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Distributional Effects of Monetary Policy on Income Inequality: Evidence from Thailand

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Abstract

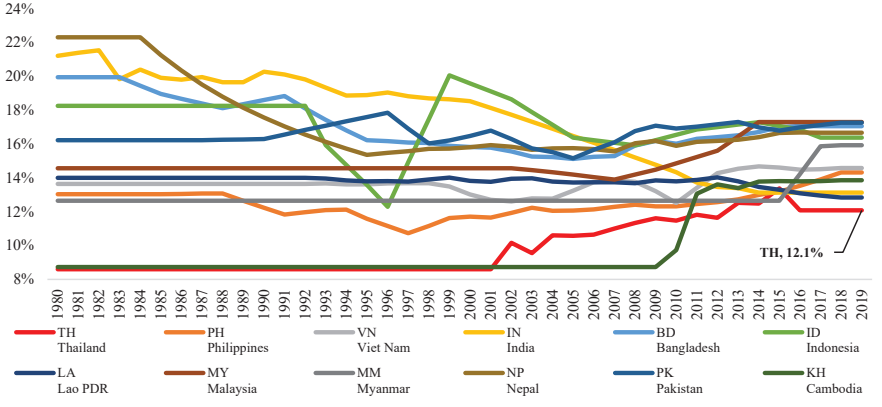
This study aims to discuss whether a central bank should have a role in inequality, even if it is beyond the policy objectives' mandate. We employ the Time-Series Analysis and income inequality dataset from the World Inequality Database to investigate the short- and long-run influence of the expansionary monetary policy on income inequality in Thailand during 1980-2021. Our short-run results demonstrate that expansionary monetary policy leads to GDP growth and decreases income disparity in a certain period, while greater inflation appears to exacerbate inequality. In the long run, expansionary monetary policy results in higher inflation, cointegrated with the income gap as it increases the income share of the affluent while decreasing the income share of the poor. Besides relying heavily on fiscal policy, our findings encourage the monetary policy in Thailand to take into account the distributional effects when determining long-term monetary policy goals.

Keywords: distributional effect, monetary policy, income inequality, vector autoregression, ARDL bound test.

1. Introduction

The conventional views on the target of monetary policy are to preserve economic stability, i.e., inflation and departures from the natural rate of unemployment (output gap). Unlike fiscal policy, the monetary target has nothing to do with the trickle-down effects or distributional issues. For example, the New Keynesian Model proposed that monetary policy stabilizes domestic inflation (Walsh, 2017). However, the growing role of an unconventional monetary policy such as quantitative easing has caused several markets, e.g., asset prices in financial markets, to react strongly to the monetary shock. Following that, the impact of monetary policy on other aspects of the economy, such as poverty and inequality, has been widely questioned (Albert et al., 2020; Andersen et al., 2021; Bartscher et al., 2021; Mumtaz & Theophilopoulou, 2017). Despite the minority view supporting distributional concerns in monetary policy choices, the rising voices over the problem of the role of monetary policy in inequality have intensified in recent years.

Figure 1. The pre-tax national income shares of the bottom 50%



Source: World Inequality Database (WID)

Recently, the COVID-19 pandemic exacerbated concerns about the consequences of inequality and poverty (World Bank, 2021). In developing nations, a significant income loss in vulnerable households due to the pandemic made poverty and inequality a primary global agenda (World Bank, 2021). Figure 1 illustrates an issue of income inequality in Asian developing countries, showing that the income of the poor (represented by the bottom 50%) was less than 20% of total national income from 1980 to the present, while the remainder went to the wealthier (represented by the top 1% richest). During 2010-2020, Thailand had the lowest income share and strongest income inequality compared to the other Asian developing countries. The problems of "poverty" and "inequality" (SDG goals 1 and 2) are projected to become strongly critical after the pandemic, particularly in Thailand and other developing countries (World Bank, 2021).

Even though our understanding of the distributional effect of monetary policy is still limited, inequality should be addressed at the monetary authority's table (Ilzetzki, 2021). Jongwook (2021) shows that the transmission mechanism of monetary policy could affect income inequality in the long run. Recent studies also provide empirical evidence for the impact of monetary policy shocks on inequality. Mumtaz & Theophilopoulou (2017) show that monetary policy shocks have significant effects on income and wealth distribution in the UK. Guerello (2018) investigated this issue in the case of the Eurozone and found high heterogeneity of the results across the countries. Moreover, the empirical studies in the case of Asian developing countries, where income distribution is the primary concern, are still very limited.

In Thailand, the monetary policy framework has placed a strong emphasis on price stability under the inflation-targeting framework since 2000. Other dimensions of economic stability, such as the output gap, exchange volatility, and financial stability, are usually mentioned in recent policy statements. However, the effects of monetary policy on income distribution in the short- or long-term still receive insufficient attention. Therefore, in this

paper, we raise the question, does the monetary policy in Thailand significantly creates an effect on income inequality? First, we observe the short-run policy effect based on the Vector Autoregressive (VAR) model which allows us to construct the policy Impulse Response Function (IRF) of the income gap to monetary policy shock during the period of study. Second, we construct the long-run cointegration test based on the Autoregressive Distributed Lagged (ARDL) model to diagnose the long-run effects of inflation, interest rate, and GDP growth on the income of the poor, the rich, and the overall population.

Our study beneficially contributes to the empirical implications in Thailand. Specifically, it shows that using expansionary policy to stimulate short-run economic growth has a significant negative impact on income inequality. Bringing up inflation and lowering interest rates would increase the income share for the rich while lowering the income share for the poor. Thus, using an expansionary policy to boost short-run growth has its price to pay for the poor. As a result, inflation is found to widen the income gap. Therefore, we propose that using expansionary monetary policy by lowering policy interest rates and raising inflation needs to take "distributional effects" on inequality into the central bank's long-term monetary policy consideration.

The rest of this paper is outlined as follows. In the next section, we discuss the related literature on the distribution effects of monetary policy. Section 3 exhibits the research methodology to evaluate the short-run response and long-term effects of monetary policy. The empirical findings are presented in section 4. Finally, section 5 concludes the paper and discusses the policy implication.

2. Related Literature

In conventional economics literature, poverty and inequality arise from various fundamental factors and policies. A wide range of literature has explained the sources of poverty and income inequality. For example, *Macroeconomics* emphasizes the importance of endogenous growth theory in

generating revenue and employment. The growth in wage income then lifts the condition of the poor. *Labor Economics* explained the links between the labor market, wage discrimination, education, health conditions, and poverty and inequality (Lang, 2012). The labor economics framework shows that changes in labor supply, demand, regulation, price, and reallocation of workers between sectors impacted poverty and enlarged the income gap between the rich and the poor (Addison & Demery, 1993).

Political Economics, on the other hand, explains how institution efficiency, government efficiency, corruption, tax policy, and fiscal policy contribute to poverty and income distribution (Bardhan, 1996; Creedy, 1996). The redistribution of income is broadly assumed to be done by fiscal policy instruments, which include taxation, government spending, or other redistribution tools. For example, the well-known study by Hamilton (1967) discovered the link between political economics and poverty. The study initially emphasized the importance of institutional and technological variables in determining the causes of poverty and income disparity (Hamilton, 1967).

Welfare Economics put forward the social welfare function and measured the standard level that one household should have to maintain adequate well-being. For instance, Lewis and Ulph (1988) attempted to explain how poverty and inequality are interlinked and contribute to the level of social well-being. The result claimed that distribution problems mainly arise from how institutes allocate public resources (Lewis & Ulph, 1988). In addition, *International Economics* addressed the importance of openness to trade, foreign direct investment (FDI), foreign aid, and inequality, particularly inequalities between rich and impoverished countries, as illustrated in the generally known study by Meier (1958). Specifically, in the case of Thailand, Teeramungcalanon and Chiu (2020) explained the effects of sectoral FDI on income inequality reduction. They claimed that FDI in the manufacturing sector has precisely contributed to lower income inequality through employment effects and knowledge spillovers.

Monetary Economics, believed to be the principal instrument to control the economy, is limited to stabilizing price and output in the short run. It hardly describes how policy impacts the poor and income distribution (Ilzetzki, 2021). This limitation causes monetarists to ignore the "side effects" of monetary policy on the poor and its consequences on income distribution between the rich and the poor. Monetarists believe that the objective of monetary policy should be to limit target price and growth by controlling variations of money and financial markets rather than balancing who gains more from the markets. This argument appears to be strong as the objective of conventional monetary policy has nothing to do with inequality rather than keeping inflation and interest rates stabilized (Walsh, 2017). In fact, our state of knowledge is limited and in its infancy (Ilzetzki, 2021). For example, Mishkin (1996) only described how monetary policy can manage the real economy, inflation, and output. Bernanke and Blinder (1992) and Shokr and Karim (2021) also showed how international monetary policy is associated with the shock to real economy, price, and bank lending in others countries. This understanding is a useful contribution to the central bank that allows them to cope with inflation and interest rates in the country. However, to make our monetary policy better and friendlier to the poor, we should allow policy objectives to oversee inequality, too.

2.1 Why should the central bank be concerned about inequality?

The overwhelming view holds that, despite the distributional impacts of monetary policy, it is up to fiscal policy and politics, not the duty of the central bank, to address income distribution. The goals of redistributive programs must match the electorate's desires, not that of the monetary policy committee. If the bank becomes involved in highly politicized choices, such as asset acquisitions intended to redistribute income and wealth, the political consensus for bank independence may be jeopardized (Ilzetzki, 2021). Some economists say that distributional concerns are at the heart of politics, and that distributional decisions should be made by elected officials rather than unelected technocrats on central bank policy committees. Further, fiscal tools

can be more targeted rather than the central bank's monetary toolboxes. Thus, most monetarists believe that inequality should play a minimal role in monetary policy decisions.

The discussion about who should oversee offsetting the distributional consequences between the fiscal and monetary policy is still ongoing. "*Standard normative economics*", an economics viewpoint that expresses normative or ideologically prescriptive views about economic development, believed that the distribution problem should be determined by fiscal policy. The transmission mechanism of monetary policy ends at the inflation and output gap (see Figure A.1), not the inequality (Mishkin, 1996). Hence, the role of inequality and income distribution usually refers to, e.g., tax policy, welfare policy, and government investment in infrastructure.

However, "*modern economical literature"*, an economic perspective that describes the economic phenomena based on the positive economic statement or empirical facts, is more open to changes over this issue. Multiple empirical studies found a significant relationship between monetary policy and inequality, including the labor income of the poor, for example (Colciago et al., 2019; El Herradi & Leroy, 2019; Jongwook, 2021; Kurita & Kurosaki, 2007; Taresh et al., 2020). Moreover, monetary policy was also found to involve the condition of the poor and income disparity both in the short and long run through the inflation channel (Romer & Romer, 1998). According to this study, countries with higher average inflation and more unstable economies have more income distribution problems. The authors clarified that monetary policies that boost average inflation by 1% cause the Gini coefficient to jump by 0.2 percentage points. They concluded that, in the long run, countries should maintain low-interest rates and steady economic growth.

Although inequality is beyond the mandate of central banks, top central bankers are considering distributional issues more. Recent academic investigation has concentrated increasingly on the effect of monetary policy on inequality, and some have disagreed that distributive concerns should play

a greater role in monetary policymaking (Ilzetzki, 2021). Similarly, recent advancements in economic theory have provided new light on the relationship between monetary policy and inequality (Hansen et al., 2020). Therefore, we need to consider the following arguments to answer why inequality should be a part of monetary policy goals.

First, monetary policy involves several market interactions – the fundamental goal of monetary policy is to keep prices and output stable. It has nothing to do with income distribution or poverty. However, its implementation necessitates several market interventions, resulting in economic volatility and household behavior adaptation. In both the short and long run, the volatility of macroeconomics fluctuates, clearly resulting in income and distribution (Amberg et al., 2021; Jongwook, 2021; Lambrecht et al., 2015; Romer & Romer, 1998). Since the monetary policy was universally used to boost the economy from the financial crisis in 2008 onward, the monetary authority should get involved in poverty and inequality, too, especially during the COVID-19 pandemic. Also, to comply with the SDGs (goals 1 and 2), considered the global urgent agenda, central banks needed to play an essential role in parallel with the fiscal policy.

Second, monetary policy creates a *distributional effect* on household income and inequality. In addition to the long-term goals of monetary policy that aimed to stabilize output and employment, an alternative goal of monetary policy is associated with financial and price stability. The transmission of monetary policy also involved money and financial market fluctuation. Thus, the linkage between monetary policy and inequality is possible. Moreover, the transmission of monetary policy involved money and financial market fluctuation.

Several interpretations of the role of monetary policy in poverty and inequality from previous literature have shown that i) expansionary monetary policy stimulates the real economy, employment, and price significantly; under the net financial wealth channel, differential financial assets holding between

Ricardian and Non-Ricardian households could lead to income inequality as higher asset prices benefit only the Ricardian households (Punzi, 2020). ii) Loosening monetary policy has a significant impact on earnings throughout the whole income distribution; it has a disproportionately large impact on the tails, resulting in a U-shaped response pattern (Amberg et al., 2021). iii) Unanticipated inflation worsens the inequality and condition of the poor both in the short and long run (Romer & Romer, 1998). iv) In the United Kingdom, the expansionary monetary policy reduces inequality in labor wages, consumption, and expenditures (Mumtaz & Theophilopoulou, 2017), and similar results are found in the U.S. (Coibion et al., 2017). v) Earnings and wealth disparities between black and white households are both affected by monetary policy shocks; although more accommodative monetary policy boosts black household employment more than white household employment, the total impacts are minor; moreover, because black families own fewer financial assets that rise in value, an accommodating monetary policy shock exacerbates the wealth gap between black and white households (Bartscher et al., 2021). vi) A shock resulting from an expansionary monetary policy could lead to a rise in wealth disparity, especially in the long run; its policy shock significantly boosts the net worth of the wealthiest and poorest families, while the middle class benefits the least (Albert & Gómez-Fernández, 2021). vii) The effect of expansionary monetary policy and contractionary monetary policy on inequality are asymmetric; income disparity rises because of expansionary monetary policy shocks produced by a lower-than-expected bank rate, whereas income inequality falls because of contractionary monetary policy shocks (Kronick & Villarreal, 2020).

Third, modern monetary policy (unconventional monetary policy) has been universally implemented to tackle poverty and lower the income gap after the global financial crisis. After the 2008 hamburger crisis, we have seen many central banks expand their goals beyond stability. Following the worldwide economic downturn, the subject of economic inequality began to

gain traction. During that time, the rise in unemployment, the uneven evolution of house and stock prices, and the decline in interest rates all had varied effects on households. Since the 1980s, income and wealth inequality has increased in most industrialized countries, with some nations now seeing levels close to those seen at the turn of the twentieth century, generating concerns about the political and economic ramifications of this trend (Dossche et al., 2021). In academic literature, the European Central Bank examined the effects of its policies on income distribution and concluded that quantitative easing (QE) has decreased inequality (particularly regional inequality) across the employment channel (Dossche et al., 2021). Thus, many countries' Federal Reserve and central banks also stimulated growth and equitable distribution through unconventional monetary policy, i.e., quantitative easing (Dell'Ariccia et al., 2018; Gertler, 2013; Kuttner, 2018). With the recent trend of rising globalization and technological change, central banks are also trying to move into social engineering, precisely the policy response to inclusive growth, rising income, and wealth equality.

Fourth, the review of empirical studies has proved that relying on a single approach may not be enough to achieve the goals (Berry, 2003; Colciago et al., 2019; Huang et al., 2015). Changing only fiscal policy instruments may not resolve structural problems, such as distribution, or improve the well-being of the poor (Amberg et al., 2021). Since fiscal policy might not fully trickle down to poverty and inequality, the alliance between economic policies must be redesigned, especially in light of rapid changes in economic structure, globalization, technological disruption, and the COVID-19 pandemic (World Bank, 2021). Therefore, a better policy to create equality requires the cooperation of all economic authorities, including the central bank.

Even if only a minority perspective thought that monetary policy had a significant effect on inequality, it is difficult to argue that monetary policy does not fully involve inequality. As long as the interest rates influence a household's savings and investments, central bank asset purchasing affects asset price and

returns, and monetary policy will unavoidably have a significant impact on wealth distribution. Therefore, it is important to look at how monetary policy has an influence on inequality distribution, and central banks (with non-monetary hats) should put this on their agenda.

2.2 Transmission of monetary policy to income inequality

As well-summarized in Jongwook (2021), the final consequences of monetary policy shocks on income inequality depend on the relative significance of each channel. To clarify this, consider the model with two households: high-income (superscript H) and low-income earners (superscript L). The difference in the change rates in market income (Y) earned by each group may be used to quantify changes in income disparity.

$$\frac{\Delta Y^H}{Y^H} - \frac{\Delta Y^L}{Y^L} = r_w^H \frac{\Delta W^H}{W^H} + r_b^H \frac{\Delta B^H}{B^H} + r_f^H \frac{\Delta F^H}{F^H} + r_o^H \frac{\Delta O^H}{O^H} - \left(r_w^L \frac{\Delta W^L}{W^L} + r_b^L \frac{\Delta B^L}{B^L} + r_f^L \frac{\Delta F^L}{F^L} + r_o^L \frac{\Delta O^L}{O^L} \right) \quad (1)$$

Where market income (Y) is the sum of wage (W), business earning (B), financial gain (F), and transfer income (O). r_w, r_b, r_f, r_o indicate the ratio of wage, business earning, financial gain, and other transfer incomes, respectively. These ratios may be understood as the weights that represent how much of each revenue is in relation to the others. The disparity between the high-income and low-income households will be positive when the income earning of high-income households increases more than that of low-income. This implies that income inequality is increasing. To classify this distributional effect in each transmission channel, equation (1) can be illustrated as

$$\frac{\Delta Y^H}{Y^H} - \frac{\Delta Y^L}{Y^L} = (\alpha + \beta + \gamma + \delta) \quad (2)$$

Where represent each channel, respectively.

Earnings heterogeneity: $\alpha = \frac{r_w^H + r_w^L}{2} \left(\frac{\Delta W^H}{W^H} - \frac{\Delta W^L}{W^L} \right) + \frac{r_b^H + r_b^L}{2} \left(\frac{\Delta B^H}{B^H} - \frac{\Delta B^L}{B^L} \right)$ (3)

Interest rate income: $\beta = \frac{r_f^H + r_f^L}{2} \left(\frac{\Delta F^H}{F^H} - \frac{\Delta F^L}{F^L} \right)$ (4)

$$\textit{Transfers heterogeneity}: \quad \gamma = \frac{r_o^H + r_o^L}{2}\left(\frac{\Delta O^H}{O^H} - \frac{\Delta O^L}{O^L}\right) \tag{5}$$

$$\textit{Income composition}: \quad \delta = \frac{r_w^H - r_w^L}{2}\left(\frac{\Delta W^H}{W^H} + \frac{\Delta W^L}{W^L}\right) + \frac{r_b^H - r_b^L}{2}\left(\frac{\Delta B^H}{B^H} + \frac{\Delta B^L}{B^L}\right) + + \frac{r_f^H - r_f^L}{2}\left(\frac{\Delta F^H}{F^H} + \frac{\Delta F^L}{F^L}\right) + \frac{r_o^H - r_o^L}{2}\left(\frac{\Delta O^H}{O^H} + \frac{\Delta O^L}{O^L}\right) \tag{6}$$

Where (i) the *earnings heterogeneity channel* shows how expansionary monetary policy shocks enhance income disparity by improving the wage of low-wage workers less than that of high-wage workers ($\Delta W^H / W^H > \Delta W^L / W^L > 0$); this may also be by increasing the profits of small businesses less than the large firms ($0 > \Delta B^H / B^H > \Delta B^L / B^L$). (ii) The *interest rate income* or *saving redistribution channel* explains why expansionary monetary policy shocks exacerbate income inequality by favoring borrowers while punishing small savers ($\Delta F^H / F^H > 0 > \Delta F^L / F^L$). (iii) The *transfer heterogeneity channel* shows how contractionary monetary policy shocks, on the other hand, might improve income inequality during the recession by transferring income from high-income earners to low-income earners ($\Delta O^H / O^H > 0 > \Delta O^L / O^L$). (iv) The *income composition channel* explains the different components of business income ratio to each household. If the business income of the high-income household is more than low-income household ($r_b^H > r_b^L$), then expansionary monetary policy is likely to increase business income more than wage income ($0 > \frac{\frac{\Delta W^H}{W^H} + \frac{\Delta W^L}{W^L}}{2} > \frac{\frac{\Delta B^H}{B^H} + \frac{\Delta B^L}{B^L}}{2}$). Thus, expansionary monetary policy can increase income inequality.

Additionally, the partial effect on consumption in reaction to the variation in income, interest rate, and price as a result of monetary policy as in Household Welfare Theorem 3 of Auclert (2019), explained that the first-order aggregate consumption changes in response to and is:

$$\partial C = \underbrace{E_I\left[\frac{Y_i}{Y}\widehat{MPC}_i\right]\partial Y}_{Aggregate\ income\ channel} + \underbrace{Cov_I\left(\widehat{MPC}_i, \partial Y_i - Y_i\frac{\partial Y}{Y}\right)}_{Earning\ heterogeneity\ channel} - \underbrace{Cov_I\left(\widehat{MPC}_i, NNP_i\right)\frac{\partial P}{P}}_{Fisher\ channel} + + \underbrace{(Cov_I(\widehat{MPC}_i, URE_i))}_{Interest\ rate\ exposure\ channel} - \underbrace{E_I[\sigma_i(1-\widehat{MPC}_i)\,c_i])\frac{\partial R}{R}}_{Substitution\ channel} \tag{7}$$

Each shock is a transitory conduit between inequality and monetary policy. The transmission consists of (i) the *aggregate income channel* which illustrates that expansionary monetary policy increases individual and aggregate income. (ii) The *earning heterogeneity channel* stated that lower-income families have a larger marginal propensity to consume (MPC); thus, monetary expansions are expected to enhance aggregate consumption. (iii) The *fisher channel* (also known as a price channel) indicates that the MPC of the nominal borrowers is higher than asset holders; then, this channel implies that when the unanticipated price rises because of a loose monetary policy, nominal debtors profit while nominal creditors deteriorate; households with relatively substantial mortgage loans, for example, will benefit, while those renting apartments would suffer; thus, Ricardian (high-income) households benefit more from expansionary monetary policy. (iv) The *interest rate exposure channel* specifies that MPCs are larger for families with unhedged borrowing needs than for those with unhedged saving needs; this has the inherent result that aggregate consumption reacts to real interest rates more than it would if intertemporal substitution were used alone. (iv) The *substitution channel* said that the σ_i of ith household income group's discount is given at 0.5 consistently for every one of the different income classes; the substitution channel implies the standard interest rate channel.

Regarding the distributional effect of monetary policy on inequality in the long run, Romer and Romer (1998) examined the relation and effect of monetary policy on the well-being of the poor and income distribution in the long run. For income inequality, they adopted the Gini coefficient as a measure of income distribution. Their primary sample was 76 countries globally. The empirical model was set up to draw out the effect of monetary policy through average inflation (as inflation channel) and the standard deviation of nominal GDP growth (as growth channel). The authors claimed that the distribution of income was less equivalent in countries with greater average inflation and greater economic instability. This empirically implied that expansionary

monetary policy tended to increase income disparity. In the case of the poor, the average-income countries, as well as the OECD countries, having higher inflation and economic volatility were associated with a rise in income inequality. The findings of Romer and Romer (1998) are consistent with multiple research projects within the same period of study. For example, Al-Marhubi (1997) found a positive relationship between inequality and average inflation. He suggested that the result is more robust if controlling political stability, central bank independence, and the country's openness.

In addition, Kuznetz (1955) explained the long-run relationship between income inequality and the level of economic growth of developed and underdeveloped countries during 1780-1850. He looked at the pre-tax income of incomers along the income distribution (1st and 5th quintile) and concluded that the major offset to the increasing income inequality was associated with the shift from agriculture and the countryside to industry and the city (basically known as economic growth). To lower income inequality, the result proposed to increase the income of the poor. The author also suggested finding more empirical evidence of his implication in underdeveloped countries, particularly income disparity among nonnative minorities versus privileged native populations. In the case of Thailand, Warr (2004) found that long-term economic growth, sectoral economic growth such as agricultural, industrial, and service sector growth, association with the openness to trade, and investment strongly correlated to significant poverty reduction but not lowering the income inequality. He showed that the rate of growth had no consistent correlation to inequality in Thailand based on the data between 1969-2002.

Due to the data constraint in developing countries, we could only establish a linkage between monetary policy and income inequality through three channels. First, the *income composition channel* assumes that an expansionary monetary policy increases the income gap as it benefits the wage and business earnings of the rich more than the poor. Second, the *interest rate channel* holds that expansionary monetary policy (lower interest rate) helps

the rich (who have larger mortgages) by lowering their interest rate payments while hurting the interest rate earnings of the poor (small savers). Third, the *inflation channel* argues that increasing inflation drives up asset values and favors the rich over the poor.

2.3 Review of empirical studies

Recently, there have been several empirical research attempts to explain poverty and inequality in different dimensions. The findings and solutions are varied according to the definition of the problems investigated. Various policies and measures have been implemented to reduce poverty and inequality from the past to the present, yet they have ambiguous interpretations and have not yet reached full effectiveness (Berry, 2003). Due to differences in economic foundation, political structure, household heterogeneity, culture, and norms, the context of poverty and income inequality in industrialized and emerging countries may or may not be comparable (Berry, 2003; Colciago et al., 2019; Huang et al., 2015; Jongwook, 2021). As a result, each country acts differently in response to poverty and inequality and goals.

Table 1 summarizes the research scope, country sample, time period, methodology, and main findings from the empirical studies. Overall, recent studies (e.g., Colciago et al., 2019; Dossche et al., 2021; Hansen et al., 2020; Jongwook, 2021; Szczepaniak & Geise, 2021) revealed that monetary policy created significant impacts on income distribution. Many studies suggested that expansionary policy increases income inequality. This is because higher inflation affects purchasing power and wage income of the poor to a greater extent than the rich. Meanwhile, inflation raises the business and capital gains of the rich, particularly those households with financial assets and home mortgages. Therefore, monetary policy, through higher inflation, appears to significantly widen the income gap. If monetary policy creates an impact on the income of the poor and the rich differently, then the central bank needs to take these side effects into their consideration.

Table 1. Review of empirical studies

Authors	Period	Sample	Method	Monetary Policy	Distributional channel	Main Finding
Romer and Romer (1998)	1970-1990	76 countries	Cross-sectional regression	Expansionary monetary policy	Inflation	(+) income inequality
Coibion et al. (2017)	1980-2008	USA	Local projection	Contractionary (+100 bps monetary shock)	Income composition, Earning heterogeneity	(+) income and labor earning inequality
Albert et al. (2020)	1982-2014	USA	Bayesian Proxy SVAR	Expansionary monetary policy	Housing and fiscal channel	Insignificant (+) income inequality
Inui et al. (2017)	1981-1998	Japan	Local projection	Expansionary monetary policy (-100 bps monetary shock)	Earning heterogeneity	(+) income and labor earnings inequality
Andersen et al. (2021)	1987-2014	Denmark	Cross-sectional regression	Expansionary monetary policy	Earning heterogeneity	(+) income inequality
Mumtaz and Theophilopoulou (2017)	1969-2012	UK	SVAR	Contractionary monetary policy	Income composition, Earning heterogeneity	(+) earnings, income, and consumption inequality
Voinea et al. (2017)	2008-2014	EU	Cross-sectional regression	Expansionary monetary policy	Income composition, Earing heterogeneity	(+) income inequality
Albert and Gómez-Fernández (2021)	1997-2019	USA	SVAR	Expansionary monetary policy	Earnings heterogeneity, Portfolio	(+) wealth inequality
El Herradi and Leroy (2019)	1920-2015	12 advanced economies	Panel-VAR, Local projections	Expansionary monetary policy	Inflation	(+) income inequality
Jongwook (2021)	1990-2017	Korea	block-exogeneity VAR	Expansionary monetary policy	Earnings heterogeneity	(+) income inequality
Punzi (2020)	2000-2018	ASEAN	Panel VAR	Expansionary Monetary shock	Portfolio channel, Earnings heterogeneity	(-) income inequality

Authors	Period	Sample	Method	Monetary Policy	Distributional channel	Main Finding
Bajaj and Suresh (2020)	1985-2018	India	ARDL	Expansionary	Credit channel (saving redistribution)	(+) income inequality
De (2017)	1996-2013	India, China	FAVAR, DSGE	Expansionary	Inflation	(+) income inequality
Cravino et al. (2018)	1978-2008	USA	FAVAR	Expansionary	Inflation	(+) income inequality
Davtyan (2017)	1979-2012	USA	VAR	Contractionary	Inflation	(-) income inequality
Villarreal (2014)	2003-2012	Mexico	SVAR	Restrictive (exp. monetary shock)	Income composition, Earnings heterogeneity	(-) income inequality
Cloyne et al. (2018)	1975-2007	UK, USA household survey data	Romer and Romer procedure	Expansionary monetary policy shock	Income composition	(+) income inequality
Guerello (2018)	2001-2015	Euro	Panel VAR	Expansionary (-100 bps monetary shock)	Income composition, Earnings heterogeneity	(-) income inequality
Samarina and Nguyen (2019)	1999-2014	10 euro countries	Panel VAR	Expansionary shock	Inflation	(-) income inequality

In a review of current empirical research, most studies relied heavily on time series and panel data analysis using the dataset from high-income countries. Only a few studies were conducted in ASEAN (Punzi, 2020), where the inequality problem is severe. Hence, an analysis of the distribution effects of monetary policy in this study could provide crucial implications in the literature.

3. Econometric methodology and data

3.1 VAR Specification

The Vector Autoregressive (VAR) model is frequently applied to explore dynamics among key macroeconomics and financial market variables.

In monetary literature, since the pioneer works of Bernanke and Blinder (1992) and Sims (1992) have been published, a large body of work has sought to identify and analyze the impacts of monetary policy innovations on macroeconomic variables using Vector Autoregression (VAR) approaches. This makes VAR widely applied to draw out the dynamic impact of monetary policy innovations on the economy, commercial forecasting, risk and volatility modeling, and scenario forecasting (Bernanke et al., 2005).

VAR is one of the multivariate models specifically designed to assess the linear correlation and dependency between several macroeconomic variables. VAR provides advantages to time series analysis as it can effectively handle the macro data that are often self-correlated by the value of its historical lag and trends. It allows the system of equations to be estimated simultaneously based on the optimal lag and allows researchers to illustrate the Impulse Response Function (IRF) graphically. Therefore, the VAR model is suitable for determining the interaction among key economic variables based on the optimal lag.

In this study, the distributional effect will be traced over six steps. First, we assume the policy shock can be observed based on arbitrary lagged economic variables and could reasonably be assumed to be independent of contemporaneous economic disturbance (Bernanke & Blinder, 1992). As in Bernanke and Blinder (1992), the economy is represented by a general structural model:

$$Y_t = B_0 Y_t + B_1 Y_{t-1} + C_0 P_t + C_1 P_{t-1} + u_t \quad (8)$$

$$P_t = D_0 Y_t + D_1 Y_{t-1} + G P_{t-1} + v_t \quad (9)$$

Where a vector of nonpolicy variables is represented by vector Y, P is a vector of policy variables, and u and v are orthogonal disturbances. It was assumed there was no feedback from the economy to policy action during the period. Then, if $D_0 = 0$, there is assumed to be no Y_t inequation (9). We can transform this system to a standard vector autoregression (VAR) by replacing (9) with (8) to get:

$$P_t = D_1 Y_{t-1} + G P_{t-1} + \nu_t \tag{10}$$

$$Y_t = (I - B_0)^{-1} + [(B_1 + C_0 D_1) Y_{t-1} + (C_0 G + C_1) P_{t-1} + u_t + C_0 \nu_t] \tag{11}$$

The impulse response function of Y to past fluctuations in v in the VAR with (10) and (11) may be used to identify the impacts of policy innovations on nonpolicy variables in this scenario. Another hypothesis is to assume that contemporaneous P does not go through equation (8), which implies that $C_0 = 0$. Thus, policy factors influence real variables only with a lag (Bernanke & Blinder, 1992). Therefore, the standard VAR has P last in the ordering is expressed as:

$$Y_t = (I - B_0)^{-1} [B_1 Y_{t-1} + C_1 P_{t-1} + u_t] \tag{10'}$$

$$P_t = (D_1 + D_0 (I - B_0)^{-1} B_1) Y_{t-1} + (G + D_0 (I - B_0)^{-1} C_1) P_{t-1} + \nu_t + D_0 (I - B_0)^{-1} u_t] \tag{11'}$$

Hence, v_t is still a policy innovation, but P_t is now affected by contemporaneous macroeconomic shocks u_t. The external shocks, such as socio-economic factors, demographic, household preferences, education, labor productivity, technology, government consumption, transfer to retirees, interest payments on government debt, and behavior of the foreign sector as advocated by Meh et al. (2010) are controlled as exogenous. Despite a plethora of theoretical and empirical research, economic theory remains incapable of providing a comprehensive and accurate definition of all variables influencing income disparity (Onafowora & Owoye, 2017). We avoid the omitted-variable bias (OVB) by ensuring the model specification is carefully set up based on empirical frameworks and assuming the irrelevant shock is presented through the lag or kept in the error term. Econometrically speaking, based on the above system, we can now perform an empirical model for this study in the following reduced form:

$$y_t = \sum_{j=1}^{p} A y_{t-j} + \mu_t \tag{12}$$

$$\begin{bmatrix} y_{1,t} \\ y_{2,t} \\ y_{3,t} \end{bmatrix} = \sum \begin{bmatrix} \alpha_{1j} & \gamma_{1j} & \beta_{1j} \\ \alpha_{2j} & \gamma 2j & \beta_{2j} \\ \alpha_{3j} & \gamma_{3j} & \beta_{3j} \end{bmatrix} \begin{bmatrix} y_{1,t-1} \\ y_{2,t-1} \\ y_{3,t-1} \end{bmatrix} + \begin{bmatrix} \mu_{1,t} \\ \mu_{2,t} \\ \mu_{3,t} \end{bmatrix} \quad (13)$$

Where y_t is a vector of the dependent variables. In our case, dependent variables consist of 1) income inequality proxies, represented by Income Gini, Income share of top1, Income share of bottom50; 2) monetary policy instrument and targeted variables represented by policy interest rate, consumer price index, and GDP growth; 3) educational attainment included as an exogeneous variable to control for effect of socio-economic factors. y_{t-j} represents the matrix of lagged variables, is a matrix of coefficients, and μ_t is a matrix of white noise error.

Second, Sims (1992) suggested that variable y_t should be stationary, and the residuals are mutually uncorrelated to compile with a stationary assumption and to prevent spurious results. Thus, we need to ensure that a time series is statistically stationary remaining steady across time, e.g., mean, variance, and autocorrelation. The stationary process ensures that our data is not associated with random walk problems. Preparing for the VAR estimation, we tested the unit root and the test for cointegration. The unit root tests were based on the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) to test the stationary and level of integration to prevent spurious results and price puzzle difficulty.

Third, before VAR estimation, it is critical to determine the optimal lag length. The three main criteria for determining the optimum lag length for VAR estimation are the Likelihood Ratio Test (LR), Akaike Information Criterion (AIC), and Bayesian (Schwartz) Information Criterion. Fourth, we constructed an impulse response function (IRF) to investigate the dynamic responsiveness of the income inequality to one standard deviation shock in monetary policy innovation based on the Cholesky composition method. Fifth, we constructed a Variance Decomposition (VD) to break down the forecast error variance for a specific time horizon based on the Cholesky composition method. The advantage of VD is that it can reveal which factors have

short- and long-term effects on a secondary variable. Essentially, variance decomposition may inform a researcher how much of a time series' volatility can be attributed to other variables at a selected time horizon. Lastly, we interpreted the distributional effect of monetary policy shock on income inequality.

3.2 ARDL Specification

According to long-run Romer's procedure, it is assumed that income inequality (Y_{it}) arises from monetary policy shock (X_{it}) through the deviation of GDP, interest rate, and inflation, where the irrelevant external shocks are controlled in the lag period and residuals. Then, we set up the nexus between income inequality and conventional monetary policy tools in accordance to this procedure as:

$$Y_{it} = \alpha_{it} + \beta_{it} X_{it} + \varepsilon_{it} \tag{14}$$

In this study, we apply the ARDL bound testing proposed by Pesaran et al. (2001) to check for cointegration between variables. This method is based on estimating the Autoregressive Distributed Lag (ARDL) model without the consideration of the level of stationary. The equation is presented as the following expression:

$$Y_{it} = \alpha_{it} + \sum_{i=1}^{k} \delta_{ij} \left(Y_j\right)_{t-i} + \sum_{i=0}^{q} \beta_{it} \left(X_j\right)_{t-i} + \varepsilon_{it} \tag{15}$$

Empirically, we set up the empirical model by following the transmission of monetary policy to inequality based on three channels (inflation, interest rate income, and income composition channel) as pioneered by Kuznetz (1955), Romer & Romer (1998), and recent empirical studies (Auclert, 2019; Bernanke, 2015; Jongwook, 2021; Meade, 1964) as the following:

$$lnIGN_{it} = c + \theta_1 lnIGN_{j,t-1} + \theta_2 lnRP_{j,t-1} + \theta_3 lnCPI_{j,t-1} + \theta_4 lnGDP_{j,t-1} + \sum_{i=1}^{k} \alpha_{ij} lnIGN_{i,t-i} + \sum_{i=0}^{k} \beta_{ij} \Delta lnPR_{j,t-i} + \sum_{i=0}^{p} \gamma_{ij} lnCPI_{j,t-i} + \sum_{i=0}^{p} \delta_{ij} lnGDP_{j,t-i} + \varepsilon_{jt} \tag{16}$$

When the cointegration relationship is found, the ARDL equation can be rewritten in term of the error-correlation model to display the long-term relationship and short-run dynamic between variables. The equation is expressed as follows:

$$\Delta lnIGN_{it} = c + \theta_1 lnIGN_{j,t-1} + \theta_2 lnRP_{j,t-1} + \theta_3 lnCPI_{j,t-1} + \theta_4 lnGDP_{j,t-1} + \sum_{i=1}^{k} \alpha_{ij} \Delta lnIGN_{i,t-i} + \sum_{i=0}^{k} \beta_{ij} \Delta lnPR_{j,t-i} + \sum_{i=0}^{p} \gamma_{ij} \Delta lnCPI_{j,t-i} + \sum_{i=0}^{p} \delta_{ij} \Delta lnGDP_{j,t-i} + \varepsilon_{jt} \quad (17)$$

Where *IGN* is income Gini, *PR* is the policy interest rate, and *GDP* is the gross domestic product. The final step is to conclude the cointegration. To do so, we estimated equation 17 to obtain the F statistics and identify if cointegration exists by comparing it with the critical value from Narayan (2005) in case 3: unrestricted intercepts with no trends as it suits better with a small number of observations.

3.3 Data

Thailand's annual data during 1980-2021, as seen in Table 2, were collected from various sources. For monetary policy proxy, we used the conventional monetary policy variables, i.e., policy interest rates, inflation, and GDP, from the International Monetary Fund (IMF) and World Bank as they are widely used to represent monetary policy. For income inequality, data were collected and compiled by the World Inequality Database (WID), where income refers to the sum of all pre-tax personal income flows accruing to the owners of the production factors, labor, and capital, before considering the operation of the tax/transfer system, but after considering the operation of the pension system. The income shares of the top 1% represent the total income shares of the rich, while the bottom 50% represent the income shares of the poor. Lastly, the inequality was measured by the Gini of personal income. The Gini coefficient of personal income is widely used to represent income inequality. It ranges from 0 (perfect equality) to 1 (perfect inequality)—the more Gini coefficient, the more serious the income inequality problem. To

control the effect of socio-economic, educational attainment as a percentage of people aged 15 and above for male and female is employed here.

Table 2. List of time-series data of Thailand from 1980-2021

Variable		Unit	Sample	Source
Monetary Policy Instruments				
1. Policy Interest Rate	PR	%	1980-2021	IMF
2. Consumer Price Index	CPI	2010=100	1980-2021	Word Bank
3. Gross Domestic Product	GDP	%	1980-2021	World Bank
Income Inequality				
1. Pre-tax national income: Bottom 50% share	IBT50	Share	1980-2021	WID
2. Pre-tax national income: Top 1% share	IT1	Share	1980-2021	WID
3. Gini coefficient of personal income	IGN	Perfect equality (0) to perfect inequality (1)	1980-2021	WID
Dummy and Controlled variables				
1. Dummy: Post-financial crisis	D1	1=1997-2021	1980-2021	
2. Educational Attainment: Literacy Rate	EDU	% of people aged 15 and above	1980-2021	Word Bank

Note: The policy interest rate prior to 2000 is the discount rate retrieved from the IMF. Dummy variables represent the structural break and exchange rate regime switching during the Tom-Yum-Kung financial crisis in 1997.

4. Findings

The first part of the results focuses on the short-run response of inequality to the monetary policy shock, which is shown by the conventional VAR, IRF, and VD in the first difference form. The second portion concentrates on the long-run cointegration between monetary policy and income inequality which is shown by the non-stationarity and the ARDL bound technique.

4.1 Short-run Response of Monetary Policy on Income Inequality in Thailand

To prevent spurious regression and price puzzle difficulties, we guarantee that our data, based on its level form and first different level, pass the stationary assumption before using the VAR technique (Bernanke et al., 2005). We found that IGN, IT1, IBT50, GDP, CPI, and PR contain the unit root but are cointegrated. As a result, we take the first differentiation on these variables and test for the unit root again based on the ADF and Phillips-Perron unit root test. Results in Table 3 show that all non-stationary variables become stationary at the first difference level, which is appropriate for the model.

Table 3. Test of unit root

Variables	Level	ADF Statistic		Phillips-Perron	
		without trend	with trend	without trend	with trend
Income Gini	Level	-0.081[2]	-2.073[2]	0.399<9}	-2.149<4}
		(0.945)	(0.544)	(0.981)	(0.50)
Income Gini	First diff.	-3.534*[1]	-10.61***[0]	-10.12***<0}	-10.18**<*3}
		(0.012)	(0.000)	(0.000)	(0.000)
Income of top 1%	Level	-0.376[0]	-2.099[0]	-0.142<1}	-2.099<0}
		(0.904)	(0.531)	(0.937)	(0.531)
Income of top 1%	First diff.	-7.683***[0]	-7.929***[0]	-7.641***<1}	-7.873***<1}
		(0.000)	(0.000)	(0.000)	(0.000)
Income of bottom 50%	Level	0.713[1]	-1.895[2]	0.473<9}	-2.009<4}
		(0.991)	(0.6382)	(0.984)	(0.579)
Income of bottom 50%	First diff.	-9.559***[0]	-9.914***[0]	-9.171***<2}	-10.414***<5}
		(0.000)	(0.000)	(0.000)	(0.000)
Consumer Price Index	Level	-1.289[0]	-0.279[0]	-1.083<3}	-1.089<3}
		(0.626)	(0.989)	(0.713)	(0.919)
Consumer Price Index	First diff.	-4.619***[0]	-4.617***[0]	-4.742***<3}	-4.750***<3}
		(0.000)	(0.003)	(0.000)	(0.002)
Gross Domestic Product	Level	-0.341[0]	-2.334[0]	-0.360***<1}	-2.340***<0}
		(0.901)	(0.404)	(0.906)	(0.404)

Variables	Level	ADF Statistic		Phillips-Perron	
		without trend	with trend	without trend	with trend
Gross Domestic Product	First diff.	-5.345***[0]	-5.278**[0]	-5.313***<3}	-5.24***<3}
		(0.001)	(0.005)	(0.000)	(0.000)
Policy Interest Rate	Level	-1.483[0]	-3.061[1]	-1.499<3}	-2.501<1}
		(0.537)	(0.129)	(0.524)	(0.326)
Policy Interest Rate	First diff.	-5.34***[0]	-5.334***[0]	-5.282***<4}	-5.273***<5}
	Level	(0.000)	(0.00)	(0.000)	(0.000)

Note: a) The number in [square brackets] is the optimal lag length determined by Schwartz information criterion (SIC) with the maximum lag of 9. b) The number in <curly brackets} is the optimal bandwidth determined by the Newly-West using Bartlett Kernel. C) The number in (parentheses) is the p-value provided by MacKinnon (1996). d) *, **, and *** denote 10, 5, and 1 percent significance levels, respectively.

4.1.1 Selection of the Optimum Lag

As the model assumed, the policy shock can be observed based on an arbitrary lagged economic variable. We use the Lag Length Criteria to trace the optimal lag by comparing the statistics of LR, FPE, AIC, SC, and HQ. Due to our small sample size, a VAR model with n variables and a lag of p necessitates the estimation of $(n \times p) + n$ parameters; the inclusion of more lags or variables will reduce the remaining degree of freedom. Thus, our maximum lag before testing is limited to lag 4. According to Table 4, the majority rule suggests the lag of 4 to be the optimum lag for the estimation (as most lag length criteria suggested the lowest AIC, FPE, and HQ). Therefore, we proceeded to the estimation of the VAR (4) to trace the response of income inequality to the expansionary monetary policy shock.

Table 4. Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	446.1187	NA	1.88e-18	-23.79020	-23.52897*	-23.69810
1	491.4606	73.52744	1.16e-18	-24.29517	-22.46656	-23.65050
2	518.2031	34.69295	2.25e-18	-23.79476	-20.39877	-22.59752
3	573.2061	53.51644*	1.28e-18	-24.82195	-19.85858	-23.07213
4	648.4515	48.80783	**4.59e-19***	**-26.94332***	-20.41257	**-24.64093***

Note: * Indicates lag order selected by the criterion; LR: sequentially modified LR test statistic (each test at the 5% level); FPE: final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

4.1.2 Stability Diagnosis

We applied the Chow breakpoint test (Lütkepohl, 1991) to check the existence of the structural break during the Tom-Yum-Kung financial crisis in 1997. To do so, we estimate baseline VAR with ordinary least squares based on a sample from 1980-2021. Then, the breakpoint test is applied to 1997. The estimated F-statistics (2.240217, p=0.0664) show that we are unable to reject the null hypothesis of no breaks at the specified breakpoints at 1% and 5% levels of significance. Thus, we persisted and applied our model to 1980-2021. In addition, to ensure that our VAR model for income inequality and impulse response standards error was stable and valid, we plotted the Inverse Roots of AR Characteristic Polynomial to observe if it lies inside or lower than one. The results (presented in Figure A.2) report that all roots have a modulus of less than one and lie inside the circle. Thus, we ensure that our estimated vector autoregressive model is dynamically stable.

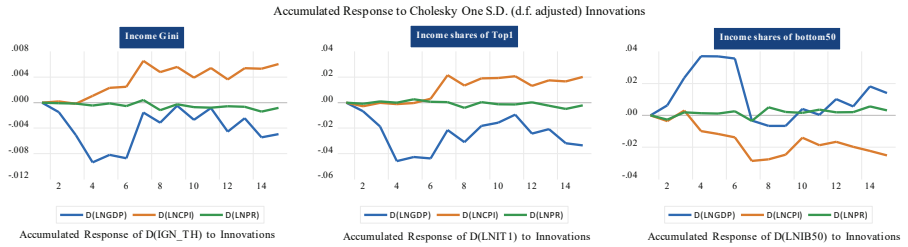
4.1.3 Short Term Response of income inequality to the monetary policy shock

For simplicity, we developed the accumulated impulse response function (IRF) after estimating VAR (4) to observe the dynamic impact of the system of endogenous variables (income Gini, income share by top 1%, and income share by bottom 50%) in response to the one standard deviation change

resulting from an expansionary monetary policy shock based on the Cholesky composition method. The impact of socio-economic factors as exogenous factors was found insignificant. Results in Figure 2 depict the comparative responsiveness of income Gini, income share of the top1, and income share of the bottom50 to the shock arising from expansionary monetary policy shock. We compartmentalized the policy shock by relying on three channels including income, inflation, and the interest rate channel, respectively.

According to Figure 2, (i) the income Gini (left panel) responds to the changes in GDP negatively in all periods while it positively responds to inflation after period 3 onward. The responsiveness is less observable in the case of interest rates channels. (ii) The income shares of the top1 (middle panel) show a similar pattern to the income Gini. It responds positively to the change in inflation after period 5 onward, reacts negatively to the change in GDP, and is irresponsive to the change arising from interest rates. (iii) The income shares of the bottom50 show different results. It responds positively to the GDP growth up to period 2 before dying out in period 7 onward, reacts negatively to the change in inflation, and is irresponsive to the change arising from interest rate. Even though the response is quite small to observe, inflation appears to be the most responsive channel in relation to the income and interest rates channels in all periods.

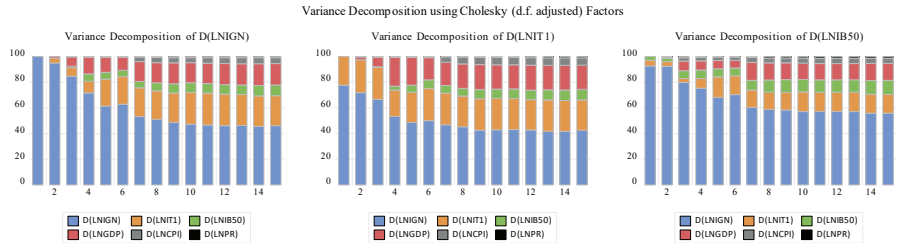
Figure 2. The impulse response function of income inequality in response to policy innovation



Note: The time interval on the x-axis is the year; units on the y-axis are in percentage points. The blue line indicates income channel, the orange line indicates the inflation channel, and the green line indicates the interest rate channel. The estimation includes dummy: post-financial crisis, and controlled variable: literacy rate. The controlled variable is found to be insignificant.

Additionally, Variance Decomposition (VD) was constructed to crosscheck the result of IRF and explore the breakdown of the forecast error variance on the income Gini, the income shares of the top 1%, and the income share of the bottom 50%. It shows how much of a time series' volatility may be related to other external shocks over a certain length of time, as compared to the IRF. Figure 3 reveals VD for income Gini, the income share of the top1, and the bottom50 of Thailand, respectively. It depicts the contributions of each shock as a percentage of the total area at any given time. In the VD of income Gini, in the initial period, approximately 90% of the variation of LNIGN arises from the shock to LNIGN itself and most of the remaining 10% is from the shock of income share of the top1 and the GDP growth, while the inflation and interest rate appear to be less than 10% in all periods. The system becomes dynamically stable after 8 periods for all VD. A similar pattern is found in the case of VD for LNIT1 and LNIT50.

Figure 3. Variance Decomposition



Note: Y ranges from 0 to 100%. X is the time period (year).

In the short run, both results confirm that the expansionary policy shock produces the largest distributional effects on household through income channel followed by inflation and interest rate channel. Specifically, we found two pieces of evidence analogous to empirical frameworks and support the findings in developed countries (e.g., Meade, 1964; Davies & Shorrocks, 2000; Coibion et al., 2017); Albert & Gómez-Fernández, 2021; Albert et al., 2020), which are evident from inflation and interest channel.

(i) Inflation channel – the expansionary policy that results in higher inflation and widens the income gap as it increases income share of the top1 while lowering income share of the bottom50. The simple intuition is that when inflation rises because of a loose monetary policy, nominal borrowers profit as the real value of loans becomes smaller. Meanwhile, nominal creditors would be worse off as the amount of return money is devalued by higher inflation. For example, rich households with relatively larger mortgage loans will benefit, while those poor who rent apartments would suffer. This finding supports the framework of Auclert (2019), Jongwook (2021), and Meade (1964) that inflation is bad for the poor and results in higher income inequality.

(ii) Net interest rate income channel – the expansionary monetary policy hardly affects the inequality through the interest rate channel as the response is quite small to observe. Expansionary monetary shock tends to increase income Gini in the first 3 periods, but notably less than 5%. In this

period, expansionary monetary policy, which results in a lower interest rate, hurts the depositors (poor households) who save their money in deposit accounts. In contrast, this effect indirectly lowers interest rate payments of the rich households. The response of the top1 and the bottom50 to changes in interest rate was observed to be less than 5% over all periods.

(iii) income channel – this result *contradicts* the framework and findings in developed countries. It is found that expansionary would increase income inequality. As in Voinea et al. (2017) and Punzi (2020), wealthier families, for example, tend to receive greater business income, whereas the poorer families receive a smaller amount of labor wage. Therefore, expansionary monetary policy that leads to higher GDP growth possibly benefits business incomes of the rich more than the wage income of the poor. In the case of Thailand, we found that, surprisingly, the poor seem to positively respond to the expansionary monetary shocks, while the richest 1% react negatively, particularly during the first 4 periods. The positive response pattern supports the finding results from the microdata in Tapasanan and Ronaparp (2020) and Warr (2004). They explained that economic growth, sectoral economic growth such as agricultural and industrial sector growth, and association with international trade and investment correlated to poverty reduction and improved the condition of the poor in Thailand. Nevertheless, we observe the saddle jump in income inequality during period 6-1. The results clearly show that income Gini increases rapidly after 6 periods, the income shares of the rich rise, and the income share of bottom50 declines.

4.2 Long Run Cointegration of Monetary Policy and Income Inequality in Thailand

After evaluating how and how much inequality responds to monetary policy shock in the short run, the next question is whether it has a long-term distributional effect. To answer this question, we created ARDL bond testing to establish and confirm the long-term connection between the two proxies.

The findings of ARDL double-confirmed that cointegration exists in the long term. As shown in Table 5, the F-statistic (F=5.354) is above the top bound of Narayan (2005) critical bounds at a 5% significant level. We compared our F-statistics to Narayan (2005) case 3 unrestricted intercept and no trend as it is applicable for a small number of observations. Additionally, to confirm the existence of long-run cointegration, we also progressed to the Wald-coefficient restriction test with the hypothesis testing restriction as C(2)=C(3)=C(4)=C(5)=0. We found that the F-statistics (F=39.798) was greater than the upper bound of Peraran (2001) and Narayan (2005) at a 10% significant level (4.04- 4.78 and 2.96- 4.10). We then concluded that the long-run cointegration between monetary policy and income inequality in Thailand is significant. Additionally, to avoid omitted variables bias and endogeneity problems, we constructed the long-run equation for Thailand based on the Romer's procedure by focusing on the monetary policy tools only. The other irrelevant shocks may be captured in the residuals and lag of endogenous variable.

Table 5. Results of ARDL Test for long-run Cointegration and cointegrating equation

LNIGN = 0.1227INCPI - 0.1774LNGDP - 0.0314LNPR + ε_{it}			
	(1.470)	(-2.617)*	(-1.586)
Computed **F = 5.354,** χ^2 (4) = 0.283 (p=0.076)			

Note: a) The number in parenthesis is t-statistics. b) *, **, and *** denote 10, 5, and 1 percent significance levels, respectively. c) LM is statistics for testing no residual serial correlation against orders 4. Our model was robust as the Breusch-Godfrey Serial Correlation LM Test indicates no serial correlation problem since the p-value is greater than 0.05. The F-statistic is compared to the 5% critical values based on Narayan (2005). The lower and upper bound are 3.62 and 4.91, respectively.

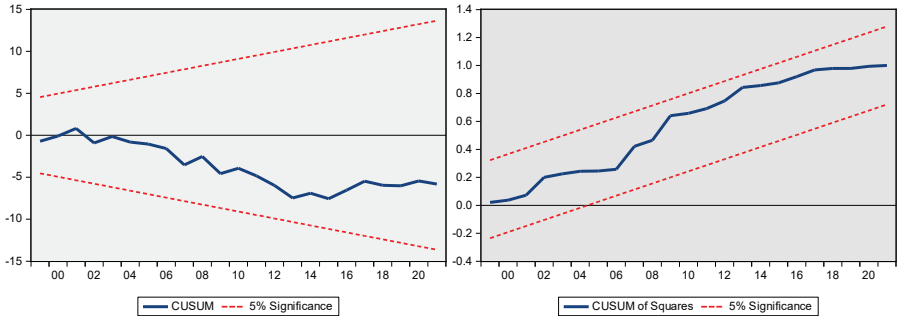
As presented in Table 5, inequality is statistically affected by GDP growth (LNGDP) only (at a 10% significance level). Both inflation rate (LNCPI) and monetary policy rate (LNPR), however, do not impact LNIGN at a 5% sig-

nificance level. The long-run results show that inflation led to higher inequality, GDP growth led to lower equality, and lower interest rates made higher inequality. Economic growth (LNGDP) reduces income disparity (LNGNI) over time for two reasons. First, it allows the poor to catch up to the affluent. This is because economic growth helps company owners reinvest their profits by producing more and paying greater wages. Second, low-income people benefit from business expansion by gaining excess earnings, which allows them to invest that amount in financial assets. This result contradicted Romer and Romer (1988) which showed negative cointegration. It is, however, in line with Kuznetz (1955) which shows that higher growth leads to better equality in the long run. According to our ARDL estimation, we can confirm a long-run cointegration between policy interest rate, inflation, and economic growth to income inequality in the cases of Thailand. We found that economic growth can lower inequality significantly while higher inflation and lower interest rates widen the income gap in the long run.

4.2.1 Parameter Stability Diagnosis

To ensure the stability of the long-run parameters of our ARDL model, the recursive estimation of CUSUM and CUSUMSQR tests were applied in the error-correction equations. The stability diagnosis result displayed in Figure 4 appears evident that our model presents no sign of instability and structural break as the static remains within the boundaries of 5% significance. This result confirmed that the long-run coefficient of the ARDL model is correctly specified and free of structural break and dynamic instability during the period of study.

Figure 4**:** Recursive Estimation of CUSUM and CUSUM of Squares



5. Conclusion

This study applied time-series econometric models to map out the distributional effects of monetary policy on income inequality in Thailand during 1980-2021. We raised awareness and showed why the central bank should get involved in inequality. This is because relying on only fiscal policy might not be fully efficient when combatting distribution issues. The monetary policy was also found to involve several market interactions, and it created a significant distributional effect on household income and inequality in both the short and long run. Therefore, a better policy to promote equality requires the cooperation of all economic authorities, including the central bank. We also questioned the short-term consequences of expansionary monetary policy on income distribution and the long-term link, which has received less attention among recent studies in Thailand and developing nations. Our main goals were to provide more detailed empirical evidence on monetary policy and inequality literature and enhance the stage of knowledge on the nexus between monetary policy and inequality. Our methodology is straightforward, with no sophisticated models or fancy methodologies to contribute to readers. However, we tried our best to ensure that our time-series models passed the fundamental diagnostic tests and that our model was robust and compatible with other research worldwide.

The findings draw two important conclusions, the first being the short-run response of income inequality to expansionary monetary policy shock. We found that the expansionary policy shock produces the largest distributional effects on household through income channel, followed by inflation and interest rate channel in the short run. We also discovered that the poor positively respond to GDP growth. However, stronger inflation appears to widen the income gap significantly in the later period as it benefits the rich more than the bottom half. The impulse response through interest rate channel appears to make less impact on income Gini, income shares of the richest 1%, and the bottom 50%. Second, we found that Thailand's monetary policy exhibits "a long-term effect", which could result in a significant increase in the income gap through inflation. Our long-run finding shows that inflation is bad for inequality, while long-term economic growth cointegrated with the inequality reduction significantly. This finding is inconsistent with Romer and Romer (1998) but supports the U-curve hypothesis of Kuznetz (1955) that economic growth could lower inequality in the long run.

The central bank should not overlook income inequality, and optimal monetary policy should consider distributional issues (IMF, 2020). Monetary policy that aims at lower inflation and stable aggregate demand is most likely to permanently improve the condition of the poor (Romer & Romer, 1998). Using monetary policy to stimulate growth has its price to pay as inflation widens the income gap in both the short and long run. While using monetary policy to stimulate short-run economic growth, the central bank should signal its policy effect to fiscal policy designers so that there will be room for compensation to subsidize those the monetary policy has impacted.

One study may not change the whole world, but this study is one among hundreds of empirical studies aimed at expanding the monetary literature and raising awareness for the central bank on its policy effect on inequality. We disagree that income distribution is only up to fiscal policy and politics, but rather the duty of the central bank should be to address income distribution.

Monetary policy produces policy effects on inequality in some ways. This study does not end up answering who should be responsible for income distribution or what should a central bank do to combat inequality. We conclude that monetary policy does have significant consequences on income inequality in Thailand and that relying on a single fiscal approach may not be fully sufficient. The general suggestion for the central bank is to be open-minded to modern monetary literature, be aware of distributional effects, wear a non-monetary hat (if necessary), and redesign the way of thinking before formulating a policy.

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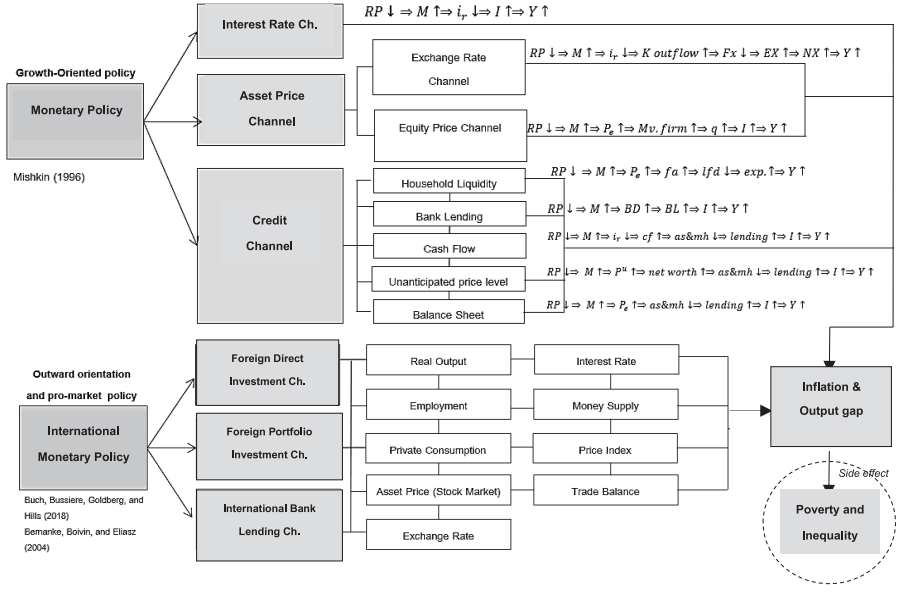
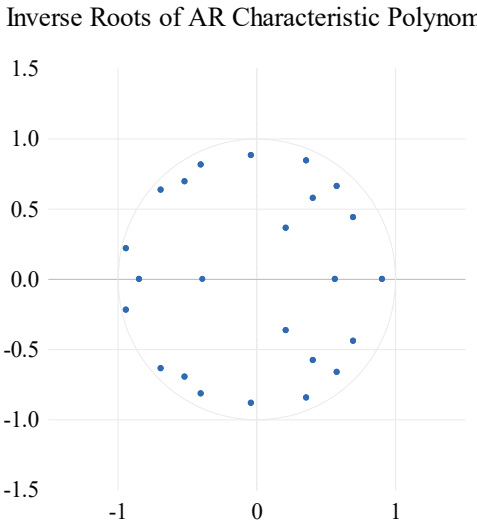
Appendix

Figure A.1: Transmission Mechanism of Monetary Policy



Note: RP = policy interest tate, M = money supply, i = interest rate, I is investment, Y = output, K is capital, Fx = exchange rate, EX = export, NX = net export, BD = bank deposit, BL = bank lending, Mv = market value, Pe = price of equity, fa = financial asset, q = Tobin'q value

Figure A.2: Stability test: Inverse Roots of AR Characteristic Polynomial.



Note: Each eigenvalue is contained within the unit circle. VAR meets the stability requirement.

Source: Author's calculation.