers, as income inequality has long been considered as a destructive force for any country`s growth and development (Marmot, Friel, Bell, Houweling & Taylor, 2008; Azam, 2019). High income disparity has been shown to have a negative impact on social integration, well-being, and a nation`s ability to attain long-term economic growth and development (Veenhoven, 2008). Inequality as per Stiglitz (2012), erodes an economy`s strength and leads to economic instability. The persistent increase in income gap between the rich and the poor, and also the existence of inconsistent policies to tackle the issues of poverty in developing countries, are the main targets of modern economic policies (Reardon, 2011).

However, income inequality and poverty have grown to be significant worldwide concerns. Governments are very keen to address the issue of income inequality and poverty across the globe. Many researchers believe that government spending is one of the most essential strategies for reducing income disparity and poverty rates. Therefore, the impact of government spending on income inequality and poverty is still a hot topic of discussion. Anderson, JallesD'Orey, Duvendack & Esposito, (2017) suggested that certain sort of government spending could decrease income disparity and poverty. The Global financial crisis spurred a significant change in monetary policy. The central banks are using unconventional monetary policy tools to raise nominal expenditure, increase liquidity, and to fulfil their inflation targets as policy rates approached the zero lower bound (Evgenidis & Fasianos 2021). Unconventional monetary policy is not only critical in minimizing the influence of the financial crisis, but it also raised policy issues that such policies could exacerbate economic inequality (Casiraghi et al., 2018; Colciago et al., 2019). The distribution of income and monetary policy has typically been seen as a different concern. Following on the impact of global financial crisis, major financial institutions began to soften their monetary policies. This sparked growing interest in the association between income inequality and monetary policy, especially the programs included in capital purchase by central bank. It is also interesting that changes in asset prices have effect on income inequality. However, a systematic effect of monetary policy on income disparity has been demonstrated in recent contribution by Mumtaz & Theophilopoulou (2017) for the UK, Coibion, Gorodnichenko, Kueng & Silvia (2017) for the US, and Furceri, Loungani & Zdzienicka (2018) for a broader set of economies; inequality grows as monetary policy is tightened.

Many other studies expound on the significance of the role played by monetary policy in accomplishing desirable macroeconomic objectives. For example, Peña (2020) documented that "monetary policy caused financial and economic variables. Concretely, as our results show, monetary policy caused credit growth, and therefore, unchained the credit boom which led to the sub-prime crisis that originated the GFC…helped by the interdependence between financial and economic variables of that period.". Güler (2021) noted that over the past 30 years, several central banks have implemented inflation targeting system as a monetary policy framework to control hikes in the general price level. In fact, high inflation is closely associated with growing income inequality. Khan (2023) opined that monetary policy usually implemented achieve the required macroeconomic objectives, including to adjust a deficit in the balance of payments. Visco (2023) concluded that inequalities must be considered by central banks as they are fundamentally linked to upsurge in prices because they impact, and are impacted by, monetary policy. However, handling inequalities remains predominantly a liability of governments and the government can adopt fiscal measures as well to lower inequality.

Income inequality is a common issue across the world. The pattern of income distribution is increasing the gap between have and have not in societies. However, developing Asian and African countries have low economic growth, low per capita, no proper education, very poor health facilities, poor values of HDI, high income gap between rich and poor, and the presence of high poverty makes the standard of living in these countries very low. The main reason for poverty in these countries is low income. Practically, it is an example of a vicious circle of poverty with low income causing low investment in infrastructure, plant, machinery, and health care and education which in turn results in low productivity and a low standard of living. Around 80 percent of the capital is held by 20 percent of people in developing countries, where one can live on less than 2$ per day and the wealthy segment continue to amass wealth by using their money to generate more wealth. Moreover, industrialization in these countries is very sluggish and GDP per capita income of these countries is also very low. Additionally, these economies are facing high mortality rates, high birth rates, and low life expectancy along with poverty and unemployment. Almost all developing countries of the selected panel are carrying identical stage of growth with uniform economic and social problems.

Following the extant literature, the primary aim of this empirical study is to assess the effect of monetary policy proxied by money supply along with other important regressors on income inequality for ten Asian and African developing economies. As per the World Bank grouping, the ten Asian-African developing

countries are Algeria (upper-middle income), Ethiopia and Nigeria (low-income countries), Ghana, Kenya, Sudan, Tunisia, Philippines, Nepal, and Bhutan (lower-middle income countries). The attributes of these ten Asian and African developing countries are supposed to be nearly identical. This study, on the other hand, differentiates in that it uses latest econometric techniques and data to assess the impact of monetary policy on income inequality in Asian and African developing countries.

The present study is a ground-breaking investigation that focuses on the effect of monetary policy on income inequality in Asian-African developing states. However, this study investigates whether or not monetary policy worsens income inequality. Second, the selected panel of 10 Asian and African developing countries have never been empirically investigated before. The third contribution of the present study is the time span. Study is based on the latest and a longer time period that will definitely create a strong footing for the addressed argument. Forth contribution of the study is the application of the most suitable panel econometric techniques such as ARDL/PMG, FMOLS, and D-H Granger causality test. This research is significant because it will help relevant authorities in the formulation of successful public strategies to mitigate income inequality in these states.

The structure of this article is as follows: Section 2 deals with review of literature. Section 3 presents data description, model, and estimation techniques. The empirical findings and discussion are given in section 4. Final section 5 deals with the summary and conclusion of the study.

2. Review of Literature

Theoretical Literature

Monetary policy`s aggregate distributional influence is determined by different channels by which it can hinder income inequality. Though, as per Coibion et al., (2017), there are five theoretical routes through which monetary policy might impact income inequality. These are income composition, financial segmentation, portfolio, redistributive saving, and earning heterogeneity channels. Furthermore, according to the first three channels, expansionary monetary policy worsens income inequality, whereas expansionary monetary policy mitigates income inequality by last two channels. Yet, the channels should behave very significantly under conventional and unconventional monetary policies. To put in another way, according to Davtyan (2018) conventional and unconventional monetary policies can have a serious effect on these channels. In his study, Nakajima (2015)

accumulated these five channels into the "Inflation" and "Income" channels, which are the two fundamental distributive channels of monetary policy.

Empirical Literature

The relationship between monetary policy and income disparity is a neglected segment in recent research. (Romer & Romer 1998). The study of Bakker & Creedy (1999) found that macroeconomic fluctuation in growth and unemployment exacerbated inequality in New Zealand during 1987–1991. Coibion, Gorodnichenko, Kueng & Silvia (2012) observed that expansionary monetary policy (MP) decreases inequality in the USA. Bivens (2015) opined that unconventional MP has a negative effect on income inequality in the USA. Similarly, Davtyan (2016) also found that contractionary (MP) had negative influence on income disparity in the United States from 1979–2012. Villarreal (2014) found that monetary policy by interest rates has reduced income inequality in Mexico during 1951 I to 2014 IV. Coibion et al., (2017) verified that shocks of contractionary monetary policy have increased consumption and income inequality in the USA during 1980–2008. Mumtaz & Theophilopoulou (2017) found that contractionary monetary policy raised income inequality in the UK during 1969–2012. O`Farrell & Rawdanowicz (2017) observed that unconventional monetary policy has a very small influence on income disparity. Taghizadeh-Hesary, Yoshino & Rasoulinezhad (2020) found that quantitative & qualitative easing monetary and tax policies decreased income inequality in Japan during 2002Q1–2017Q3. Park (2021) mentioned that expansionary monetary policies worsen, while contractionary monetary policies improve income disparity in Korea during 2008Q4 to 2015Q1. Recently, Feldkircher & Kakamu, (2022) found that tightening monetary policy diminished income disparity in Japan during 2002Q1-2018Q4.

Literature of Asia

The existing literature reveals limited availability of studies focusing on assessing the impact of monetary policies on Asian economies. Lee, Kim & Cin, (2013) studied income disparity and economic growth and found that increasing investment leads to reducing income gap whereas trade openness and population growth can raise it. Kang, Chung & Sohn (2013) revealed that monetary policy by real interest rate has no significant influence on income inequality in Korea during 1997–2007. Saiki & Frost (2014) observed that unconventional monetary policy had positive impact on inequality in Japan during 1981–2008. Qazi, Raza, Jawaid, & Karim (2016) analysed the effect of higher education on income in-

equality in Pakistan over the period 1973–2012 and found that higher education reduces income inequality in the long run.

Bukhari & Munir (2016) studied the impact of globalization on income inequality for Asian countries from 1980–2014 and found that trade and technological globalization decreases income disparity, while financial globalization deteriorates income disparity. Azam & Raza (2018) found that financial development using different proxies have a positive and significant effect on income inequality in five ASEAN economies during 1989–2013. Kousar et al. (2019) observed that remittances and financial development worsen income inequality, while education and per capita income mitigate income inequality in Pakistan during 1980–2016. Nevertheless, the study of Taghizadeh-Hesary & Yoshino (2021) observed that monetary policy deteriorates income inequality in Japan.

Literature on Africa

African economies are also the focus of concern for the researchers. There are different studies highlighting the different facts of the region. Adams & Klobodu (2016) found that control of corruption decreases income inequality while financial development increases income inequality in 21 Sub-Saharan African economies during 1985–2011. Kaulihowa & Adjasi (2017) studied the impact of inward FDI on inequality of income in 16 African nations between 1980 and 2013 and observed that there is a non-linear correlation between inward FDI and income disparity. The empirical findings of Parlaktuna & Napari (2019) study exhibits that contractionary monetary policy slightly upsurge Ghana`s disposable income inequality during 2002Q1 to 2013Q4. In a similar vein, Aigheyisi & Egbon (2020) analysed the impact of trade openness and FDI inflows on income inequality in Nigeria over 1981–2015. Their empirical result revealed that trade openness reduces income disparity whereas FDI inflows increases income inequality.

3. The data and empirical Methodology

Empirical model

The theoretical basis of this research is based on Simon Kuznet model. According to Kuznet, model when an economy grows, per capita income also rises and as a result inequality expands. As seen in Bahmani-Oskooee, Hegerty & Wilmeth (2008). Following multivariate regression model is used to achieve the objectives of the study:

$$IIE_{it} = \Upsilon_0 + \Upsilon_1 BMS_{it} + \Upsilon_2 CPI_{it} + \Upsilon_3 Y_{it} + \Upsilon_4 TD_{it} + \Upsilon_5 FDI_{it} + \Upsilon_6 UB_{it} + \varepsilon_{it} \quad (1)$$

Whereas IIE represents income inequality, BMS denotes broad money supply, Y shows GDP per capita, CPI shows inflation rate, TD represents trade, FDI denotes foreign direct investment, UB indicates urban population and Ɛ denotes error term of the model.

However, on the monetary side, Saiki & Frost (2014) argued that expansionary MP worsens income disparity, while Coibion et al., (2017) observe that expansionary MP mitigates income disparity. As a result, this study postulates that monetary policy shrinks income inequality. There are other studies like Hayrullahoglu & Tuzun (2020) and Adams & Klobodu (2019) that revealed that GDPPC has mixed impact on income inequality (either positive or negative). A rising GDP per capita, on the other hand, is a positive sign of economic development. Moreover, these studies also indicate a positive link between inflation and income inequality (Law & Soon, 2020). Similarly, studies like Xu, Han, Dossou & Bekun (2021) and Adams & Klobodu (2019) reveal that increased income inequality in developing economies is a result of trade openness. Consequently, this study postulates that a rise in trade openness will result in a notable rise in the income gap in developing economies. Furthermore, Lee, Lee & Cheng (2022) demonstrated that FDI reduces income inequality, while Herzer & Nunnenkamp (2011) revealed that FDI increases income inequality. So, based on these previous studies, this research hypothesizes that FDI (helps to reduce) increases income inequality. In addition, Ha, Le & Trung-Kien (2019) found that urbanization helps to mitigate income inequality. Similarly, in another study, Adams & Klobodu (2019) noted that urbanization worsens income inequality. So, this study postulates that a rise in urbanization diminishes/increases income disparity.

Data and its sources

We have examined data from a selected sample panel of 10 African and Asian countries during 1990–2020. There are two data sources utilized, including: Standardized World Income Inequality Database (SWIID, 2021) and World Development indicator. However, income inequality data has been taken from the SWIID, and data on broad money, GDP per capita, trade openness, inflation, government expenditure, FDI, education, urban population, and wages & salaries are gleaned from the World Development Indicators (WDI, 2022), the World Bank.

Table 1: Data description and sources

Variables	Definition	Unit of Measurement	Sources	Variables used by
Income inequality	The Gini index of disposable income inequality has a value range 0-1, however, 0 representing no-inequality, whereas 1 indicates higher inequality	Gini index	SWIID	Ahmad et al. (2021), Hayrullahoglu & Tuzun 2020, Law & Soon, 2020, Kousar et al., (2019)
Broad Money Supply	Broad money supply refers to the quantity of money in circulation in a given economy.	Percentage of GDP	WDI (2022)	Coibion et al. (2012), Saiki & Frost (2014), Coibion et al. (2017)
GDP Per Capita	GDP per capita is a measure of country total output divided by its total population	GDPPC (constant 2015 US$)	=	Ahmad et al. (2021), Hayrullahoglu & Tuzun. (2020), Law & Soon (2020), Kousar et al. (2019)
Inflation	Inflation is defined as the rate at which prices rises over time	Inflation, GDP deflator (annual %)	=	Ahmad et al. (2021), Law & Soon (2020), Hayrullahoglu & Tuzun (2020)
Trade Openness	TO is measures as the sum of goods and services (exports + imports)	percentage of GDP	=	Khan & Padda (2021), Xu et al., 2021, Adams & Klobodu, 2019)
Foreign direct investment	FDI is when a company located in another state makes a financial commitment to handle some aspect of a company in another state	FDI (net inflows) Percentage of GDP	=	Khan & Padda 2021; Herzer et al. (2014), Kaulihowa and Adjasi (2017)
Urban population	Urban population; people living in cities as a proportion of the total population	(Annual %)	=	Ha et al. (2019), Adams & Klobodu (2019)

Source: Authors compilation

Note: SWIID: Standardized World Income Inequality Database

WDI: World Development Indicators, the World Bank.

Empirical Strategy

Panel Unit tests

The panel unit root techniques is used to investigate that all the dependent and independent variables are stationary at I(0). These techniques are commonly employed in research to test the nature of stationarity. The existing literature divides panel unit root tests into two categories, 1st and 2nd generation (Hurlin, 2010). The methods presented by Levin et al. (2002) and Maddala & Wu (1999) are utmost significant in the 1st generation. The augmented DF model for a panel is used in these tests, as follows:

$$\Delta Y_{it} = \lambda_i Y_{i,t-1} + \sum_{j=1}^{ki} \beta_{ij} \Delta Y_{i,t-1} + \delta_i Z_{it} + \varepsilon_{it} \quad (2)$$

Where, $Yi, t-1$ is a variable of interest for unit root, i = 1, 2, 3, 4…, N and also k indicates the lag length, t = 1, 2, 3, 4…,T, and Z is a vector of deterministic terms, under the time series unit root including constant term, time trend, both or none,. δ shows the coefficient vector of the corresponding causal terms. Further $\mathcal{E}_{it}$ indicates the error term, and the coefficient λ_i is equivalent to ρ_i - 1. The null and alternative Maddala & Wu (1999) test hypotheses are as follows:

H_0: for all cross-section units, $\lambda_i = 0$ (has a unit root)

H_1: for a single unit, $\lambda_i < 0$ (has no unit root)

In their study, Maddala and Wu (1999) expound that IPS better performs each cross-section unit root technique using the sum of the logs of ρ-values. Construct the test-statistic for all Cross-section (N) under the null of unit root:

$$\rho = -2\sum_{i=1}^{N} \ln(\rho)_i \rightarrow x_{2N}^2 \quad (3)$$

However, the alternative hypothesis in LLC implies that λ_i is the same across cross-sections and imposes a homogeneous λ_i. The test procedure examines the alternative hypothesis that all Cross -sections within the panel are stationary.

This study, in relation to the MW and LLC tests, uses the most well-known "second generation" technique defined as the Cross-sectional Augmented IPS (CIPS) method (Pesaran, 2007). Cross-sectional Augmented IPS uses cross-sectional ADF (CADF) regression to examine the stationary series of panel time-series data, taking into account both heterogeneity and Cross sectional dependence. The tests employ the corresponding Cross-section Augmented Dickey Fuller (CADF) regression:

$$\Delta Y_{it} = \lambda_i + p_i Y_{it-1} + q_i \bar{Yg}_{t-1} + r_i \Delta \bar{Yg}_t + \mathcal{E}_{it} \quad (4)$$

To account for the impacts of the common component, however, Eq (4) includes lagged cross-sectional means of individuals` $\bar{Yg}$. Where $\bar{Yg}_{t-1} = (1|N)\sum_{i=1}^{N} Y_{i,t-1}$, and $\Delta \bar{Yg}_t = (1|N)\sum_{i=1}^{N} \Delta Y_{i,t}$. If T > N, then this model should be applied, and for hypothesis test, assumes that:

H_0: for all cross-section units (i), $p_i = 0$ (unit root)

H_1: for a single unit, $p_i < 0$ (has no unit root)

PMG estimator

To assess the reliability of the estimates, the PMG test developed by (Pesaran, Shin & Smith., 2001, 1999; Pesaran & Shin, 1999) is being used. Long-run relationships, according to Phillips & Hansen (1990) and Johansen, (1988), take place only in the perspective of co-integration between variables of the same integration order. Nevertheless, as per Pesaran et al. (2001), the Auto RDL test improved in Pesarn & Shin (1999) is appropriate regardless of whether the explanatory variables are purely level, first difference, or mixed co-integrated. This approach, particularly the PMG estimator, offers reliable estimates given the possibility of endogeneity since it includes response lags and regressors (Pesaran, Shin & Smith, 1999). However, according to Pesaran et al. (1999), the ARDL model`s unrestricted error correction for the dependent variable IIE_{it} is represented as follows:

In this study, the panel Auto Regressive DL approach (p, q, q …q) proposed by Pesaran et al. (1999) has been used, which can be written as:

$$IIE_{it} = \sum_{j=1}^{\rho} \delta_i, IIE_{i,t-j} + \sum_{j=0}^{q} \Omega_{ij} Z_{i,t-j} + u_i + \varepsilon_{it} \quad (5)$$

In equation (5), country and time period are represented by the subscript "i" and "t" respectively. Time period t = 1, 2, 3… T (i.e., 1990 -2020), and the countries i = 1, 2, 3 …N. However, in this case, N = 10. Further, IIE_{it} is known as income inequality (dependent variable). Z_{it} (k×ˣ1) is the vector of explanatory variables, including broad money supply, GDP per capita, inflation, trade openness, FDI, education, urbanization for countries "i". u_i denotes fixed effects; and δ_i shows the Co-efficient of the lagged dependent variable; and also Z_{it} (k*1) are Co-efficient vectors showing the Co-efficient of the independent variables; ε_{it} is a residual. Moreover, T should be greater enough so that the model for every state could be assessed independently.

The re-parameterized form of Eq. (1) shown below could be used to obtain the study`s specific objectives, which are relied on the type of data.

$$\Delta IIE_{it} = \sigma_i IIE_{i,t-1} + \beta_i Z_{it} + \sum_{j=1}^{p-1} \delta_{i,j} \Delta IIE_{i,t-j} + \sum_{j=0}^{q-1} \Omega_{i,j} \Delta Z_{i,t-j} + u_i + \varepsilon_{i,t} \quad (6)$$

Where

$$\sigma_i = -(1 - \sum_{j=1}^{p} \delta_{i,j}), \beta_i += \sum_{j=0}^{q} \Omega_{i,j}$$

$$\delta_{it} = -\sum_{m=j+1}^{p} \delta_{im}, \text{ j = 1… p-1.} \quad (7)$$

and

$\Omega_{it} = \sum_{m=j+1}^{q} \Omega_{im}$, j = 1…q-1

However, σ_i is the Co-efficient of speed of correction toward the long run in Eq. (7).

Panel FMOLS test

The fully modified OLS technique was introduced by Phillips & Hansen (1990) to provide an efficient Co-integrating regression analysis. Furthermore, for the panel co-integration regression, the Pedroni (2001) heterogeneous fully modified OLS test was utilized since it has the ability of addressing endogeneity bias and serial correlation. This approach, as per Hamit-Haggar (2012), which incorporates heterogeneous co-integration, is the best fit for the panel. In a study by Kao & Chiang (2001), this method has also the benefit of reducing bias in conventional least squares caused by endogeneity and autocorrelation of explanatory variables. According to Pedroni (2001), this approach is non-parametric test that uses auto-correlation problem. Further, this test might be stationary for all coefficients and the variables might be Co-integrated, which aids in limiting skewed result (Isiksal & Joof, 2021).

Assuming that the coefficient β of model (1) was estimated using a FMOLS estimator:

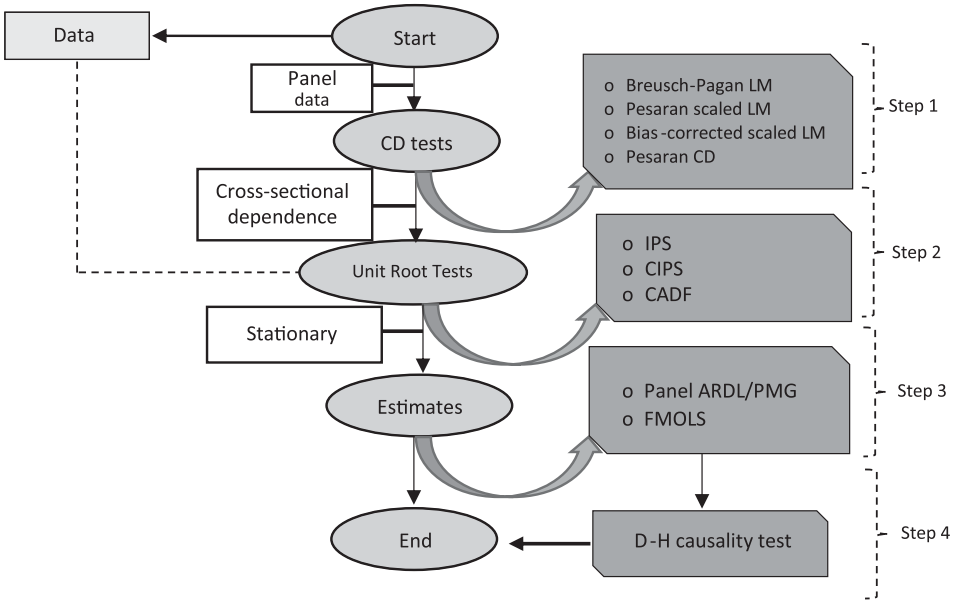
$$\beta_{pq}^{*} - \beta = \sum_{i=1}^{p} K_{22i}^{-2} \sum_{i=1}^{q} (x_{it} - \bar{x_{it}}) \sum_{i=1}^{p} K_{11i}^{-1} K_{22i}^{-1} (\sum_{i=1}^{q} (x_{it} - \bar{x_{it}}) u_{it}^{*} - TY_{i}\hat{}) \grave{} \qquad (8)$$

Where, $u_{it}^{*} = u_{it} - L\hat{}_{21i}/L\hat{}_{22i}\Delta x_{it}$, $Y_{it}\hat{} = Ь\hat{}_{21i}\Omega\hat{}^{0}_{21i} - L\hat{}_{21i}/L\hat{}_{22i}(Ь\hat{}_{22i} + \Omega\hat{}^{0}_{22i})$

and L_i represented the smaller triangulation Ω^i.

To verify the consistency of the empirical estimates, we also employed the FMOLS estimator. Details of the analytical framework are shown in Figure 1.

Figure 1: Analytical Framework



Source: Authors` construction

4. Results and discussions

The descriptive statistics and correlation matrix based on panel data averages from 1990 to 2020 presented in Table 2 shows that the positive average changes in all variables. However, result found that the average income inequality is 48.04%, the standard deviation is 7.02, the maximum value is 66.22, and the minimum value is 33.64. Furthermore, the mean and standard deviation of money supply is 48.26% and 27.13. The maximum and minimum value of money supply is 136.31 and -35.34. Similarly, the respective average and standard deviation values of GDP per capita are 1836.33 and 1073.71, and the maximum and minimum values are 4224.04 and 218.71, respectively. The result of descriptive statistics represents that the average value of inflation is 9.95% and standard deviation is 11.08. The respective maximum and minimum values of inflation are 80.75 and -11.16. The mean, standard deviation, the maximum and minimum value of trade are 65.28%, 22.12, 121.37, and 20.72, respectively.

Table 2: Descriptive statistics and correlation matrix

	IIE_{it}	BMS_{it}	Y_{it}	CPI_{it}	TD_{it}	FDI_{it}	UB_{it}
Mean	48.03806	48.25668	1836.330	9.945906	65.27546	1.700579	3.560219
Median	47.93300	45.35308	1675.097	6.931403	61.59653	1.249647	3.621731
Maximum	66.21800	136.3093	4224.035	80.75458	121.3680	9.466664	6.994615
Minimum	33.63500	-35.34045	218.1018	-11.16162	20.72252	-0.675563	1.280489
Std. Dev.	7.018028	27.13205	1073.708	11.08297	22.11916	1.760717	1.368646
Skewness	-0.119369	0.472175	0.458994	2.618539	0.315764	1.859207	0.210606
IIE_{it}	1						
BMS_{it}	-0.4306	1					
Y_{it}	-0.7349	0.4841	1				
CPI_{it}	0.2943	-0.4477	-0.2312	1			
TD_{it}	0.0456	0.3399	0.2249	-0.1778	1		
FDI_{it}	0.0549	-0.0918	0.0805	0.0554	0.1904	1	
UB_{it}	0.5017	-0.5848	-0.6517	0.2934	-0.2806	-0.2120	1

Source: Authors` computation

Moreover, the average value of FDI is 1.70% and standard deviation is 1.76, while the maximum and minimum values are 9.47 and -0.68, respectively. The result of descriptive statistics explored that the mean and standard deviation of urban population is 3.56% and 1.37, as well as the maximum and minimum value of urban population is 6.99 and 1.28.

This study employed the CD test to evaluate whether to employ the 1st generation or the 2nd generation unit root methods. Nevertheless, Table 3 is summarizing the outcomes. Three approaches have been utilized to affirm the credibility of the results. However, these approaches indicate that all statistical values are significant at the 1% level, proving that the variables under consideration are having cross-sectional dependence.

Table 3: Result of Cross-sectional dependence tests

Tests	IIE_{it}	BMS_{it}	Y_{it}	CPI_{it}	TD_{it}	FDI_{it}	UB_{it}
Breusch-Pagan (LM)	599.91***	674.20***	1205.12***	109.16***	219.13***	83.14***	445.02***
Pesaran scaled (LM)	58.49***	66.32***	122.28***	6.76***	18.36***	4.02***	42.17***
Bias-correlated Scaled (LM)	58.33***	66.16***	122.12***	6.59***	18.19***	3.85***	41.99***
Pesaran (CD)	8.69***	15.29***	34.64***	6.8[5]***	3.04***	3.42***	15.33***

Note: Null hypothesis: No cross-sectional dependence, d.f = 45, Asterisks *** shows 1% level of significance

This present study employs both the 1st and 2nd generation tests (IPS, CIPS, & CADF) panel unit root test for the selected variables. The result of these unit root tests is given in Table 4. The result of panel unit root test (IPS) indicates that some variables are stationary at level, and some are stationary at 1st difference. However, result of IPS unit root test reveals that inflation, FDI, and urban population are stationary at level, whereas income inequality, broad money supply, GDP per capita, and trade are stationary at first difference. Likewise, results of CIPS and CADF unit root tests demonstrate that income inequality, inflation and FDI are stationary at first difference, while money supply, GDP per capita, trade, and education are stationary at second difference.

Table 4: Unit root test results

Variables/Tests	IPS		CIPS		CADF	
	Level	1stdif	Level	1stdif	Level	1stdif
IIE_{it}	0.0607	0.0000***	-2.154**(0.016)	----	-2.114**(0.016)	----
BMS_{jt}	0.9999	0.0000***	0.933 (0.824)	-4.564* (0.000)	0.933 (0.824)	-4.564* (0.000)
Y_{it}	1.0000	0.0151**	0.607 (0.728)	-3.058* (0.000)	0.607 (0.728)	-3.924*(0.000)
CPI_{jt}	0.0000***	0.0000	-6.493* (0.000)	----	-6.493* (0.000)	----
TD_{it}	0.4294	0.0000***	0.130 (0.552)	-7.200*(0.000)	0.130 (0.552)	-9.012* (0.000)
FDI_{it}	0.0001***	0.0000	-2.970* (0.001)	---	-2.970* (0.001)	---
UB_{it}	0.0172**	0.0000	0.163(0.565)	-2.270**(0.012)	0.163(0.565)	-2.270**(0.012)

The PMG/panel ARDL approach, which has advantages over other panel error correction techniques, is used in this study based on the characteristics of the data and the outcomes of the panel unit root tests (IPS, CIPS, CADF) in table 5. However, table 5 shows the estimates of long and short run parameters linked with money supply, GDP per capita, inflation, trade, FDI, urban population and income inequality utilizing PMG/panel ARDL estimators.

The empirical findings of the Pooled MG/panel ARDL technique in Table 5 demonstrate that all of the investigated explanatory variables had substantial effects on income inequality, except inflation in the long run of the selected African and Asian countries. The computed models are confirmed as being technically and statistically suitable by the fact that almost all of the independent parameters are individually and statistically significant. The predicted coefficient signs are present for every regressor.

Table 5 reveals that money supply has a significant negative influence on income disparity in the long run, while positive but not significant impact in the short-term. However, the empirical findings indicate that money supply carried out the expected negative and positive sign. The outcome of this study confirms the

estimated negative impact of money supply on income inequality. The calculated coefficients for the money supply variable, which are statistically significant at 1% level of significance, are -0.143 in the long run.

The study outcome demonstrates that an increase in money supply by 1% diminishes income inequality by the same amount of the predict coefficients of money supply. However, the results of the current study are consistent with those of Coibion et al., (2012), Hohberger, Priftis & Vogel, (2020), and Siami-Namini, Lyford & Trindade, (2020). The empirical findings of this study contradict the findings of Saiki & Frost (2014); Feldkircher & Kakamu (2022); El Herradi & Leroy, 2019; and Taghizadeh-Hesary et al., (2020).

This study includes GDP per capita because it is one of the main factors of income inequality. Table 5 demonstrates the long and short term negative and positive correlation between GDP per capita and income inequality. The calculated GDP per capita coefficient is -0.003 over the long-term, and 0.001 over the short-term, and statistically significant over the long run at the 1% level. According to this finding, an increase of 1% in GDP per capita declines income inequality by about 0.003 percent in the long run over time. This outcome is in accord with the findings of Ali, Tariq & Azam (2022); Ahmad et al., (2021); and Hayrullahoglu & Tuzun, 2020). Furthermore, the empirical outcome of the study is not similar to Khan & Padda (2021).

In a similar vein, the inflation variable is added to assess the degree of macroeconomic instability and uncertainty, both of which seem to raise income inequality. However, the empirical findings confirm that the inflation variable`s predictable positive mark. The findings thus confirm the predicted positive influence of inflation on income inequality. The inflation variable has calculated coefficients of 0.006 and 0.0013 over the long and short run, and statistically insignificant at 1% and 5% levels, respectively. The study suggests that greater inflation is associated with high income inequality because low real balance cuts the purchasing power of people. According to the finding, if inflation rises by 1 percent, income inequality will rise by 0.006 and 0.003 percentage (over the long and short run) but it will not be statistically significant. As a result, the positive effect of inflation on income inequality is consistent with the findings of Hayrullahoglu & Tuzun (2020); and Balseven & Tugcu (2017).

Likewise, trade openness is an important determinant of income inequality, so it has been included in the model. The result explores that trade openness has a negative impact on income inequality. The estimated coefficient for trade is 0.027% over the long-term and 0.002% over the short-term and significant at

1% level in the long-term. Results given in Table 5 reveal that a 1% rise in trade openness will reduce income inequality by 0.027%. The empirical findings of this study contradict the result of Calderon & Chong (2001).

FDI inflow is taken into account in this study since it is one of the main production inputs. Result in table 5 reveals that the long run and short run negative association between FDI inflow and income inequality. The estimated FDI coefficient is -0.14 and -0.006% in the long and short-term, and significant over the long run at 1% level of significance. This finding explores that an upsurge of 1% in FDI decreases income inequality by nearly 0.14% in the long run. However, theoretically as well as empirically, FDI is considered to have a direct impact on growth by increasing capital stock in countries and serving as a channel for the transmission of managerial, technological, skill, and knowledge. This procedure, in turn, creates new jobs, boosting long term domestic productivity and economic growth across the economy Ausloos et al., (2019). The negative impact of FDI on income inequality is in accords with the findings of (Lee et al., 2022; Rezk, Amer, Fathi & Sun, 2022). Furthermore, the findings of this study contradict with the results of Herzer & Nunnenkamp (2011).

In addition, result of PMG/panel ARDL estimator reveals that urban population has positive influence on income inequality both in the long and short run. Nevertheless, the empirical outcomes of the study support the expected positive sign of urbanization. Further, the calculated co-efficient value of urban population is 0.76% over the long, and 0.43% over the short run, which are statistically significant at 1 percent level in the long-run. Empirical result of this study is matching with the result of Adams & Klobodu (2019), while the findings of this study are not similar with the findings of Ha et al. (2019).

It is interesting to note that the error correction coefficient, which represents the speed at which the model is adjusting to the long run equilibrium, is revealed by the short-term equation. The result of the ECM model is -0.1377 that is statistically negative but significant at 1 percent level of significance. These findings show that the model`s annual speed to the long-run equilibrium is close to 14%. These statistics show that the rate of alteration at 14% per annum is slow and that it will take almost seven years to reach the long-run equilibrium. The negative and statistically significant outcomes of the error correction model thus provide substantial support for the prediction made by theory. Furthermore, convergence to the long-run equilibrium is indicated by the significantly negative ECM.

In addition to using the PMG method and taking co-integration among the parameters, this research examines the long-run equilibrium relationship. It in-

vestigates this relationship by employing the panel FM-OLS methodology on stationary data and utilizing equation 3 to get clear findings to confirm whether money supply, inflation, GDP per capita, trade, FDI and urban population contributes to income inequality.

Table 5: PMG/ ARDL and FMOLS estimations

	ARDL Long run estimates		FMOLS	
Variables	Coefficient [St. Error]	P. value	Coefficient [St. Error]	P. value
BMS_{it}	-0.1435* [0.0162]	0.0000	-0.1349** [0.06121]	0.0401
Y_{it}	-0.0033* [0.0008]	0.0001	-0.0024* [0.0006]	0.0002
CPI_{it}	0.0062 [0.0118]	0.5985	0.1069* [0.0266]	0.0001
TD_{it}	-0.0279* [0.0065]	0.0000	-0.0716* [0.0198]	0.0004
FDI_{it}	-0.1395** [0.0714]	0.0520	-0.3857* [0.1736]	0.0270
UB_{it}	0.7615* [0.1982]	0.0002	-0.2849 [0.3475]	0.4130
Adj. R^2	-		0.8805	
	ARDL Short run estimates			
ECM	-0.1377* [0.0530]	0.0101		
$\Delta(IIE_{it}(-1))$	0.5244* [0.0651]	0.0000		
$\Delta(BMS_{it})$	0.0389 [0.0299]	0.1955		
$\Delta(Y_{it})$	0.0011***[0.0005]	0.0561		
$\Delta(CPI_{it})$	0.0013 [0.0045]	0.7826		
$\Delta(TD_{it})$	0.0015 [0.0092]	0.8678		
$\Delta(FDI_{it})$	-0.0062 [0.0221]	0.7811		
$\Delta(UB_{it})$	0.4344 [0.4756]	0.3622		
Constant	7.9281* [3.2319]	0.0150		
@Trend	-0.0103 [0.0194]	0.5966		

Note: Asterisks *, **, and *** show significant at the l1%, 5%, and 10% levels, respectively.
Lag: (2, 1, 1, 1, 1, 1, 1)

Table 5 provides the empirical findings for both estimators and demonstrates the panel FM-OLS estimation`s strong instructive power based on adj. The R2 values of 0.88 (FM-OLS). The adj. R2 explains nearly 90 percent of the variation by the regressors (money supply, GDP per capita, inflation, trade, FDI, and urban population) in the regressand (income inequality measured by Gini coefficient). The predicted coefficient signs are present for every independent variable. All of the examined regressors had substantial effects on income inequality, according to the empirical findings in Table 5. Furthermore, all of the regressors are statistically significant on their own, suggesting that the expected models are technically and statistically sound. The FM-OLS empirical results demonstrate that money supply has positive and negative effect on income inequality but statistically insignificant at 1% level of significance. These results imply that the effect

is negative and positive, meaning that money supply has the capability to reduce and increase income inequality, but the effect is not significant enough. Further, empirical findings indicate that GDP per capita has a negative influence on income inequality and is statistically significant at 1 percent level of significance. It means that GDP per capita has the potential to reduce income inequality.

Likewise, the result in Table 5 reveals that inflation has a positive and significant influence on income inequality at 1% significance level, observe that inflation has the capability to increase income inequality. Moreover, empirical outcomes of FM-OLS test show that trade has positive and significant effect on income inequality at 5% level of significance. The empirical result of FM-OLS test suggests that FDI has a negative and significant impact on income inequality at 10% level of significance. This means that FDI has ability to reduce income inequality Similar inverse relation between inward FDI and income inequality in case of sub- Saharan African countries also observed by Xu et al., (2021). In addition, results explored that urban population have negative and insignificant influence on income inequality at 1% level of significance.

Further examining the causal relationship between the variables, Dumitrescu & Hurlin (D-H) (2012) test of causality is applied. This technique enables for heterogeneity throughout Cross-sections, and causality findings are shown in Table 6 which shows that there is a two-way causality between GDP per capita and income inequality, as well as urban population and trade. Result of D-H reveals that there is a unidirectional causality from urban population to income inequality, GDP per capita, and FDI, from money supply to trade, from GDP to inflation and trade. Moreover, result of D-H Granger causality test reveals that no causal relation exists between money supply and income inequality, inflation and income inequality, trade and income inequality, FDI and income inequality, as well as GDP per capita and money supply, inflation and money supply, FDI and money supply, urban population and money supply. Similarly, no causality exists between FDI and GDP per capita, trade and inflation, FDI and inflation, urban population and inflation, FDI and trade, urban population and trade.

Table 6: Result of Dumitrescu and Hurlin Panel Granger causality tests

Variables	IIE_{it}	BMS_{it}	Y_{it}	CPI_{it}	TD_{it}	FDI_{it}	UB_{it}
IIE_{it}	--	3.057 (1.155) [0.2477]	4.616*** (3.220) [0.0013]	5.253 (4.064) [5.E-05]	3.156 (1.289) [0.1972]	2.478 (0.392) [0.6946]	3.030 (1.122) [0.2615]
BMS_{it}	2.431 (0.328) [0.7424]	--	5.593 (4.508) [7.E-06]	3.027 (1.116) [0.2641]	4.619*** (3.221) [0.0013]	2.374 (0.253) [0.7998]	2.289 (0.141) [0.8874]
Y_{it}	4.272*** (2.766) [0.0057]	7.962 (7.640) [2.E-14]	--	3.693** (2.000) [0.0454]	4.364*** (2.887) [0.0039]	1.931 (-0.330) [0.7409]	6.213 (5.334) [1.E-07]
CPI_{it}	1.263 (-1.214) [0.2245]	2.141 (-0.054) [0.9562]	2.073 (-0.143) [0.8855]	---	2.138 (-0.057) [0.9540]	1.964 (-0.287) [0.7737]	2.438 (0.339) [0.7341]
TD_{it}	3.401 (1.614) 0.1065	2.671 (0.646) [0.5180]	3.2232 (1.377) [0.1682]	2.955 (1.024) [0.3058]	---	5.139 (3.912) [9.E-05]	4.308*** (2.813) [0.0049]
FDI_{it}	2.751 (0.753) [0.4513]	1.440 (-0.980) [0.3268]	2.480 (0.394) [0.6930]	3.283 (1.458) [0.1448]	1.601 (-0.767) [0.4425]	---	2.859 (0.896) [0.3702]
UB_{it}	11.41*** (12.222) [0.0000]	1.754 (-0.565) [0.5715]	3.960** (2.353) [0.0186]	2.786 (0.800) [0.4233]	3.585* (1.857) [0.0633]	3.457* (1.688) [0.0914]	---

Note: Asterisks *, **, and *** indicate level of significance at 10%, 5%, 1% respectively.

5. Conclusion

This study aims to explore the impact of monetary policy along with some other factors (i.e., GDP per capita, inflation, trade, FDI, and urban population) on income inequality in ten (10) selected Asian-African economies between 1990 and 2020. The money supply variable, along with some other regressors such as GDP per capita, inflation, trade, incoming FDI, and urban population have been used in the model to accomplish the purpose of the research. The prime objective of the present study is empirically investigated by using recognized and appropriate techniques in order to comprehend how monetary policy affects income inequality in the selected panel of countries. The PMG/panel ARDL model and panel FM-OLS model are utilized for the ten Asian-African countries. However, the selection of the appropriate models is done on the basis of the 1st and 2nd generation unit root results. Furthermore, empirical outcomes of the PMG/panel ARDL model demonstrate that monetary policy has negative and significant influence on income inequality. Additionally, panel FM-OLS estimator affirm that mon-

etary policy has negative but insignificant influence on income inequality in 10 Asian-African countries.

These findings suggest that the volume of exports needs to be enhanced by executing export encouraging policies, and it is also documented within the UN SDG Goal 10, Target 10.A: "implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with WTO agreements". Inward FDI needs to be enhanced, and it is also documented by UN SDG Goal 10 Target 10.B: "Encourage official development assistance and financial flows, including foreign direct investment, to States where the need is greatest, in particular least developed countries, African countries, small island developing states and landlocked developing countries, in accordance with their national plans and programmes". National income needs to be enlarged by optimally utilizing the scarce resources of the country while keeping in mind sustainable development policy. Price stability needs to be ensured by increasing the supply of goods. As a result, it is stated that monetary policy is also an important determinant of income inequality.

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