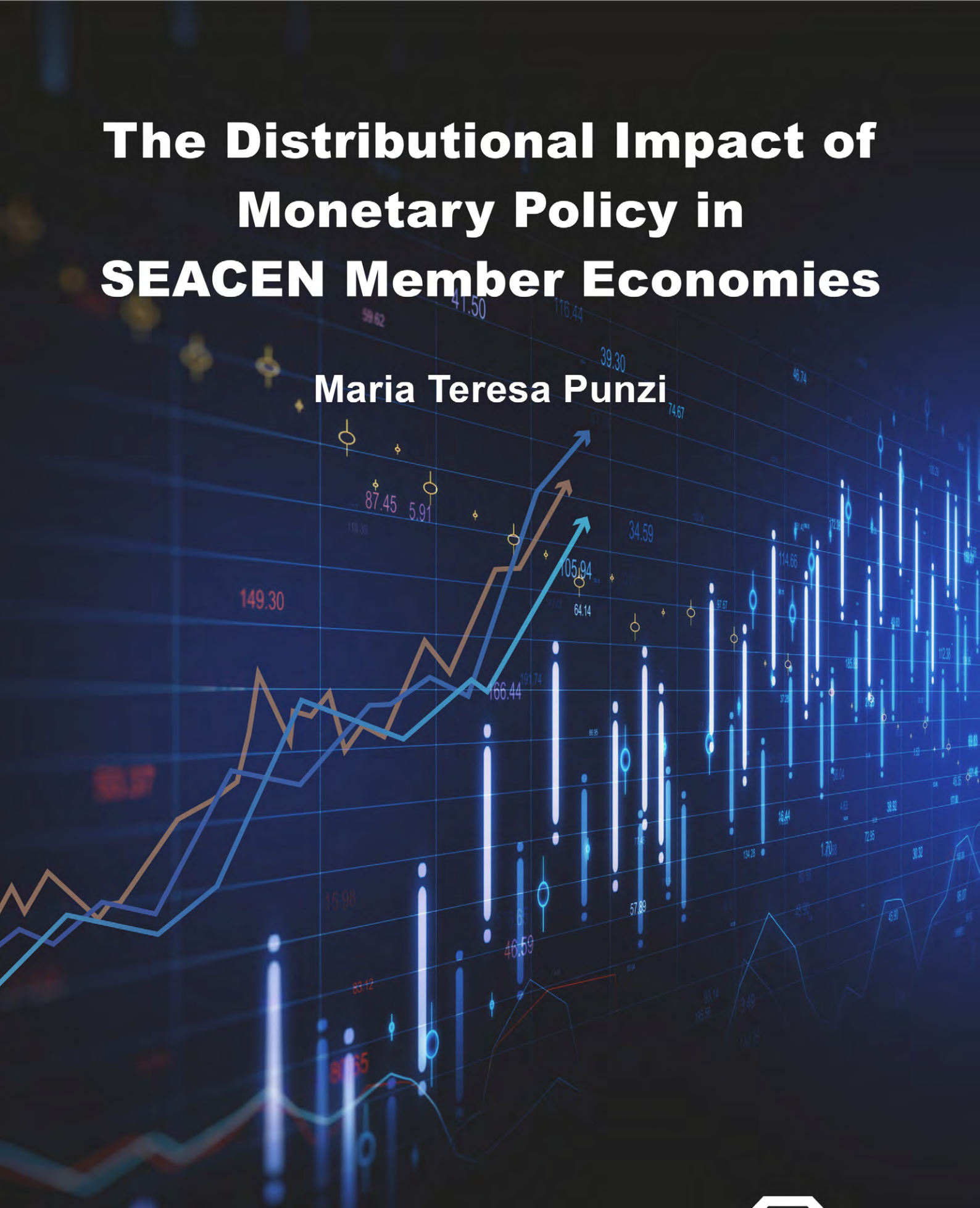
The Distributional Impact of Monetary Policy in SEACEN Member Economies

Maria Teresa Punzi



The South East Asian Central Banks (SEACEN)
Research and Training Centre
(80416-M)

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FOREWORD

The idea that an expansionary monetary policy can exacerbate inequality has become popular again since the global financial crisis. The post-crisis period has been characterized by very low interest rates and persistent low inflation rates. This situation is common to both advanced and emerging economies. The concern about exceptionally low interest rates stands on the fact that they tend to induce soaring equity and real estate prices, thus increasing the income and wealth of savers. Therefore, income and wealth are being redistributed towards the already very wealthy households. However, the impact of monetary policy on income and wealth distribution is rather difficult to disentangle. This study shows that the asset price and inflation channels are the main conduits affecting income and wealth inequality through monetary policy actions.

These results highlight the role of central banks in influencing income and wealth inequality, which hark back to earlier SEACEN research studies. The reason for such a relationship is due to macro-financial linkages, the topic of a SEACEN research study in 2010. The result argues for a more formal adoption of the monetary policy mandate including a financial stability objective in these jurisdictions and if not, for strengthening the role and implementation of macroprudential policies, which we addressed in 2012 and 2018.

As many SEACEN economies are using monetary policy to control inflation, in the principle of inflation targeting as implemented in many advanced economies, it would be important to consider if it would be beneficial to increase the target, or use alternative instruments, as it has been found that the inflation channel is quite important in determining inequality in the SEACEN-8 (Cambodia, India, Mongolia, Philippines, Sri Lanka, Chinese Taipei, Thailand and Vietnam). Further, a booming housing market that follows from an accommodative monetary policy, contributes to higher income and wealth inequality. Thus, the SEACEN-8 should pursue macroprudential policies to lean against the housing boom-bust cycle.

In addition, many SEACEN economies have been implementing measures to slow the increase in household debt and house prices. While macroprudential measures have been used extensively, these tools have had marginal impact in leaning against excess credit and the housing boom. This is due mainly to strong capital inflows and lower interest rates, which render macroprudential tools less effective. Therefore, it is important to balance the short-term benefits with the long-term costs of increasing household debt, and instead adopt a combination of appropriate policies, effective institutional structures, and regulations, as using only macroprudential tools is not sufficient.

This collaborative research project on “The Distributional Impact of Monetary Policy in SEACEN Economies” looks at how central bank policy implementation affects income and wealth distribution, both from a cross-country and a country-specific perspective, and discusses how ultra-low interest and inflation rates influence income distribution.

The project was led by Maria Teresa Punzi, Assistant Professor of Economics at Webster Vienna Private University, Austria, and Visiting Research Economist at The SEACEN Centre in 2019/2020. The project team consisted of representatives from the National Bank of Cambodia; Reserve Bank of India; Bank of Mongolia; Bangko Sentral ng Pilipinas; Central Bank of Sri Lanka; Bank of Thailand; Central Bank, Chinese Taipei and State Bank of Vietnam. SEACEN also wishes to express it sincere gratitude to the participating member central banks for their support.

The assistance of SEACEN staff members, in particular Dr. Ole Rummel and Mrs. Jami'ah Jaffar, is most gratefully acknowledged. SEACEN is pleased to have been able to provide input for the project at a research workshop and seminar held at The SEACEN Centre where the findings of the project were presented and discussed. We would also like to acknowledge the helpful comments and suggestions from Professor Masashige Hamano of Waseda University, Tokyo, on the integrative report prepared by Dr. Punzi. The views expressed in this study are those of the authors and do not necessarily reflect those of The SEACEN Centre or the SEACEN member central banks/monetary authorities.

Dr. Mangal Goswami
Executive Director
The SEACEN Centre
April 2020

EXECUTIVE SUMMARY

During the last 25 years, many advanced economies (AD) as well as several emerging economies (EME), have adopted inflation targeting to control the general rise in the price level, as price stability has been found to be a prerequisite for sustained economic growth as well as full employment. As global inflation rates have been quite low and stable, the distributional impact of income had not garnered much interest. However, new frontiers in research have shown that there could be a strong impact of monetary policy on rising asset prices, contributing to increasing income and wealth of households belonging to the top percentile of income distribution. Thus, the issue of the distributional impact of monetary policy has once again become an important topic to investigate. While several studies have been conducted for advanced economies, the distributional impact of monetary policy on emerging Asian economies is largely unexplored. Thus, this research project aims at investigating how monetary policy contributes to the income and wealth distribution of eight SEACEN economies (SEACEN-8): Cambodia, India, Mongolia, Philippines, Sri Lanka, Chinese Taipei, Thailand and Vietnam.

The findings are summarized as follows:

- the study reveals that an expansionary monetary policy leads to a lower Gini Index, thus favoring lower income inequality for the SEACEN-8;

- the distributional impact of monetary policy works mainly through the asset price channel with the Gini Index decreasing or increasing following lower or higher housing prices;

- the inflation channel is found to be also very important: an expansionary monetary policy tends to decrease the Gini Index during periods when the inflation rate is larger than 2 percent, otherwise it tends to increase for lower inflation;

- during periods of ultra-low interest rates and low inflation, a positive supply shock has limited effects on the GDP as well as limited impact on households' income.

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CHAPTER 1

INTEGRATIVE REPORT: THE DISTRIBUTIONAL IMPACT OF MONETARY POLICY IN SEACEN ECONOMIES

By

Maria Teresa Punzi[1; 2]

1. Introduction

This research project aims at studying the distributional impact of monetary policy on SEACEN economies, with focus on Cambodia, India, Mongolia, Philippines, Sri Lanka, Chinese Taipei, Thailand and Vietnam. The impact of monetary policy on inflation and GDP growth has been extensively investigated, but the distributional impact has been more or less overlooked, until the question of the role of monetary policy in affecting the income and wealth distribution came into the spotlight again in the recent years.

During the last 25 years, many advanced economies (AD), as well as several emerging economies (EME), have adopted inflation targeting to control the general rise in the price level, as price stability has been found to be a prerequisite for sustained economic growth as well as full employment. Indeed, most countries have experienced a stable inflation coupled with low volatility, leading to the era of the Great Moderation. When inflation rates are high, households and companies face difficulties in making financial decisions, as large fluctuations in inflation affect the real value of debt, investments and savings. Under high inflation rates, savers are negatively affected as they receive a lower real value of the assets they hold, and borrowers have a clear advantage given by a lower real debt to repay. As inflation rates around the world have been quite low and stable, the distributional impact has become of lesser interest. However, the new frontiers in research have shown a strong impact of monetary policy on rising asset prices, which contribute to the increasing income and wealth of households belonging to the top of the income distribution. Thus, the question on the distributional impact of monetary policy is again an important topic to investigate.

The idea that an expansionary monetary policy can exacerbate inequality has become popular again since the global financial crisis. The post-crisis period has been characterized by very low interest rates and persistent low inflation rates. This situation is common to both ADs and EMEs countries. The concern about exceptionally low interest rates stands on the fact that they tend to induce soaring equity and real estate prices, thus increasing income and wealth of savers. Therefore, income and wealth are being redistributed towards the already very wealthy households. However, the impact of monetary policy on income and

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2. I would like to thank Ole Jens Rummel, Victor Pontines, Rogelio Mercado, Jami'ah Jaffar and seminar participants at the SEACEN Workshop 2019 for valuable comments. Ali Rasulov provided excellent research assistance. I would also like to thank Jami'ah Jaffar for excellent project managing.

wealth distribution is rather difficult to disentangle. Different transmission channels work contemporaneously. On the one hand, an expansionary monetary policy leads to a gain for households holding equities and other types of assets, as the underlying prices increase. On the other hand, an interest rate cut leads to a reduction in interest payments for borrowers, who are made better off. Conversely, savers are made worse off as they receive lower net interest income. However, income comes from two main sources: wages as remuneration to the labor and profits as a remuneration to capital. An expansionary monetary policy boosts employment and increases wages. Firms also experience larger profits. Finally, monetary policy affects inflation, and thus the real value of nominal debt. High levels of inflation tend to reduce the real value of debt and deposits. Moreover, there are some homogeneous channels, such as aggregate income and substitution channels, that affects income and wealth with the same sign across all households, and heterogenous channels that affect different types of households with a different sign. The substitution effect is concerned about how households respond to unexpected changes in the interest rate in the intertemporally substituting between consumption and saving, while the aggregate income channel implies an increase in households' expenditure and firms' investment stimulating output, employment and wages after a monetary easing. Auclert (AER, 2019) refers to them as the earning heterogeneity channel (related to the labor and profit earnings), Fisher channel (related to changes in price level) and interest rate channel. The last channel is very important as lower real interest rates tend to increase financial asset prices. However, as specified by Auclert (AER, 2019), the winner and loser of asset holdings are defined by the duration and maturity of their assets and liabilities. For example, households holding short-term deposits would have a positive unhedged interest rate exposure, while those who hold long-term bonds or adjustable-rate mortgage liabilities would have a negative unhedged interest rate exposure. Thus, an expansionary monetary policy would distribute wealth from the households with negative interest rate exposure to those with positive exposure.

This research project aims at investigating how monetary policy contributes to the income and wealth disributions of the SEACEN-8: Cambodia, India, Mongolia, Philippines, Sri Lanka, Chinese Taipei, Thailand and Vietnam. However, for various economies, it is difficult to obtain data on income and wealth across the five-quantiles. Thus, most of the research will focus on the Gini Coefficient, which indicates the dispersion of the income inequality, meaning that the Gini Index measures the degree of inequality in the distribution of family income in an economy. The more nearly equal an economy's income distribution, the lower its Gini Index.

In order to understand the distributional impact of monetary policy, this chapter will show results on the responses of the Gini Coefficient based on a Panel VAR estimation. Due to data limitation for the SEACEN-8, this empirical strategy will focus only of income distribution, proxied by the Gini Index. Several experiments are run in order to highlight the distributional impact during the last 10 years, comparing periods of pre-crisis and post-crisis, and showing the different impact in case of expansionary and contractionary monetary policy. Results show that an expansionary monetary policy tends to lower the Gini Index, while an contractionary policy raises it. However, the order of magnitude is quite different, revealing a clear asymmetric effect. Moreover, the inflation channel is very important, as the Gini Index tends to decrease by less when the inflation response to an expansionary monetary policy is weak. Also the response of the Gini Index is less pronounced when the GDP is not expanding much, indicating the importance of the aggregate income channel. Finally, the Panel VAR

analysis shows that the asset price channel is also very important, as the Gini Index response to an expansionary monetary policy has a similar path to the response of asset price, and this is more evident when the model includes housing price.

The chapter also offers an overview of the short-term interest rates and inflation rates in the SEACEN-8. Most of the economies have been experincing ultra low inflation rates, coupled with downward trending policy rates. An interesting question is understanding how monetary policy affects income inequality given the historical low inflation levels. Chinese Taipei and Thailand are two very good example of such a situation. Moreover, these economies have shown a flat policy rate for a prolonged period.

Finally, I develop a dynamic stochastic general equilibrium (DSGE) model for a small economy to show how a technology shock is transmitted to the rest of the economy when the central bank change the policy rate to ensure price stability, in comparison with a situation where the policy rate is very low. Results show that the distributional impact is contained when the policy rate channel is shut down. A VAR model applied to Chinese Taipei shows that the results of the DSGE model are robust, as a temporarily techonology shock tends to decrease income inequality with a lower magnitude when the interest rate channel is not at work.

It is not easy to identify all the transmission channels through which monetary policy affects income distribution. While the Panel VAR analysis can highlight the importance of inflation and asset prices channels, and give directions of the sign of the Gini Index, the DSGE model is more informative in terms of various transmission channels, even if such a model has limitations in identifying all possible channels described in the recent literature.

The chapter is developed as follows. Section 2 describes the recent economic development in the SEACEN-8. Section 3 gives an overview of the transmission channels in the literature review. Session 4 estimates a Panel VAR model to show the impact of monetary policy on the Gini Coefficient. Session 5 delves into the development of a DSGE model for a small open economy to highlight the transmission channels of monetary policy shocks on income and wealth distribution. Session 6 discusses the implications of a monetary policy shock on an environment that accounts for the ultra-low interest rate or zero-lower bound. Session 7 discusses policy implications and concludes.

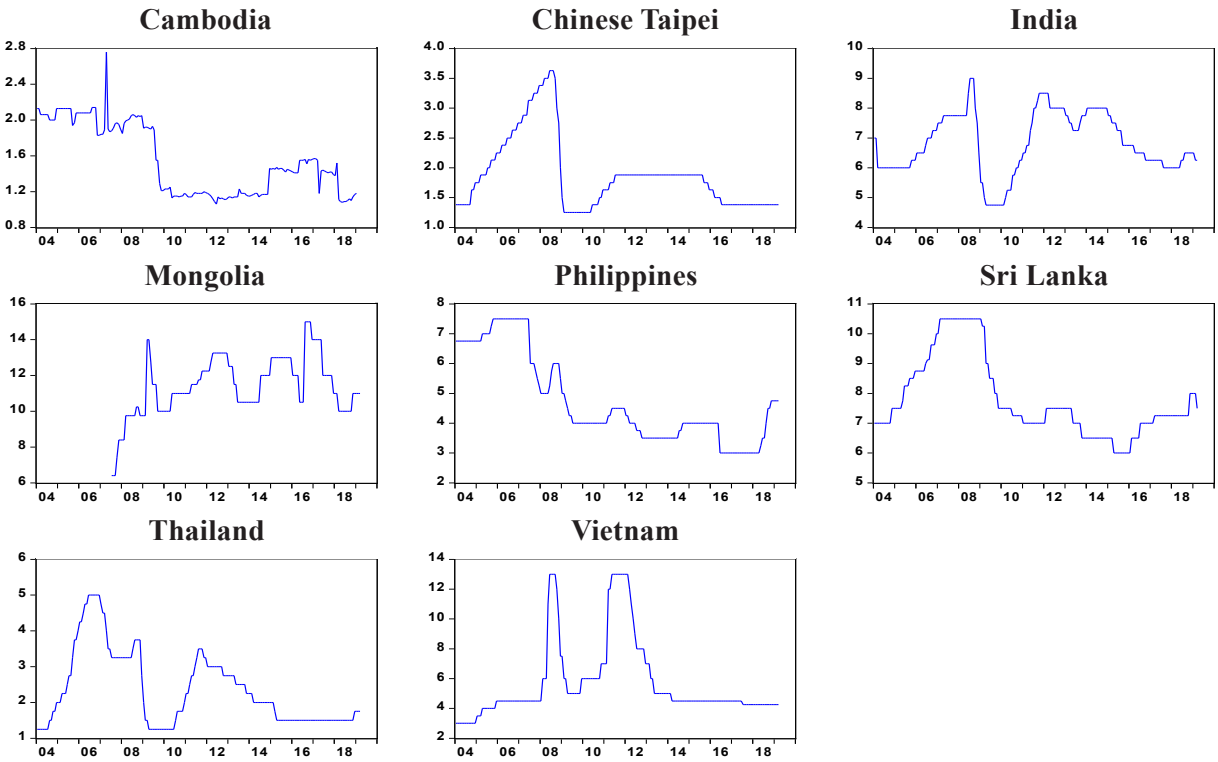
2. Economic Developments in the SEACEN-8

This section offers a brief overview of some fundamentals in the SEACEN-8 of Cambodia, India, Mongolia, Philippines, Sri Lanka, Chinese Taipei, Thailand and Vietnam. Figure 1 shows that the policy rates (i.e. short-term interest rates) have trended down in many SEACEN economies in the recent years, compared to the pre-crisis period. Since 2016, the short-term interest rate has been below its historical level in these economies, except for Mongolia and Sri Lanka, which show higher policy rates in the last 2 years relative to 2016.[3] Moreover, Chinese Taipei, Philippines, Thailand and Vietnam have experienced unchanged policy rates for some prolonged lengths of time during the post-crisis period.

3. In many SEACEN economies, long-term interest rates have declined since 2000, a period in which long-term inflation expectations have been quite stable.

Figure 2 displays five-year moving averages of the growth rate of real per capita GDP for the 8 economies of interest. Since 2010, many economies appear to be growing more slowly over time. However, for some economies there is no clear trend in the growth rate, such as Chinese Taipei, Thailand, Vietnam, and for a few economies, growth seems to be increasing as in India and in the Philippines. Mongolia and Sri Lanka display a downturn only after 2014, thus a clear slowdown in the last 4 years.

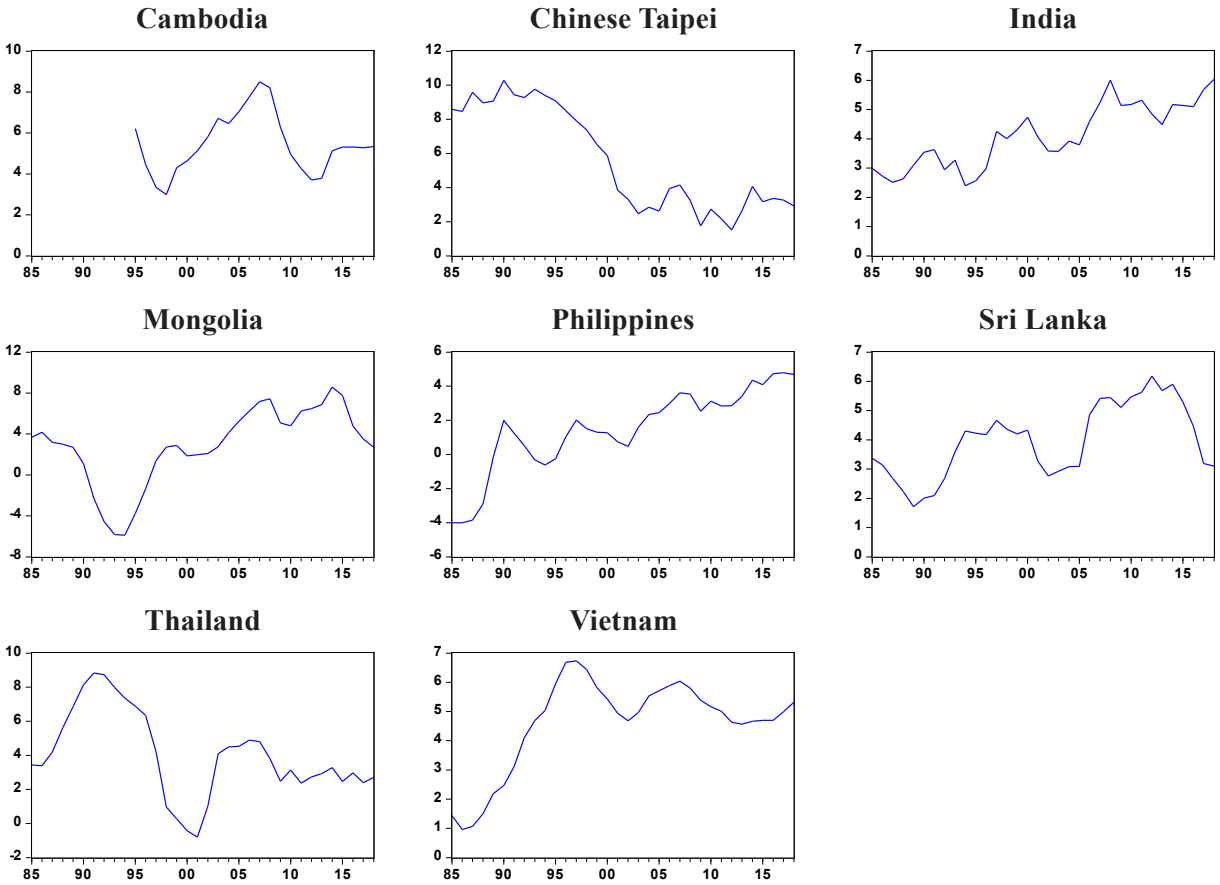
Figure 1
Short-Term Interest Rates



Sources: CEIC Database. Philippines and Thailand: BIS Policy Rate Statistics.

Figure 3 displays inflation rates in the SEACEN-8 economies. In every case, inflation in 2018 was below its historic average, often by a considerable amount. In 2018, inflation was below 5 percent in all the SEACEN-8; below 3 percent in 4 economies; and below 2 percent in 2 economies. In Chinese Taipei and Thailand, inflation was below zero in 2015. In most of the economies with very low inflation rate after 2015 — Cambodia, Chinese Taipei, Thailand, and Vietnam — GDP growth slowed markedly over time. In these economies, there was probably a gap between actual and potential GDP growth at some point either before or when inflation was declining. A key priority for monetary policy in Asia should be keeping inflation from falling persistently below 2 percent and possibly even targeting a rate slightly higher than 2 percent.

Figure 2
Growth Rate of Real per Capita GDP (5-years Moving Average)



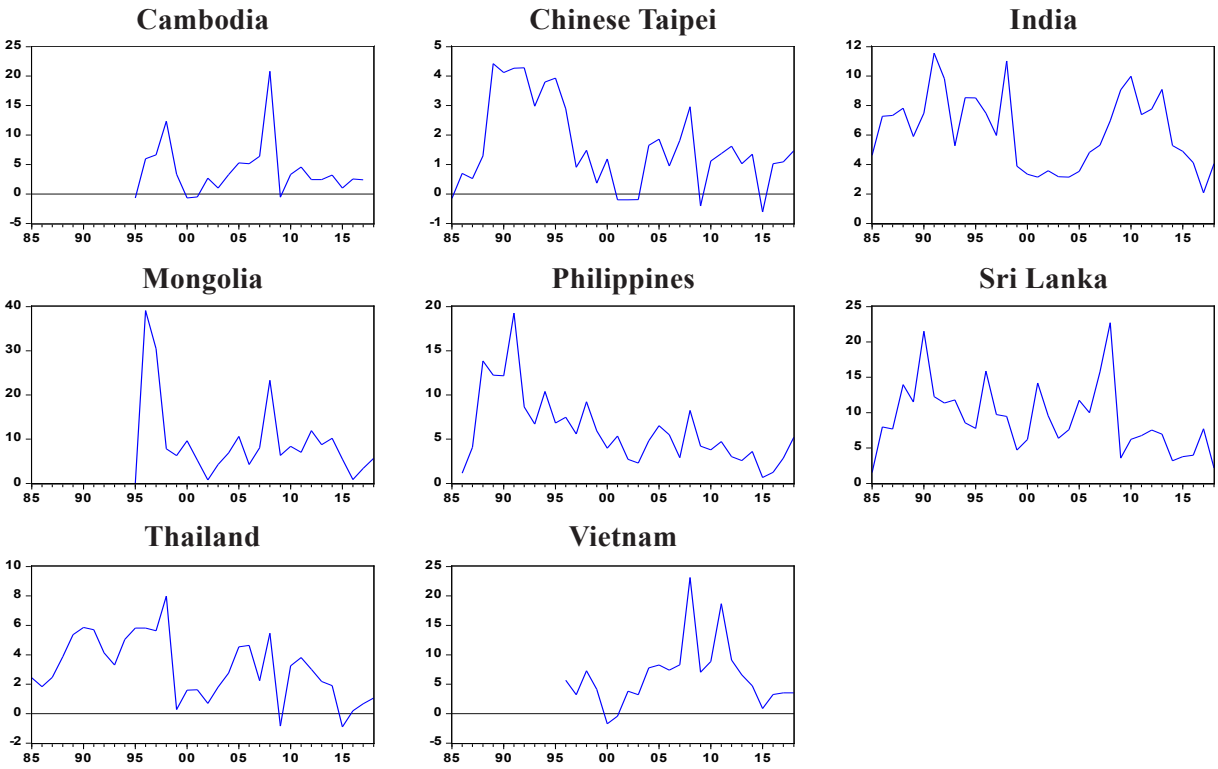
Source: CEIC Database.

In order to gain more insights, the case of Thailand is instructive. Figure 3 shows that Thailand is at risk of falling into sustained deflation. With the policy rate at 1.5 percent, the Bank of Thailand would not be able to deliver the 2-percentage point easing of conventional policy as it did during the global financial crisis. Moreover, the policy seems to be too tight as the core inflation is falling further below target.

Figure 4 describes the path of the nominal exchange rate, expressed as the value of local currency to one US$. All the SEACEN economies show a currency depreciation versus the US dollar over time, except for Thailand. Cambodia, however, has been dollarized for very long time, thus the exchange rate has been flat since the 2000. Chinese Taipei shows a clear depreciation between 1995 and 2000, after that the exchange rate shows periods of alternation between appreciation and depreciation.

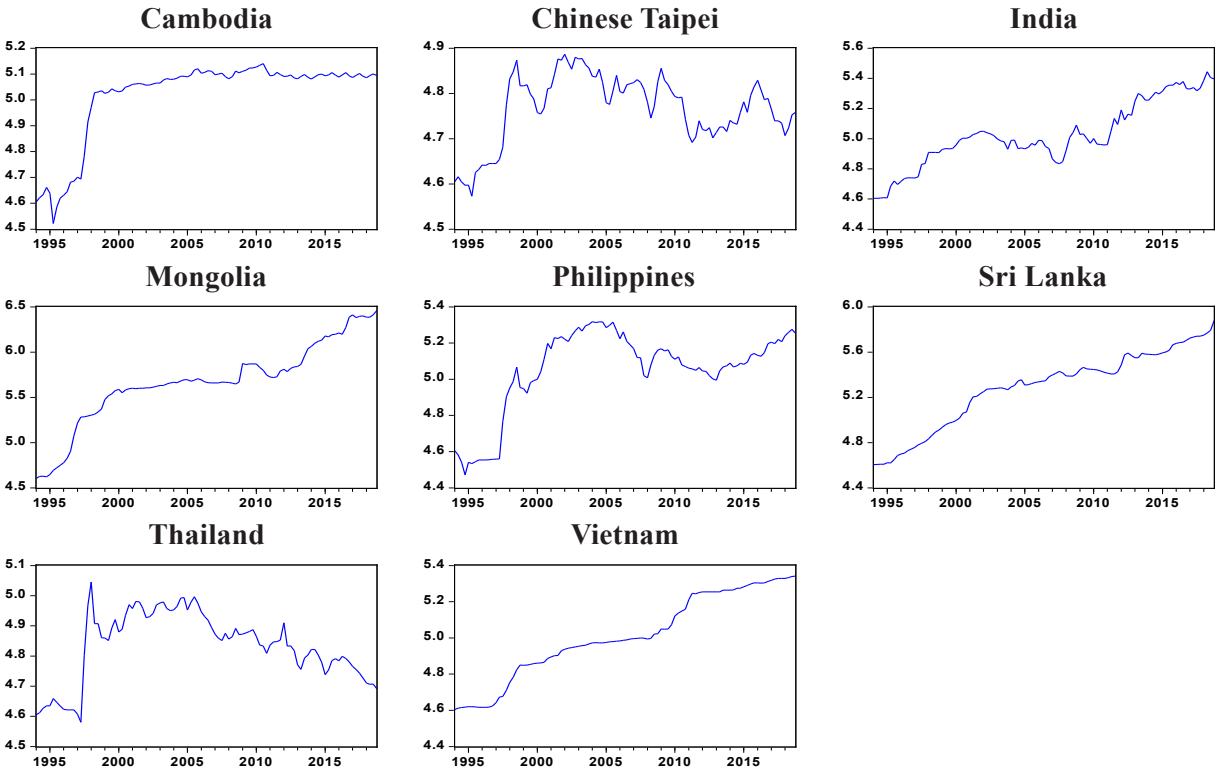
Finally, Figure 5 reports the evolution of the Gini Coefficient, expressed in terms of disposable income, over the period 1975 until 2017. The Gini Index indicates the dispersion of income inequality, meaning that the Gini Index measures the degree of inequality in the distribution of family income in an economy. The more nearly equal an economy's income distribution, the lower its Gini Index.

Figure 3
CPI Inflation Rates (Percent Per Year)



Source: CEIC Database.

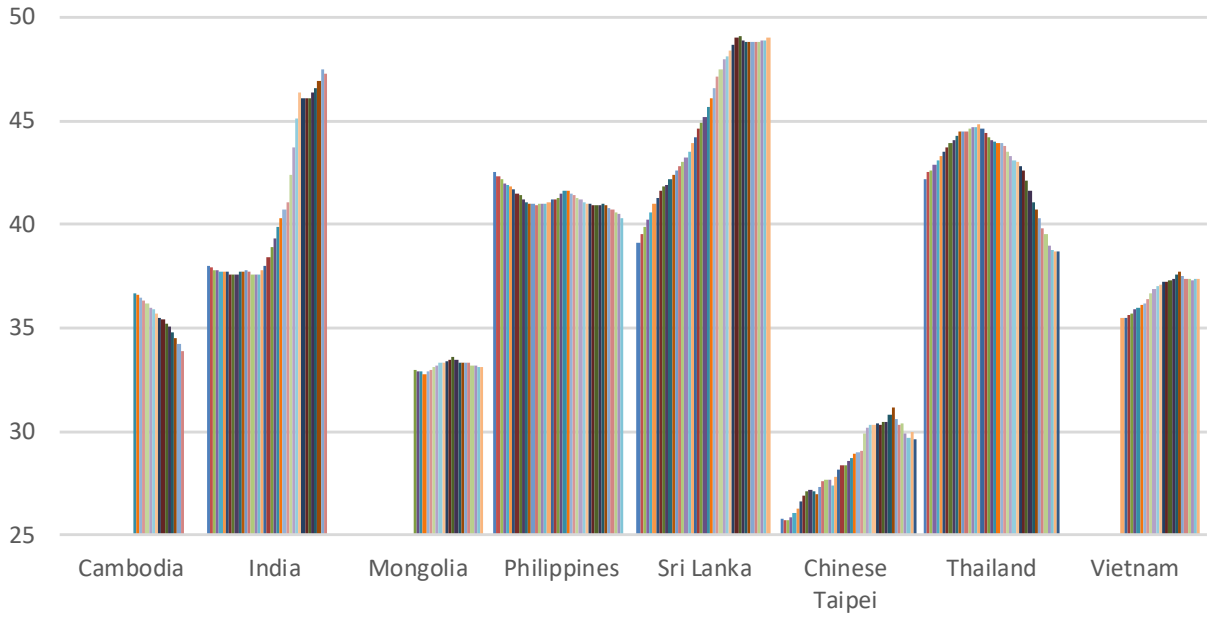
Figure 4
Nominal Exchange Rate (Local Currency to One US$)



Sources: CEIC Database. Data are normalized to 100 in 1994:Q1, and expressed in natural log.

Figure 5 reveals a certain degree of heterogeneity, as many economies show a decreasing trend in the Gini Index, such as Cambodia, the Philippines and Thailand, while an increasing trend in India, Sri Lanka and Vietnam. Chinese Taipei shows an increasing Gini Index until 2010, but after that the Gini Coefficient decreased. Mongolia instead presents a quite stable index. Moreover, India, Philippines, Sri Lanka, Thailand and Vietnam show a very high Gini Index, indicating large poverty rates and larger income dispersion, with India and Sri Lanka outpacing the others at 45 percent. On the other hand, Mongolia and Chinese Taipei have the lowest average Gini Index, below 35 percent, which is comparable to the level observed in many advanced economies. Finally, it has to be noted that most of the SEACEN-8 economies show a lower Gini Index in the most recent period, which corresponds to ultra-low interest rates.

Figure 5
Gini Index, Disposable Income (1975-2017)



Sources: The Standardized World Income Inequality Database (SWIID – Frederick, 2019).

The goal of this chapter is to identify how monetary policy influences the Gini index described in Figure 5. Recent theoretical developments have highlighted the direct and indirect effect of monetary policy transmission in explaining developments in income and wealth inequality.[4] The direct effect works through a change in the interest rates on households, as an intertemporal substitution (lower interest rates boost aggregate demand by stimulating consumption and investment), while the indirect effect works through changes in prices, wages and unemployment. Thus, changes in policy rates by central bank affect inflation, real interest rates and real wages. However, in recent years, it has been shown that inflation has become less responsive to domestic demand pressures in many SEACEN economies. Indeed, the argument that inflation is beyond the control of central banks is questionable, putting concern on the evolution of the distributional impact of monetary policy on the SEACEN-8. The very low trend rates of inflation, occurring since the global financial crisis, coupled with downward nominal wages and price rigidity have contributed to a flattening of the Phillips

4. See Auclert (2017), and Kaplan, Moll and Violante (2018).

curve in the SEACEN-8 region. The Phillips curve indicates the strengthening of the economy, and it is associated with increasing inflation. However, the SEACEN-8 region shows only modest pickups in inflation, indicating that the Phillips curve relationship has weakened. The Phillips curve relationship depends on many economic factors, and the flattening may have been caused by a change in the way monetary policy responds to inflation and economic conditions. Another possibility is that something fundamental has changed in the economy, for instance the openness of the economy to foreign trade or the way firms set wages and prices.

The statistical Phillips curve takes the form of a regression of the difference between the current quarter's inflation, π_t, and the previous year's average inflation, $\bar{\pi}_{t-1}$, on the output deviation, $\hat{y}_t$, and a constant:

$$\pi_t - \bar{\pi}_{t-1} = \alpha + \beta \hat{y}_t + u_t$$

where β is the regression coefficient, α is the constant, and u_t is the error term. Notice that $\bar{\pi}_{t-1} = (\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4})/4$.

The regression coefficient, β, is the slope of the Phillips curve. If the slope is positive, inflation tends to rise above its previous-year average level when output is higher than its steady state, and inflation tends to fall when output is lower. If the slope is negative, the opposite relationships tend to hold.

Using data for Thailand, Figure 6, left Panel, shows that the estimated regression coefficient β is 0.69662, meaning that annualized inflation tends to rise by 0.7 percentage points above its average level in the previous year for each percentage point that output is higher than its steady state. Focusing on a more recent period, Figure 6, right Panel, indicates a clear flattening of the Thai Phillips curve, as now the estimated regression coefficient β is 0.408, meaning that annualized inflation tends to rise only by 0.4 percentage points above its average level in the previous year for each percentage point that output is higher than its steady state.

Table 1 presents the slope of the Phillips curve for the SEACEN-8 over two periods: 1994-2019 and 2010-2018. For all 8 economies, the slope of the Phillips curve has been lower since 2010, except for the Philippines. This indicates that a flattening of the curve is also occurring in the SEACEN-8, as with many advanced economies.

So far, we see slow economic growth with ultra-low inflation and policy rates in many of the SEACEN-8 economies. Many economies appear to be growing more slowly over time. However, for some economies, there is no clear trend in the growth rate and for a few economies, growth seems to be increasing. Moreover, it can be argued that monetary policy has only a weak impact on inflation, as reflected in declining estimates of the slope of the Phillips curve, and that easy monetary policy encourages risky behavior in financial markets. The ultra-low inflation and persistent negative output gaps themselves raise risks to financial stability. The question is now to understand how monetary policy affects income and wealth inequality during periods of such ultra-low inflation and policy rates.

Figure 6
Thailand Phillips Curve

(1994q1-2018q4) **(2010q1-2018q4)**

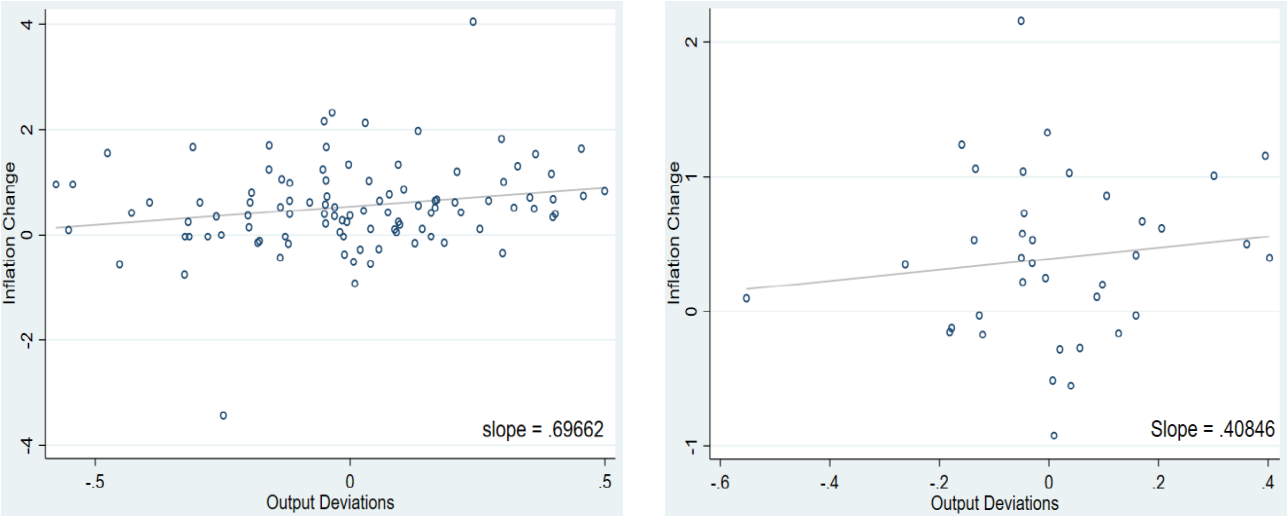


Table 1
Phillips Curve Slope

Country	1994-2019	2010-2018
Cambodia	1.21	0.04
Chinese Taipei	0.36	0.17
India	0.27	0.18
Mongolia	0.24	0.15
Philippines	0.11	0.11
Sri Lanka	0.44	0.01
Thailand	0.69	0.41
Vietnam	1.03	0.006

3. Transmission Channels of the Distrubutional Impact of Monetary Policy in the Literature

Monetary policy affects the income and wealth distribution in various ways, and this section is going to explore the transmission channels affecting decisions of heterogeneous households. An expansionary monetary policy lowers interest rates and increases aggregate demand, thus boosting economic growth. It also lowers the value of the currency, thereby decreasing the exchange rate. Lower interest rates stimulate investments, which have a positive impact on firms' profits and labor market, in the form of higher wages and lower unemployment. This represents the *income earnings channel*. In general, labor income represents the most important source of income for households in the lower and middle parts

of the income distribution, while capital income mainly influences the income of the top of the distribution. However, monetary policy affects labor earnings in different ways: the young middle-class benefits more from higher wages because the younger are more likely to work than older households and also because their job prospects tend to be more pro-cyclical. The *Fisher channel*, when there is the unexpected rise in inflation due to an expansionary monetary policy, benefits nominal debtors while making worse off nominal creditors. For instance, households with relatively large mortgage debts will be better off, but households renting apartments will be at a disadvantage.

The *net interest income channel* reduces interest payments for borrowers who are better off, while decreasing income that savers receive on their deposits. The *net financial wealth channel* affects the value of asset and equity prices. As the asset prices increase for lower interest rates, $P_t = (1/R_t)$, holders of these assets gain, including housing prices. However, the impact of monetary policy on households' income and wealth through financial assets can be heterogeneous depending on the duration and maturity of their balance sheet. For example, households holding short-term deposits would have a positive unhedged interest rate exposures, while those who hold long-term bonds or adjustable-rate mortgage liabilities would have a negative positive unhedged interest rate exposure. Thus, an expansionary monetary policy would distribute wealth from the households with negative interest rate exposure to those with positive exposure.

As the distributional impact of monetary policy has attracted public attention, a lot of research has been devoted to this topic in recent years. Dobbs et al. (2013) showed that prolonged cuts in policy rates generate large benefits for younger households that are net borrowers, while leading to income loss for older households holding interest-bearing assets. Ampudia et al. (2018) shows that the distributional impact of monetary policy has important indirect effects depending on the employment status, where lower interest rates tend to reduce unemployment rates and increase labor income. This effect is found to be quantitatively important in reducing inequality in the Euro Area. Heterogeneity across households is very important in understanding the distributional impact of monetary policy. Recent literature has shown that monetary policy can have opposite effects across various types of agents: young versus old (Wong, 2016), savers versus borrowers (Doepke and Schneider, 2006), and the financially constrained versus the unconstrained (Williamson, 2008).

More recently, Kaplan et al. (2018) introduced the Heterogeneous Agent New Keynesian (HANK) model in which households holding large liquid assets are able to smooth transitory shocks in their consumption, while 'hand-to-mouth' households holding little liquid assets have a large marginal propensity to consume, and thus are much more sensitive to transitory shocks. Moreover, Kaplan et al. (2018) also introduced a new category: 'wealthy' hand-to-mouth households. These households can hold a sizable amount of wealth in the form of an illiquid asset, such as real estate asset. Similar effects are found in Auclert (2019), Beraja et al. (2017) and Coibion et al. (2017).

Another strand in the literature focuses on the the prices faced by households of different incomes. Indeed, households consuming goods based on sticky-priced goods are less sensitive to changes in inflation, relative to households who consume mainly goods set at flexible prices. See Nakamura and Steinsson (2008), Boivin et al. (2009) and Almas (2012).

While most of the literature on the distributional impact of monetary policy has been focused on advanced economies, very little has been devoted to emerging and Asian economies. Park (2017) studied the housing market and household balance sheets in South Korea over the period 2001-2012. Park (2017) found that the share of "wealthy hand-to-mouth" households that hold little liquid wealth while owning a large amount of illiquid assets is very high in South Korea, compared to advanced economies. Moreover, wealth in South Korea is mainly concentrated on illiquid assets (i.e., housing and real estate assets). Cui and Feng (2017) analyze data from the China Household Finance Survey in 2012 and found that wealthy hand-to-mouth represent most of the hand-to-mouth households in the People's Republic of China. Taghizadeh-Hesary et al. (2018) analyzes the effect of zero interest rate policy and negative interest rate policy on income inequality in Japan during the period of 2002Q1 to 2017Q3. They find that quantitative easing (QE) and quantitative and qualitative easing (QQE) policies implemented in Japan lead to significant increases in income inequality.

Away from the focus on households, Domac (1999) analyzes credit and monetary policies in Malaysia and investigates the distributional impact of monetary policy on small- and medium-size industries and large manufacturing firms. Domac (1999) finds that monetary tightening in Malaysia disproportionately affects small and medium-size enterprises.

There has been no prior work investigating the distributional impact of monetary policy in the SEACEN-8, and this chapter will fill this knowledge gap.

4. Empirical Analysis – Panel VAR

In this section, I develop a Panel Vector Auto Regression (Panel VAR) model for the SEACEN-8 economies under consideration in this project. The sample period range from the first quarter 2000 until the first quarter 2017. The following system is estimated:

$$Y_{it} = AY_{it-1} + BX_{it-1} + u_i + e_{it}$$

where Y_{it} is a *(kx1)* vector of dependent variables, X_{it-1} is a $(1x1)$ vector of exogenous covariates, A is a *(kxk)*-dimensional matrix of the VAR coefficients on lagged domestic quantities and B is a regression coefficient to be estimated. u_i and e_{it} are *(kx1)* vectors of dependent variable-specific panel fixed-effects and idiosyncratic errors, respectively. For all $t > s$, $E(e_{it}) = 0$, $E(e_{it}e_{it}^{'}) = \Sigma$, and $E(e_{it}\, e_{it}^{\prime}) = 0$ for $t<s$.

I use the General Method of Moments (GMM) to estimate the Panel VAR, which regresses each endogenous variable on its own lag(s) as well as the lags of all other variables in the system. Following Love and Zicchino (2006), I apply forward mean differencing or orthogonal deviations (the Helmert procedure) to remove the fixed effects; all variables in the model are transformed in deviations from forward means (see Arellano and Bover, 1995).

To identify the shocks, the Cholesky's decomposition of the covariance matrix is adopted, which assumes a recursive exogeneity structure. Therefore, the first variable in the VAR is only affected contemporaneously by the shock to itself; the second variable in the VAR is affected contemporaneously by the shocks to the first variable and the shock to itself, and so on.

The endogeneous variables included in the Panel VAR are: real GDP, inflation, short-term interest rate, exchange rate, current account (percent of GDP) and the Gini Index. All variables are expressed in *log*, with the exception of the short-term interest rate and the current account, which are expressed as a percentage of GDP. The model selection has included one lag.[5] The model also includes exogenous controlling variables, such as the VIX index and the oil price.

The ordering of economic activity, inflation and interest rates is standard in the monetary transmission literature. DenHaan and Sterk (2011) and Musso et al. (2011) order inflation before economic activity. However, ordering inflation after economic activity does not alter the results. I order the exchange rate and the trade balance to GDP after the real GDP, inflation and policy rate, as it is assumed that the exchange rate responds to changes in monetary policy, thus attracting capital flows. I order the Gini Index as the last variable, as changes in monetary policy affect the income distribution. Moreover, income inequality also results from currency appreciation/depreciation as high-income households also hold foreign assets.

Figure 7 reports the impulse responses function to an expansionary monetary policy in the SEACEN-8. The estimation is carried out over the period from 2000 until 2018. The Figure shows that an interest rate cut leads to an increase in real GDP, inflation, and exchange rate.[6] Current account (percent of GDP) decreases and then increases after a few quarters. The depreciation of the exchange rate leads to a current account deficit in the short-term. Finally, the Gini Index decreases on impact. The Gini Coefficient indicates the dispersion of the income inequality, meaning that the Gini Index measures the degree of inequality in the distribution of family income in a country. The more nearly equal a country's income distribution, the lower its Gini Index. Thus, the monetary policy shock in the PVAR appears to lower the degree of inequality. Therefore, lower interest rates and higher inflation tend to make the SEACEN-8 more equal income distributed.

Figures 8 and 9 compare the PVAR over two different periods: 2000-2007 and 2010-2018. The period just after the financial crisis has not been considered. The post-crisis period shows that a monetary policy shock leads to a more amplified increase in real GDP and inflation, coupled with a current account deficit on impact. On the other hand, the current account to GDP was increasing on impact during the pre-crisis period. Since 2010, the larger impact on real GDP led imports to increase relative to exports. Most importantly, the Gini Index appears to have the same response in the pre- and post-crisis period, both in sign and quantity. This suggests that the inflation and income channels have little impact on driving changes in income inequality. Indeed, during the post-crisis period, GDP increases about 3 times more than the pre-crisis period, and inflation increases only on impact and becomes negative after few quarters, while it always shows a positive response during the pre-crisis period before returning to zero after 2 years.

5. The lag has been selected following Andrews and Lu (2001) by choosing the smallest BIC, AIC and QIC based on GMM estimation.

6. The initial drop in real GDP growth is very puzzling. Due to large heterogeneity of economies included in the sample, such a drop can be due to some economies not showing a sudden increase in GDP for lower interest rate. Moreover, some economies such as Thailand, present large fluctuations in the stochastic volatility of real GDP, thus driving this odd result.

Figure 7
Expansionary Monetary Policy Shock (2000-2018)

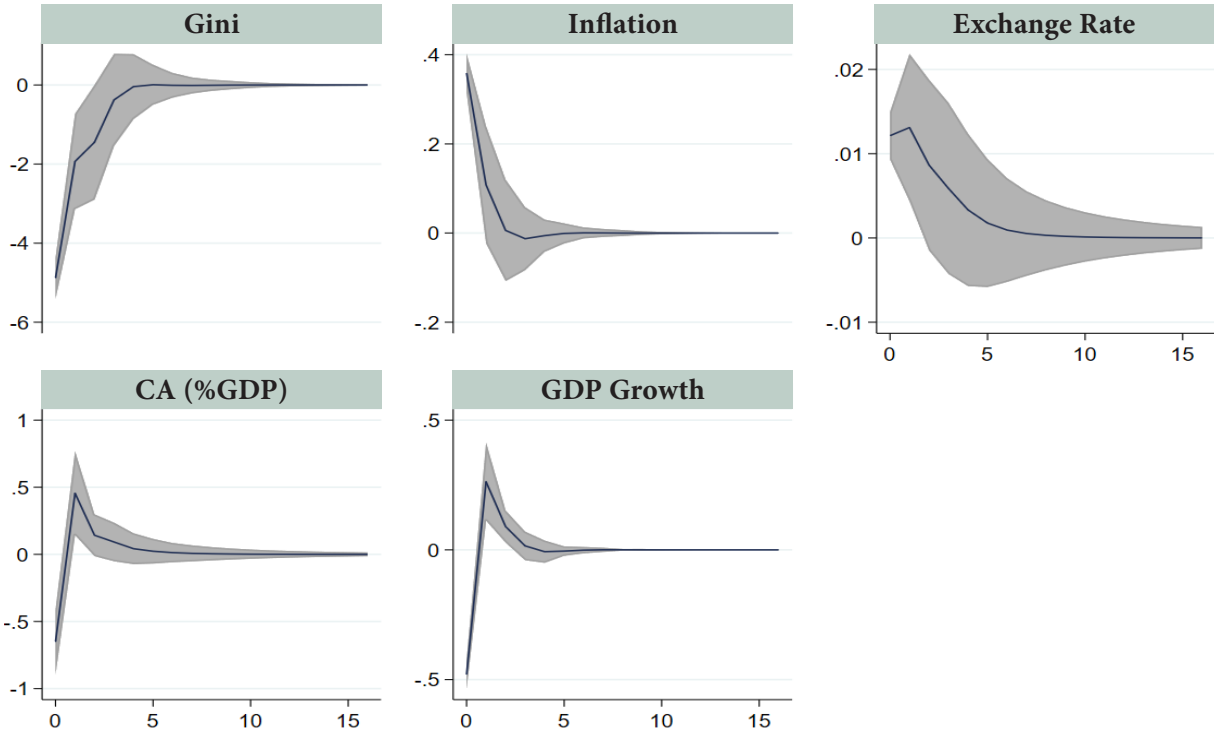


Figure 8
Expansionary Monetary Policy Shock (2000-2007)

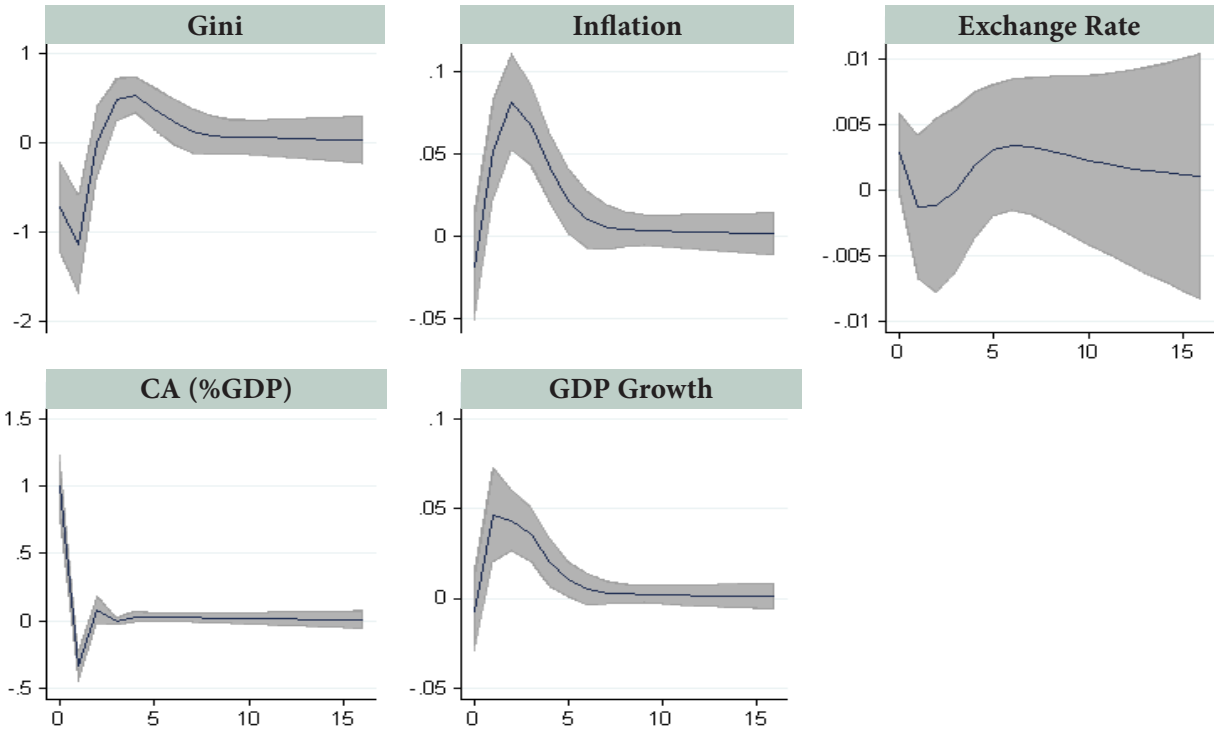
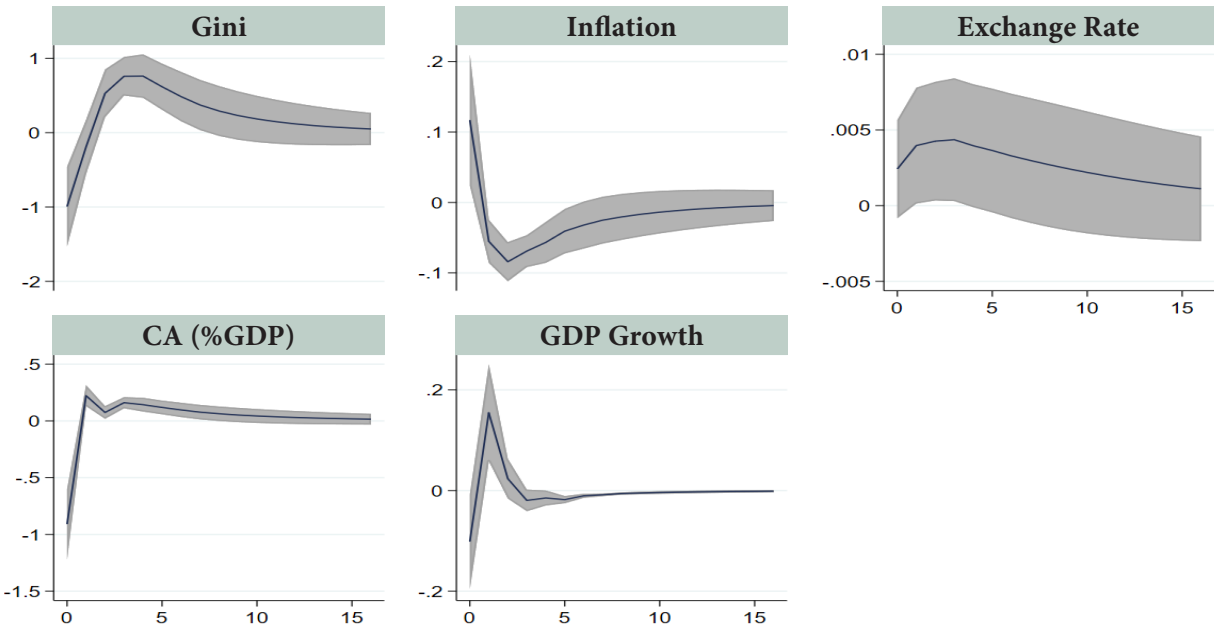


Figure 9
Expansionary Monetary Policy Shock (2010-2018)



I focus next on asset prices and thus the PVAR model also includes equity prices and housing prices. Compared to the full period in which both equity price and Gini Index increase, the post-crisis period shows that an expansionary monetary policy leads to a small increase in equity prices followed by an initial decrease of the Gini Index, which then increases after few quarters. Moreover, the positive reaction of inflation is larger for the full period relative to the post-crisis sample, which contributes to a swell in increasing inequality, while the inflation response is contained in the post-crisis period, leading to a smaller impact in the Gini Index. This indicates that monetary policy affects the income distribution through asset prices. Indeed, when asset prices increase, the Gini Coefficient increases as well, indicating more income dispersion (see Figures 10 and 11).

Relative to equity prices, house prices tend to respond more to monetary policy shocks. Despite an initial drop in house prices, an expansionary monetary policy has the effect of boosting housing prices after a few quarters. The Gini Index initially decreases by about 3 percent and then rebounds, reaching a positive peak of about 1.5 percent in the third quarter. It seems that the Gini Index is largely influenced by housing prices and housing owners (see Figure 12).

Figure 10
Expansionary Monetary Policy Shock with Equity Prices (2000-2018)

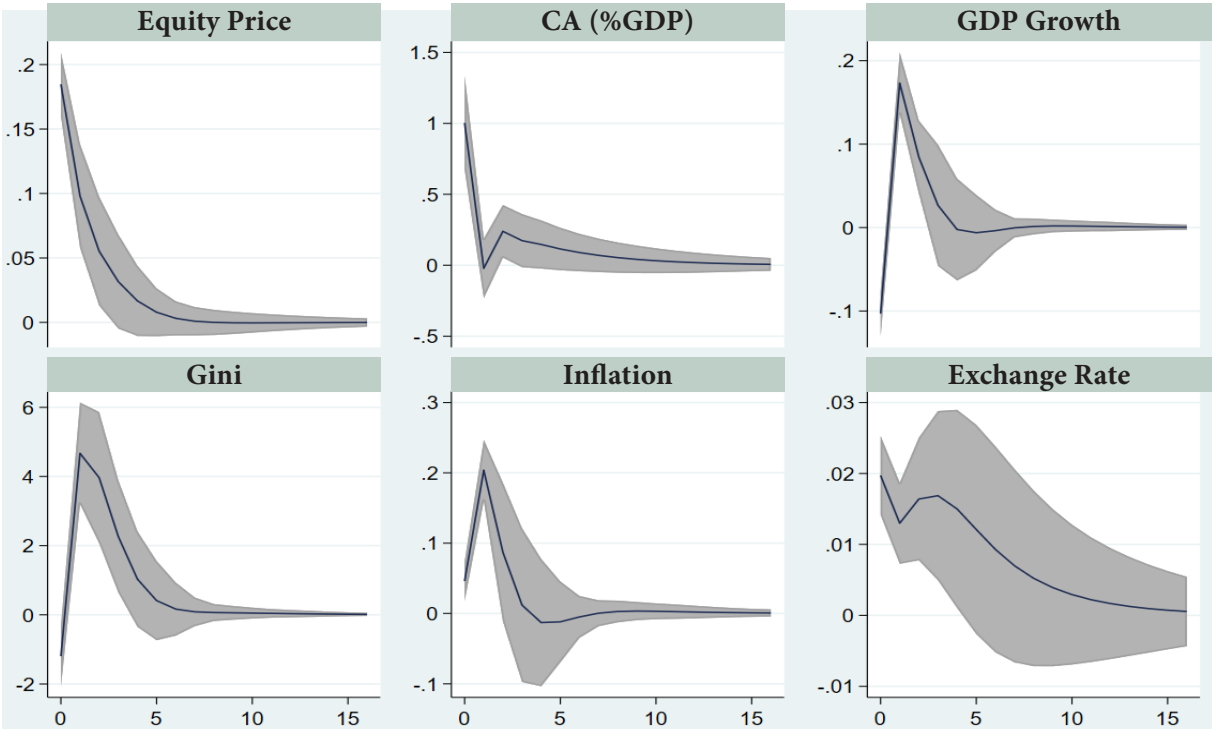


Figure 11
Expansionary Monetary Policy Shock with Equity Prices (2010-2018)

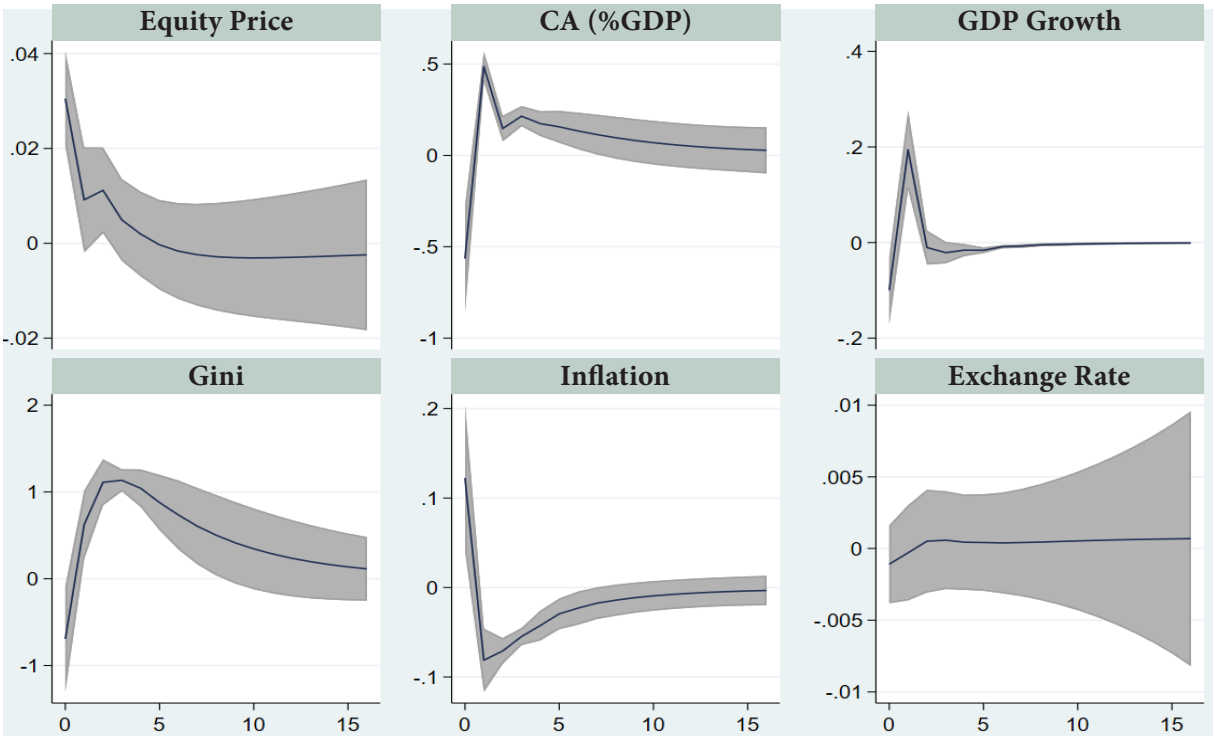


Figure 12
Expansionary Monetary Policy Shock with Housing Prices (2010-2018)

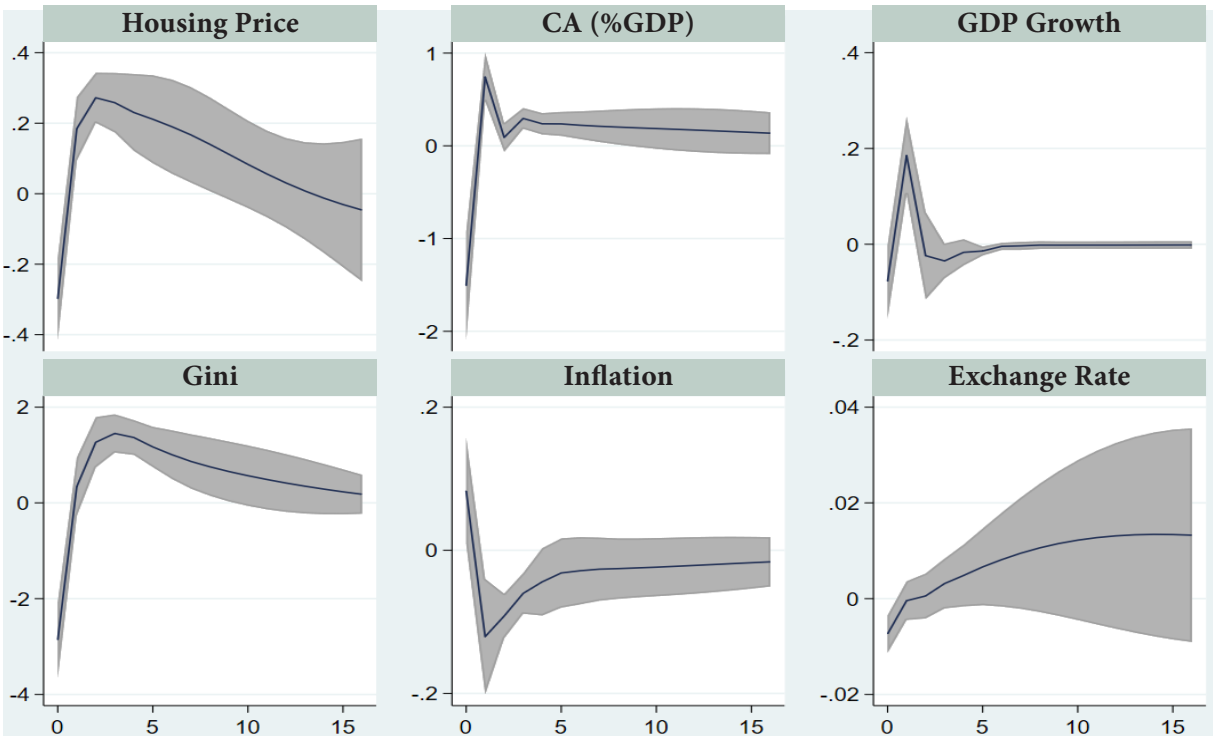
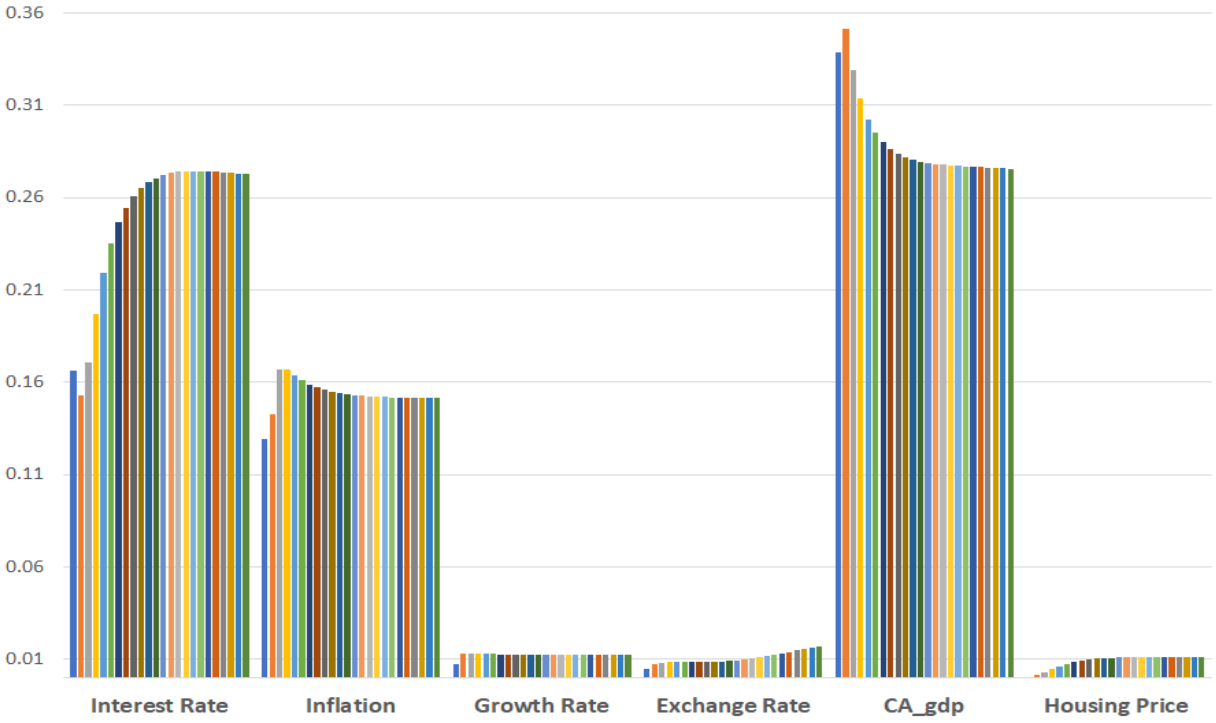


Figure 13 reports the forecast error variance decomposition and shows the proportion of the unanticipated changes of a variable that can be attributed to innovations in the variable itself and to other variables in the system. The current account and monetary policy shocks explain about 34 percent and 17 percent of the variation of the Gini Index for the first period, respectively. Over a longer horizon, the current account and monetary policy shocks both explain about 26 percent of the fluctuations in the Gini Index. Inflation contributes to explaining fluctuations of the Gini Index by about 15 percent while other variables show a marginal contribution. On the one hand, trade openness and international capital flows are very important in terms of income inequality, probably because high-income households receive capital gains from investing in foreign assets. On the other hand, the action of central banks are also a key factor in explaining the fluctuations in income inequality.

Figure 13
Variance Decomposition of the Gini Index

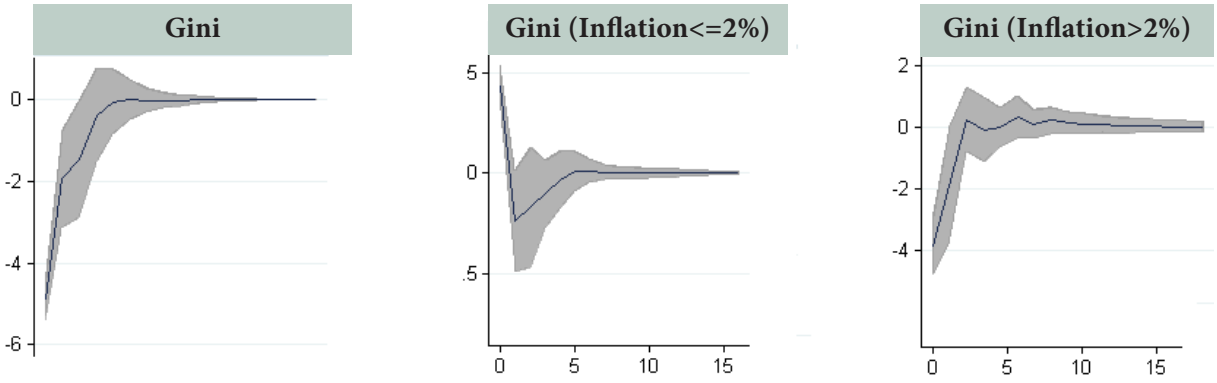


The analysis further examines the responses of the level of income inequality to expansionary monetary policy shocks and whether the responses are influenced by high and low inflation regimes. Thus, the following Panel VAR model includes bands as follows: inflation below 2 percent and inflation above 2 percent. Two policy rate dummy variables are constructed to capture the changes in the policy rate constrained by where inflation may be at the time for each band.

The first policy rate dummy equals to the values of negative changes in the policy rate when inflation is below or equal to 2 percent and zero otherwise, while the second policy rate dummy is equal to the negative changes in the policy rate when inflation is above 2 percent and zero otherwise.

Figure 14 shows that an expansionary monetary policy shock has the effect of lowering income inequality only if inflation is not too low. Indeed, when inflation is below 2 percent, income inequality increases on impact. This is because borrowers do not gain with lower real debt repayment, while savers are better off. Moreover, the low inflation rates lead to higher unemployment rates and less bargaining power for workers to increase real wages.

Figure 14
Expansionary Monetary Policy Shock (2010-2018)



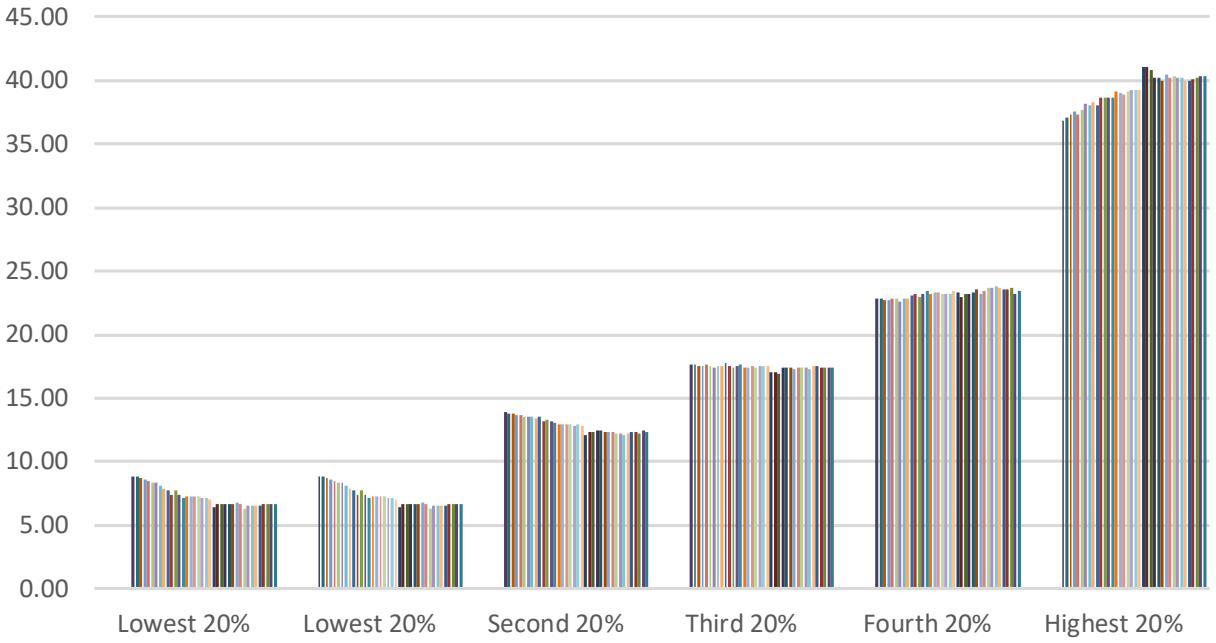
5. DSGE Model

So far, most of the analysis has been carried out based on the Gini Index as a proxy for income inequality. However, it would be very interesting to understand what the income reactions to monetary policy for specific classes of households are. Due to data limitation for the SEACEN-8 region, it was not possible to collate time series data on income and wealth distribution over the quantile population, except for Chinese Taipei.[7] Figure 15 shows that in Chinese Taipei about 40 percent of disposable income are held by the top 20 percent, while the lowest 20 percent hold less than 10 percent. Further, Figure 15 shows that disposable income has decreased over time for the bottom 60 percent of the population, while it has increased for the top 20 percent. In contrast, the third and fourth 20 percent show a constant disposable income over time. The question is whether monetary policy has contributed to decreasing incomes for the poor and the richest households.

Most models of the monetary policy transmission mechanism implicitly adopt this view by featuring a representative agent. By contrast, recent literature argues that redistribution is a channel through which monetary policy affects macroeconomic aggregates, because those who gain from accommodative monetary policy have higher marginal propensities to consume (MPCs) than those who lose. See Coibion et al. (JME, 2017), Kaplan, Moll and Violante (AER, 2018) and Auclert (AER, 2019).

7. The rest of the SEACEN-8 economies are able to collect data on income and wealth distribution only for the most recent years based on survey data collected in 2013, 2015 and 2017. This prevents any time series analysis to be carried out.

Figure 15
Distribution of Disposable Income in Chinese Taipei



Sources: Family Income and Expenditure Survey: Directorate General of Budget, Accounting and Statistics, 1980-2017.

In order to highlight the role of heterogeneity, I develop a model that focuses on two groups of households: (i) wealthier households, and (ii) poorer households. Wealthier households are financial investors who hold assets (government bonds, equity, and foreign bonds) and receive related income in addition to wages and transfers. These households usually belong to the middle/rich class and are commonly defined in the literature as Ricardian households. Poorer households are mostly asset-less households that only receive wage and transfer income. This group of households is defined in the literature as "hand-to-mouth" or Non-Ricardian households.

With this premise, I develop a dynamic stochastic general equilibrium (DSGE) model for a small open economy, following Medina and Soto (2007) and Punzi (2019).[8] The model is characterized by two types of households: (i) *Ricardian households* which receive income from working, profits from firms and by holding domestic and foreign assets, and (ii) *non-Ricardian households* which receive only labor income. These households consume all their disposable income and have no savings. From the supply side, the model considers (iii) entrepreneurs that rent capital and labor from households, and combine them with energy input to produce differentiated intermediate goods; (iv) perfectly competitive firms that produce a final consumption good by combining intermediate goods supplied by monopolistically competitive firms; (v) a capital producer that rents capital from household and produces new capital from the existing capital stock; (vi) import goods retailers which buy intermediate goods abroad to re-sell at the domestic market; and, (vii) a monetary authority that sets nominal interest rates by following a standard Taylor Rule. The Appendix presents the basic model equations. Here I simply define the equation describing the net disposable income and wealth for the two types of households:

8. The theoretical model is also very similar to Smets and Wouter (2003, 2007) and Christiano et al. (2005).

- **Income Non-Ricardian Households:**

$$(1-\tau)\, W_t\, N_t \; + TR_t - TAX_t$$

- **Income Ricardian Households:**

$$(1-\tau)\, W_t\, N_t \; + \frac{i_t}{1+i_t}\; B_t + e_t\; \frac{i_t^*}{1+i_t^*} B_t^* + TR_t - TAX_t$$

- **Wealth Ricardian Households:**

$$B_{t-1} \; + \; e_t\, B_{t-1}^* + M_{t-1}$$

where W is the nominal wage, L is the number of hours worked, B is holdings of domestic assets, B^* is holdings of foreign assets, M is money, i and i^* are the domestic and foreign interest rates, e is the nominal exchange rate, and TR and TAX are government transfer and taxes.

Figure 16 reports the impulse response functions, expressed as percentage deviations from the initial steady state to a decrease in the policy rate, as described by the Taylor Rule. An interest cut stimulates investment, consumption and output. Inflation increases due to higher aggregate demand. Given the economic boom, firms increase labor input and real wages increase as well, while the wage share falls on impact, due to wage stickiness which raise firm profits. Indeed, real wages increase less relative to hours worked. The aggregate income and intertemporal substitution channels are clearly present as household interest rate cuts boost households' consumption and firms' investment (lower cost of external funds), leading to an increase in output, employment and wages. Further, higher wages and labor demand will produce additional income, boosting GDP even more.

The short-term real interest rate declines and the domestic currency depreciates in nominal terms. Due to the increase in labor income, consumption for both Ricardian and Non-Ricardian households increase, but the increase is more pronounced for Ricardian households. Income increases for both types of households, as well as wealth for Ricardians. Similar to consumption, income increases more for Ricardians. The exchange rate depreciations coupled with a large acquisition of foreign bonds enable the Ricardian households to become richer. Figure 16 shows that the distributional impact of monetary policy works through labor earnings, interest rate exposure and the Fisher channel. Figure 16 also shows the results based on different shares of households: the dotted line indicates equal share of households' type; solid line considers only Non-Ricardian households, and circle line identifies only Ricardian households. The most interesting results concern total consumption, which would be higher if the economy were to be populated only by Non-Ricardians. This is not surprising as this group does not save, but use all its disposable income for consumption purposes. The next step is to connect this simulation with the findings on the Gini Index shown in previous section. In view of this, I calculated the deviations of the disposable income relative to the average disposable income in the economy, which are reported in Figure 17, top Panel. In the context of the assumption of only two types of households, the income deviation is a proxy to the Gini Coefficient, which measures the dispersion of income or wealth along a continuum of heterogeneous households. The Figure shows that the income shares for both households

decline, and it takes a longer time for Non-Ricardians to return to the initial level relative to Ricardians. Moreover, although the deviations fall, indicating lower income inequality, the impact is more pronounced for Ricardians. Finally, the bottom Panel of Figure 17 shows that, with regard to Ricardian households, capital income share contribute more than the income share in increasing income. Thus, profits from firms and asset holdings explain the main increase in their income.

Figure 16
Expansionary Monetary Policy Shock (DSGE Model)

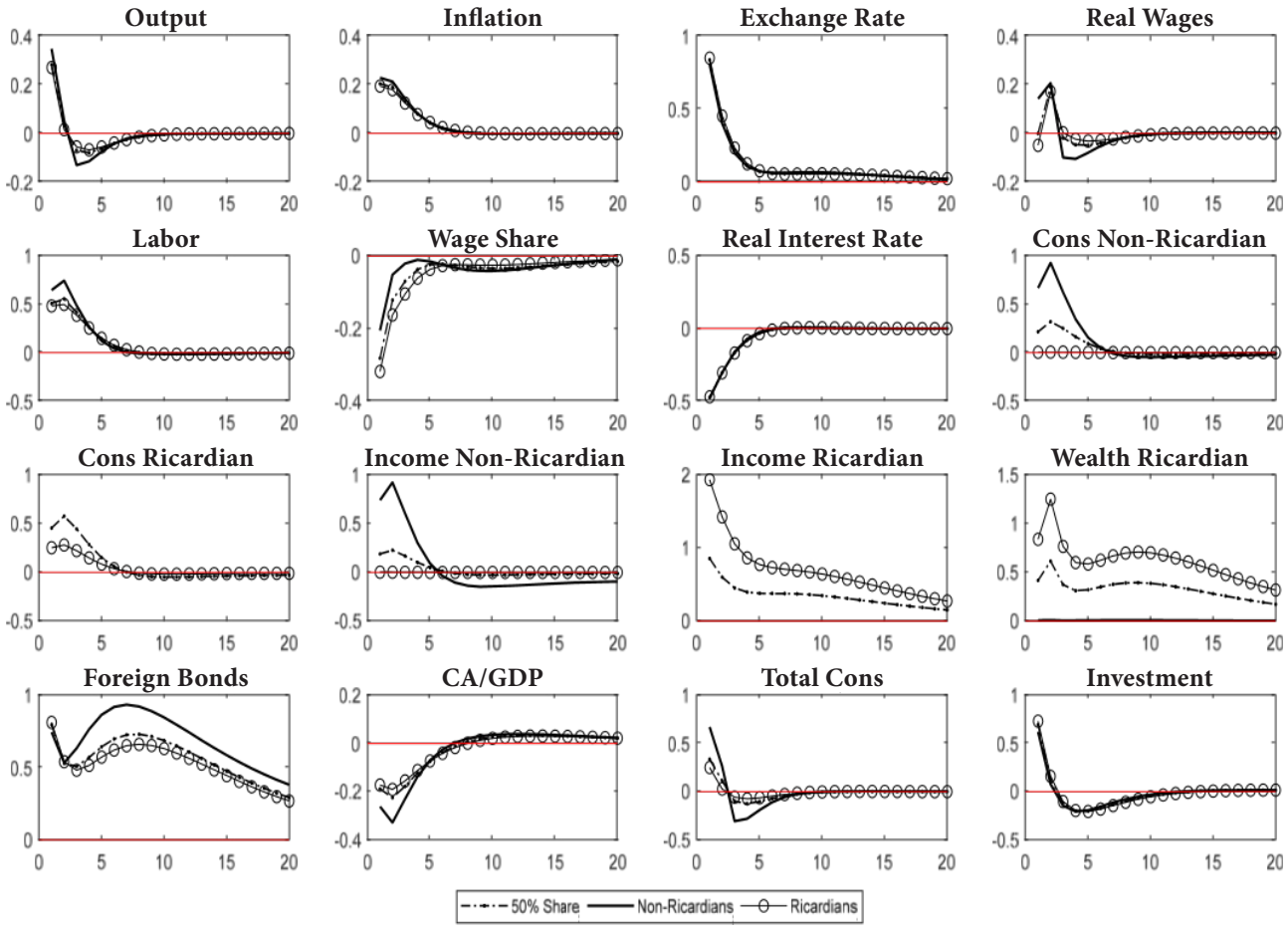
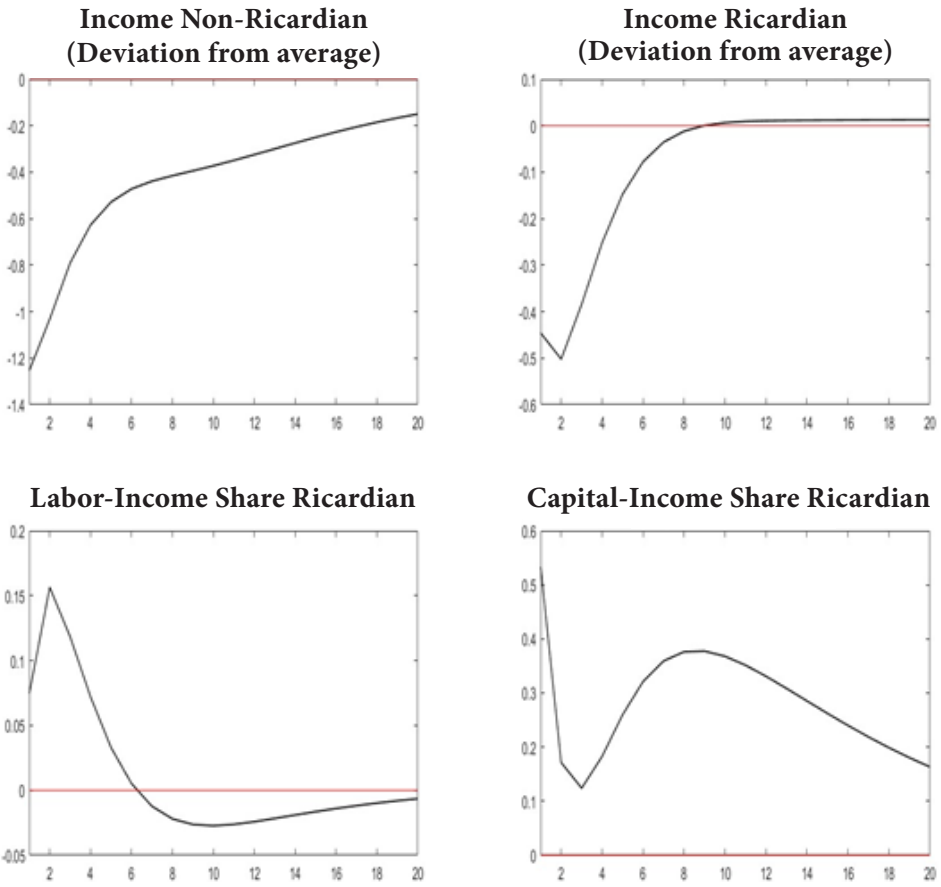


Figure 17
Expansionary Monetary Policy Shock (DSGE Model)



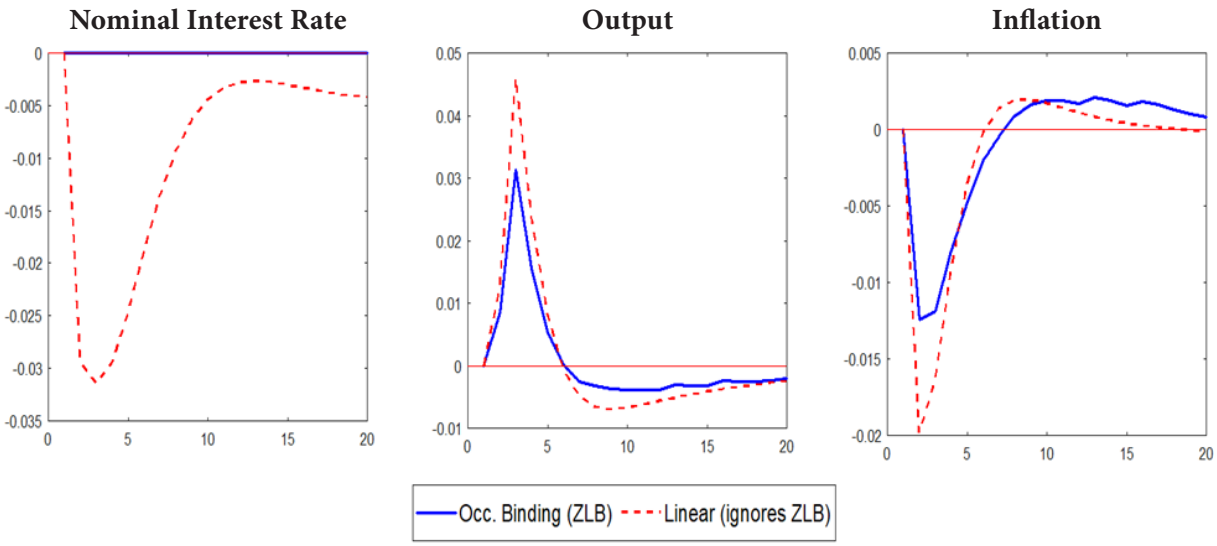
6. Ultra-Low Interest Rate

In Section 2, evidence was presented that in most of the SEACEN-8 region the short-term interest rate is well below the historical average, and very often such an environment is accompanied by low expected inflation. In particular, Chinese Taipei and Thailand have a policy rate close to 1.5 percent, which was kept constant for a very prolonged time. Clearly, these economies were avoiding extensive accommodative monetary policy to avert the reaching of the zero-lower bound.

This section aims at understanding the impact of income and wealth inequality when the policy rate is very low and resistant to change. In light of this, I consider the distributional impact of a temporary technology shock, comparing situations in which the short-term interest rate is free to fluctuate, with a situation in which it is not able to become negative. In so doing, the model needs to introduce a non-linear constraint where the interest rate is occasionally binding the zero-lower bound. Thus, the model is solved implementing the "Occbin" toolkit proposed by Guerrieri and Iacoviello (2015). The choice of simulating a temporary supply shock is motivated by the fact that some SEACEN economies have shown a moderate economic growth. In general, a supply shock leads to GDP growth and lower inflation. As the central bank's goal is price stability, the central bank implements a loose monetary policy in order to bring inflation back to the initial target. This means that the

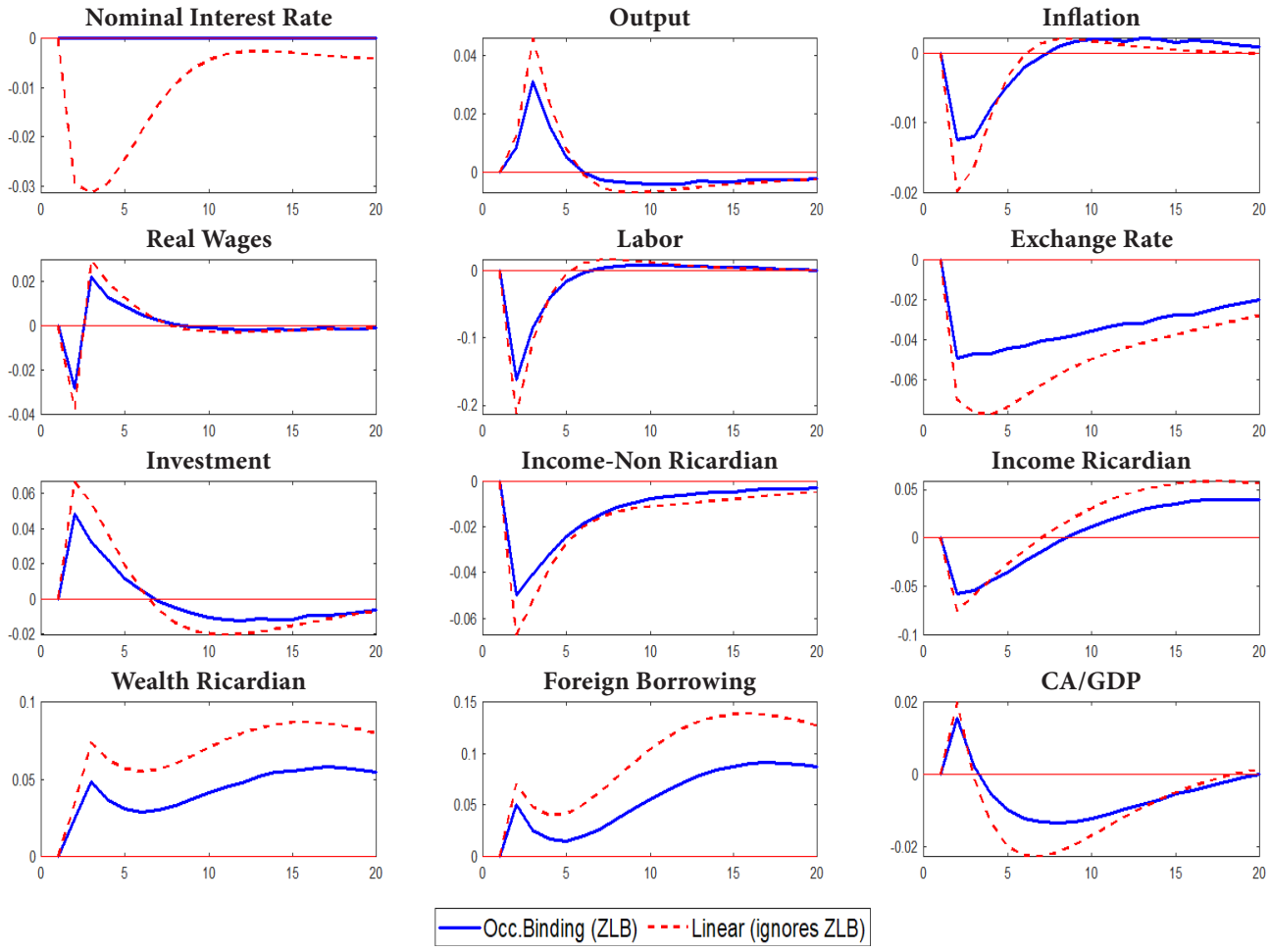
policy rate decreases, and demand is boosted, implying a further increase in GDP (see Figure 18, red dotted line). In the case of ultra-low interest rates, central banks avoid lowering the policy rate further in order to avoid a swift reaching of the zero-lower bound. This implies that central banks do not react to the temporary technology shock, and GDP increases by less relative to an unconditional case, and inflation also decreases by less.

Figure 18
Temporary Supply Shock (DSGE Model)



How does this less amplified response in GDP and inflation influence income inequality? Figure 19 shows that the ZLB prevents the necessary decrease in the short-term interest rate, thus leading to a less pronounced increase in investments. The lower impact on inflation allows real wages to decrease less, thus the supply of labor drop by less as well. The drop in labor income and the lower rates generate a drop in both households' income. However, it would seem to be as if the income inequality has tended to decrease as the quantitative change of income for both households is almost the same. Moreover, by shutting down the interest rate channel, it seems as if income distribution is driven by income changes (i.e. labor income) and inflation.

Figure 19
Temporary Supply Shock (DSGE Model)



In order to support the theoretical findings, I run a VAR model for the Chinese Taipei economy, comparing a full sample period with a period corresponding to low interest rates (from around 2010). Income for Ricardian households reflects the highest 20 percent of disposable income, while for Non-Ricardians, income is the average of the lowest 20 percent, second 20 percent, third 20 percent and fourth 20 percent of disposable income.

As the theoretical model predicts, the ultra-low interest rate allows GDP and inflation to change with less amplified responses to the technology shock. Income for Ricardian and Non-Ricardian households decrease, with the larger impact on Ricardians, meaning that inflation and labor income are affected more in this household class, relative to Non-Ricardian which can derive income from other sources of investment (see Figures 20 and 21).

Figure 20
Chinese Taipei -Temporary Supply Shock (Full Period)

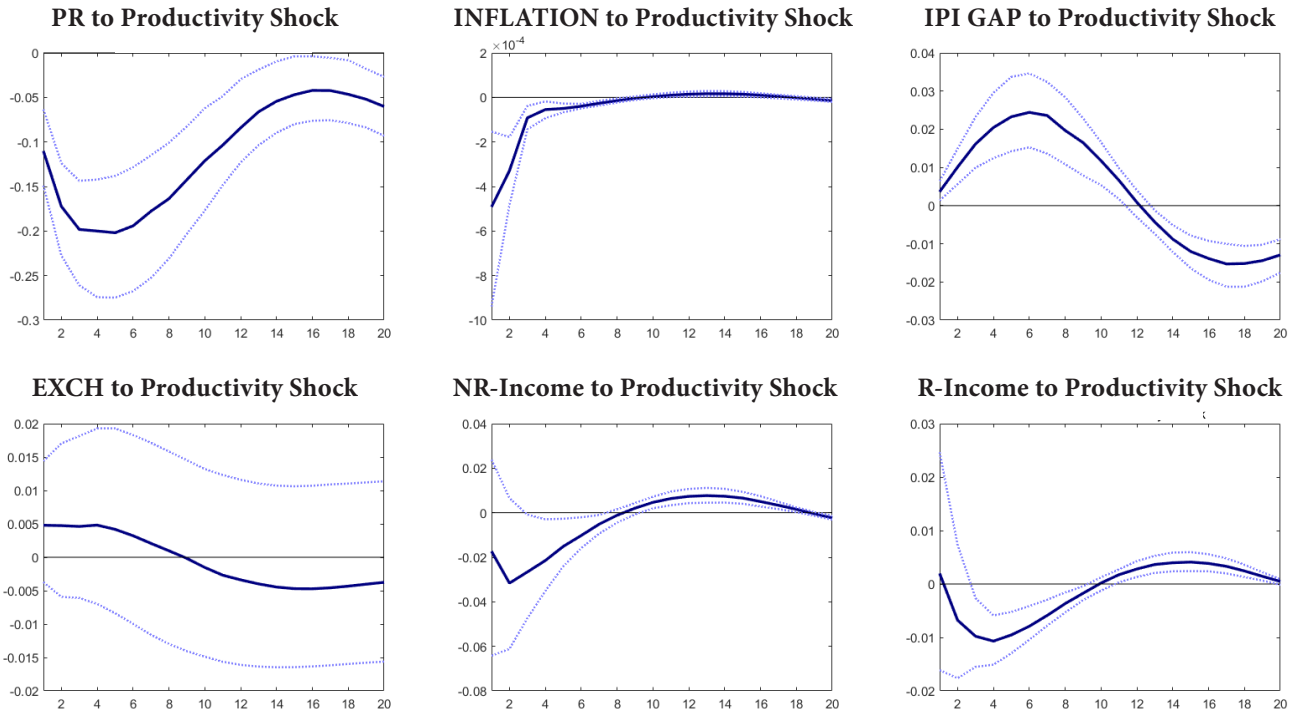
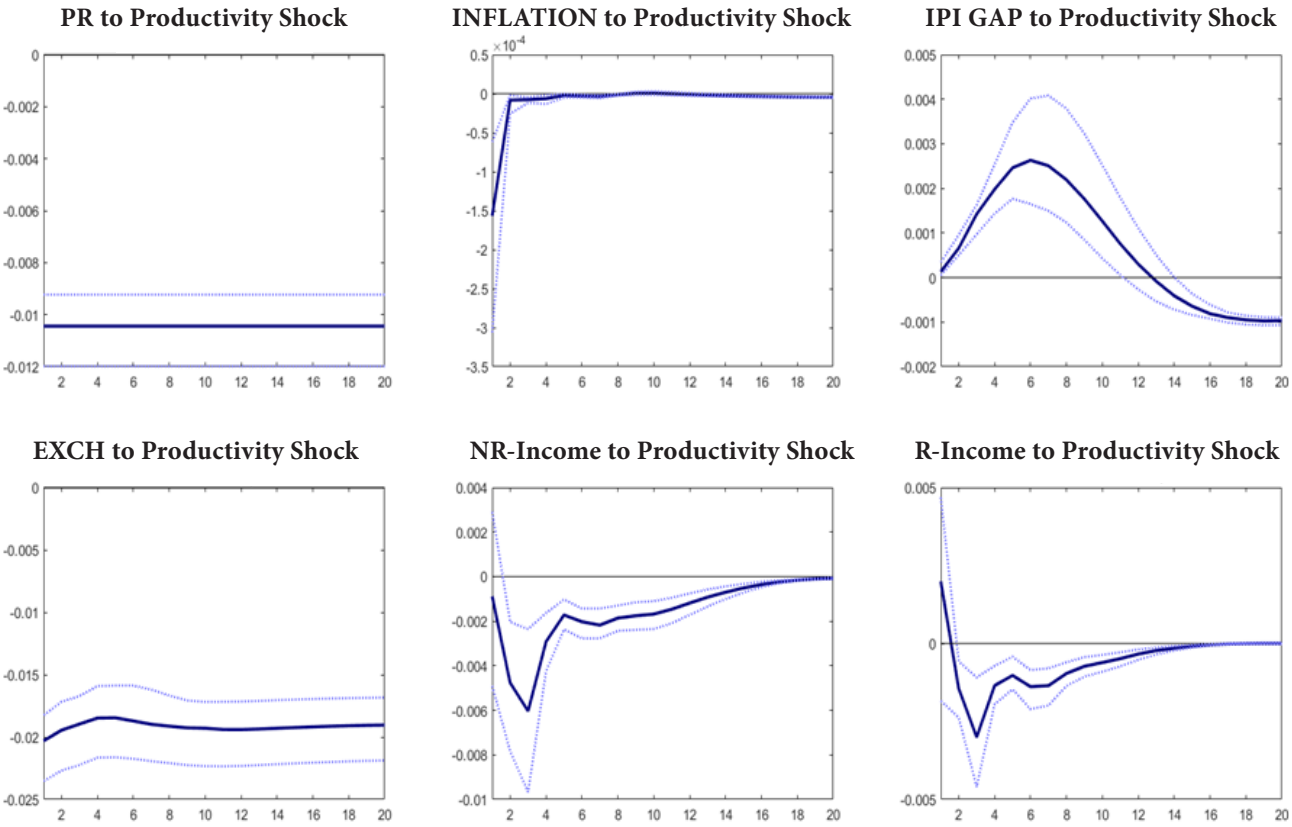


Figure 21
Chinese Taipei -Temporary Supply Shock (2010-2017)



7. Conclusions and Policy Implications

This paper analyzes the distributional impact of monetary policy on a group of SEACEN economies. While the impact of monetary policy on income and wealth inequality has been extensively discussed, very little research has been devoted to Asian economies. Moreover, after prolonged periods of stable inflation during the Great Moderation, researchers and policy makers have shown little interest on income and wealth inequality, but subsequent to the onset of the global financial crisis in 2007, the topic was revived, with particular focus on the role of central bank policies.

Using a Panel VAR estimation method, this study reveals that an expansionary monetary policy leads to a lower Gini Index, thus favoring lower income inequality for the group of SEACEN-8. However, asset prices have a large influence in determining the sign of the Gini Index. Indeed, the Gini Index decreases or increases following lower or higher housing prices. Thus, the distributional impact of monetary policy works mainly through the asset price channel. However, the inflation channel is found to be also very important: an expansionary monetary policy tends to decrease the Gini Index during the period when the inflation rate is larger than 2 percent, otherwise it tends to increase for lower inflation.

Finally, this study investigates the distributional impact of monetary policy during periods of ultra-low interest rates and low inflation. This is important as many SEACEN economies such as Chinese Taipei, Thailand and Vietnam have shown low and fixed policy rates in the recent period. This study shows that when there is a positive supply shock, the central bank is unable to cut the interest rate at the level it wishes, thus the expansionary effect on GDP is limited, as well as the impact on households' income.

These results highlight the role of central banks in influencing income and wealth inequality. As many SEACEN economies have been using monetary policy to control inflation, in line with the principle of inflation targeting similar to many advanced economies, it would be important to consider if it would be beneficial to increase the target, or use alternative instruments, as the inflation channel is quite important in determining inequality in the SEACEN-8. Further, a booming housing market, that follows from an easing monetary policy, contributes to higher income and wealth inequality. Thus, the SEACEN-8 should pursue macroprudential policies to lean against the housing boom-bust cycle. Finally, even if the data availability is a constraint for a precise assertion, it can nonetheless be reported that the distributional impact of monetary policy in the SEACEN-8 arises from its heterogeneous impact on the value of agents' income or wealth. Thus, the SEACEN-8 should collate better data on income and wealth across different households to properly understand who gains and who loses.

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Appendix

DSGE Model

I-1 Households

The domestic economy is populated by a continuum of identical economic agents, where a representative household derives utility from consuming goods, C_t and from leisure, l. However, households' heterogeneity is introduced through their income. Thus, the representative Ricardian household maximizes the following expected utility:

$$\max E_0 \sum_{t=0}^{\infty} \varepsilon_t^d \left(\beta^t\right)^t \left[\ln(C_t) - \frac{v_L}{\eta}(L_t)^{\eta}\right]$$

subject to the following budget constraint

$$P_t C_t + Q_t^k(K_t - (1-\delta)K_{t-1}) + B_t + e_t B_t^* = W_t L_t + R_t^K K_t + R_{t-1}B_{t-1} + e_t \zeta_{t-1} R^*_{t-1} B^*_{t-1}$$

where C_t is total consumption, and $L_t = 1 - l_t$ is the total hours worked. Households own capital and rent it to intermediate firms at the rental price R_t^K. F_t are dividends that household receives from firms and W_t is the nominal wage. B_t and B_t^* are domestic and foreign bonds, which pay the domestic nominal interest rate, R_t, and the foreign nominal interest rate, R_t^*. e_t is the nominal exchange rate. ζ_t represents the risk premium that domestic households pay when they borrow from the foreign country, and it is a function of the ratio of net foreign asset positions relative to GDP: $\exp\left[\varphi\left(\frac{e_t B_t^*}{Y_t}\right)\right]$ $\varsigma_t =$, where φ is the adjustment cost parameter. v_L and η are the weight of hours worked in the utility function and the inverse of the Frisch elasticity of work effort, respectively. ε_t^d is a preference shock and it can be interpreted as a demand shock.

On the other hand, Non-Ricardian households maximize similar utility function subject to:

$$P_t\, C_t = W_t\, L_t$$

The total consumption is composed by a CES aggregation of standard consumption goods, C^z, and energy consumption, C^E, such as:

$$C_t = [\gamma_C^{\frac{1}{\rho_c}}(C_t^Z)^{\frac{\rho_c-1}{\rho_c}} + (1-\gamma_C)^{\frac{1}{\rho_c}}(C_t^E)^{\frac{\rho_c-1}{\rho_c}}]^{\frac{\rho_c}{\rho_c-1}},$$

where γ_C is the share of standard goods in total consumption, and ρ_C denotes the elasticity of substitution between standard goods and energy. Energy includes oil, electricity, gas and coal. The optimal demands for the composition of total consumption are given by:

$$C_t^Z = \gamma_C\left(\frac{P_t^Z}{P_t}\right)^{-\rho_c} C_t$$

and

$$C_t^E = (1-\gamma_C)\left(\frac{P_t^E}{P_t}\right)^{-\rho_c} C_t,$$

where P_t^Z is the price of standard consumption goods and P_t^E is the energy price.

The total aggregate consumption price is given by $P_t = [\gamma_C (P_t^Z)^{1-\rho_c} + (1-\gamma_C)(P_t^E)^{1-\rho_c}]^{\frac{1}{1-\rho_c}}$.

Moreover, standard consumption goods are composed by a CES aggregation of home goods, C^H, and imported foreign goods, C^F, such as:

$$C_t^z = [\alpha_C^{1/\xi_c}(C_t^H)^{\frac{\xi_c-1}{\xi}} + (1-\alpha_C)^{1/\xi_c}(C_t^F)^{\frac{\xi_c-1}{\xi}}]^{\frac{\xi_c}{\xi_c-1}},$$

where α_C is the proportion of domestic goods in total consumption, and ξ_C denotes the elasticity of substitution between domestic and foreign goods. The optimal demands for domestic and foreign goods are given by:

$$C_t^H = \alpha_c(\frac{P_t^H}{P_t^z})^{-\xi_c} C_t^Z$$

and

$$C_t^F = (1-\alpha_c)(\frac{P_t^F}{P_t^z})^{-\xi_c} C_t^Z,$$

where P_t^H is the price of standard consumption home goods, P_t^F is the price of imported foreign goods, and $P_t^z = [\alpha_C (P_t^H)^{1-\xi_c} + (1-\alpha_C)(P_t^F)^{1-\xi_c}]^{\frac{1}{1-\xi_c}}$.

I-2 Capital Producers

Capital producers combine a fraction of the final goods purchased from retailers as investment goods, $I_{k,t}$, to combine it with the existing capital stock in order to produce new capital goods. Moreover, part of the capital is rented to retailers at R_t^K. Capital production is subject to an adjustment cost specified as $\frac{\psi_k}{2}\left(\frac{I_{k,t}}{K_{t-1}} - \delta\right)^2 K_{t-1}$, where ψ_k governs the slope of the capital producer's adjustment cost function. Capital producers choose the level of $I_{k,t}$ that maximizes their profits

$$\max_{I_{k,t}} Q_{k,t} I_{k,t} - \left(I_{k,t} + \frac{\psi_k}{2}\left(\frac{I_{k,t}}{K_{t-1}} - \delta\right)^2 K_{t-1}\right).$$

From profit maximization, it is possible to derive the supply of capital

$$Q_{k,t} = \left[1 + \psi_k\left(\frac{I_{k,t}}{K_{t-1}} - \delta\right)\right],$$

and $q_t^k = \frac{Q_{k,t}}{P_t}$ is the relative price of capital. In the absence of investment adjustment costs, q_t^k, is constant and equal to one. The usual capital accumulation equation holds

$$K_t = (1-\delta_k)K_{t-1} + I_{k,t}.$$

I-3 Domestic Firms

Final Goods Domestic Sector

The model assumes there is a continuum of retailers indexed $f \in [0,1]$ who transform intermediate goods $Y_t(f)$ into a final consumption good sold at home, Y_t^H, and abroad, $Y_t^{H_F}$, according to a constant elasticity of substitution technology:

$$Y_t^H = \left[\int_0^1 Y_t^H(f)^{\frac{\varrho-1}{\varrho^H}} df\right]^{\frac{\varrho^H}{\varrho^H-1}},$$

and

$$Y_t^{H_F} = \left[\int_0^1 Y_t^{H_F}(f)^{\frac{\varrho^{H_F}-1}{\varrho^{H_F}}} df\right]^{\frac{\varrho^{H_F}}{\varrho^{H_F}-1}},$$

where $\%^H$ and $\%^{HF}$ are the elasticity of substitution between intermediate goods sold at home and abroad, respectively.

From standard cost minimization it is possible to derive the input demand for intermediate goods f at home and abroad:

$$Y_t^H(f) = \left(\frac{P_t^H(f)}{P_t^H}\right)^{-\varrho^H} Y_t^H,$$

and

$$Y_t^{H_F}(f) = \left(\frac{P_t^{H_F}(f)}{P_t^{H_F}}\right)^{-\varrho^{H_F}} Y_t^{H_F}.$$

The price indices are aggregations of the price of intermediate goods:

$$P_t^H = \left[\int_0^1 P_t^H(f)^{1-\varrho^H} df\right]^{\frac{1}{1-\varrho^H}}$$

and

$$P_t^{H_F} = \left[\int_0^1 P_t^{H_F}(f)^{1-\varrho^{H_F}} df\right]^{\frac{1}{1-\varrho^{H_F}}}.$$

Intermediate Domestic Sector

Intermediate home goods are produced according to the following equation:

$$Y_t^H(f) = \varepsilon_t^Y[\alpha_H^{1/\xi_H}[L_t^{1-\alpha}K_t^{\alpha}]^{\frac{\xi_H-1}{\xi_H}} + (1-\alpha_H)^{1/\xi_H}(E_t^I)^{\frac{\xi_H-1}{\xi_H}}]^{\frac{\xi_H}{\xi_H-1}},$$

where E_t^I is energy input used in the production function, combined with labor and capital. ε_t^Y is the transitory productivity shock. The parameters α and α_H define the share of capital and the share of energy inputs, while ξ_H is the elasticity of substitution between energy inputs and productivity factors.

Intermediate firms are owned by households, and they are monopolistically competitive and minimize cost, such that the nominal marginal cost is equal to:

$$MC^H(f) = \frac{W_t L_t(f) + R_t^K K_t(f) + P_t^E E_t^I(f)}{Y_t^H(f)}$$

The model assumes a Calvo price-setting mechanism and intermediate goods firms adjust each period their prices with a probability $(1-\theta)$. $(P_t^H)^*(i)$ is the price that retailers are able to adjust. Thus, intermediate goods firms maximize the following expected profit:

$$\max E_t \sum_{k=0}^{\infty} \theta^k \Lambda_{t,,t+k} \left[P_t^H(f) - MC_{t+k}^H(f)\right] Y_{t+k}^H(f) \quad ,$$

and

$$\max E_t \sum_{k=0}^{\infty} \theta^k \Lambda_{t,,t+k} \left[s_{t+k} P_t^{H_F}(f) - MC_{t+k}^H(f)\right] Y_{t+k}^{H_F}(f) \quad ,$$

where $\Lambda^{t,,t+k} = \beta^{t+k} \frac{U_{C_{t+k}}}{U_{C_t}} \frac{P_t}{P_{t+k}}$.

Intermediate goods domestic firms maximize the expected profit subject to the input demand and the production function. Then, the optimality condition for prices P_t^{H*} and $PtHF*$ are:

$$E_t \sum_{k=0}^{\infty} \theta^k \Lambda_{t,,t+k} \left[P_t^{H*}(f) - \frac{\varrho^H}{\varrho^H - 1} MC_{t+k}^H(f)\right] Y_{t+k}^H(f) = 0$$

and

$$E_t \sum_{k=0}^{\infty} \theta^k \Lambda_{t,,t+k} \left[s_{t+k} P_t^{H_F*}(f) - \frac{\varrho^{H_F}}{\varrho^{H_F} - 1} MC_{t+k}^H(f)\right] Y_{t+k}^{H_F}(f) = 0$$

I.4 Import Goods Retailers

Similar to Medina, Soto, et al. (2007), the model imposes incomplete exchange rate pass-through into import prices in the short-run by introducing local currency price stickiness, such that the expenditure switching effect of exchange rate movements can be mitigated.

The model assumes there is a continuum of import goods retailers indexed $z \in [0,1]$ who transform intermediate goods $Y_t^F(z)$ into a final consumption good Y_t^F, and the demand for import goods z is given by:

$$Y_t^F(z) = \left(\frac{P_t^F(z)}{P_t^F}\right)^{-\varrho_F} Y_t^F \quad ,$$

where $P_t^F(z)$ is the domestic-currency price of imported goods z and P_t^F is the aggregate price of imported goods in the domestic market, while $\%_F$ is the elasticity of substitution of imported goods.

Import goods retailers buy intermediate goods abroad to re-sell at the domestic market. They have a monopolistic power, and adjust their prices with a probability of $(1-\theta_F)$ each period. For simplicity, the model assumes that $P_t^{F*}(f) = P_t^{F*}$, and import goods retailers choose the price that maximizes the following expected profits:

$$\max E_t \sum_{k=0}^{\infty} \theta_F^k \Lambda_{t,,t+k} \left[P_t^F(f) - s_{t+k} P_{t+k}^{F*}(f) \right] Y_{t+k}^F(f)$$

This setup allows the exchange rate pass-through to be incomplete in the short run.

I.5 Monetary Policy

The Central Bank follows a Taylor-type rule that reacts to changes in inflation and output:

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}} \right)^{\phi_R} \left(\frac{\pi_t}{\bar{\pi}} \right)^{\phi_\pi (1-\phi_R)} \left(\frac{Y_t}{Y} \right)^{\phi_Y (1-\phi_R)} \varepsilon_{R,t}$$

where φ_π is the coefficient on inflation in the feedback rule, φ_Y is the coefficient on output, and φ_R determines the degree of interest rate smoothing. $\varepsilon_{R,t}$ is an i.i.d. monetary policy shock.

I.6 Aggregate Equilibrium and the Real Exchange Rate

Domestic output, Y_t, can be consumed, invested or exported

$$Y_t = P_t C_t + Q_{k,t} I_t^k + NX_t,$$

Net exports equals:

$$NX_t = \left[e_t (P_t^{H_F} Y_t^{H_F}) \right] - \left[e_t (P_t^F Y_t^F + P_t^{E*} (C_t^E + E_t^I)) \right]$$

The real exchange rate is given by:

$$\epsilon_t = \frac{e_t P_t^*}{P_t}$$

Moreover, the model assumes the supply of energy is completely elastic at any given price, therefore the law of one price hold, and the price of energy in domestic currency is given by:

$$P_t^E = e_t P_t^{E*}.$$

I.7 Calibration

This section calibrates parameters for a small open economy, and I use long-run statistics for a small open economy in emerging Asia. Most of the parameters are picked from Kim and Loungani (1992), Huang (2005), Chang, Liu, and Spiegel (2015) and Zhao, Zhang, Wang, and Xu (2016).

The discount factor, β is set equal to 0.985 to match the annual average deposit interest rate of around 4.35 percent in the steady state. The labor disutility, υ^L, and the labor preference, η, parameters are 1 and 2, respectively. The adjustment cost on risk premium is set equal to 0.001 as in Schmitt-Grohe and Uribe (2003).

The share of standard goods in total consumption, γ_C, and the share of home goods, α_C are set equal to 98.5 percent and 65 percent. The elasticity of substitution between standard goods and energy, ρ_c, is equal to 0.30: these parameters aim to match the low elasticities of demand for energy as in Arnberg and Bjørner (2007) and to match the ratio of the unit GDP energy consumption in Asia during 2005 of 2 percent. As in Chang, Liu, and Spiegel (2015), the elasticity of substitution between domestic and foreign goods, ξ_c is set to 0.80 to match the average import-to-GDP ratio in Asia between 1990 and 2009 of 20 percent. As in Zhao, Zhang, Wang, and Xu (2016), the depreciation rate of capital, δ is equal to 0.025 and the capital share in production, α_H is 0.3 which both imply a share of investment to GDP equal to 0.393. The Calvo parameter for nominal rigidity, θ, is set to 0.85 and the monetary policy parameters φ_π, φ_r and φ_Y are equal to 0.14, 0.9 and 1.159.

Similar to Medina, Soto, et al. (2007), I set the elasticity of substitution between intermediate goods sold at home and abroad equal to 11 and the elasticity of substitution between energy inputs and productivity factors, ξ_H is equal to 0.3 and its share in the production function is 0.01. Moreover, these values help to match the ratio of energy used in the production function to GDP, E_f/Y , in Asia during 2005 of 2.8 percent.

CHAPTER 2

MONETARY POLICY IN SMALL OPEN AND DOLLARIZED ECONOMY: AN EXPERIENCE OF CAMBODIA[1]

By
Chan Hang Saing

1. Introduction

Cambodia has experienced high average output growth with a stable macroeconomic and political environment after gaining peace for the first time in 1998 since the outbreak of the civil war in 1970. The civil war during the 1970-1975 period was accompanied by a massive U.S. bombing campaign (1970-1973) while the Khmer Rouge genocide during the 1975-1979 period had destroyed vast human and physical capital including teachers, doctors, engineers, schools, hospitals, factories and land- and water-transport infrastructures etc. Consequently, it took Cambodia around two decades after the end of the genocide in 1979 to attain the same level of the share of gross capital formation to GDP of approximately 13 percent achieved in 1970 (World Bank's World Development Indicator, 2019).

Capital accumulation[2] was further bolstered by the inflow of foreign direct investment (FDI) and foreign aid[3], which resulted in part from Cambodia's regional and global integration by becoming a member of the Association of South-East Asian Nations (ASEAN) in 1999 and the World Trade Organization (WTO) in 2004. The stock of human capital had also improved as the mean years of schooling went up from 2.7 years in 1990 to 4.8 years in 2018. The human development index (HDI) rose from 0.38 in 1990 to 0.58 in 2018 (UNDP, 2019 p.3). As a result, Cambodia's average annual GDP growth in the last two decades (1998-2018) was around 7.9 percent, while growth in 2018 was 7.5 percent (NIS, 2019). Figure 1 shows the levels of Cambodia's real gross domestic product between 1993 and 2018.

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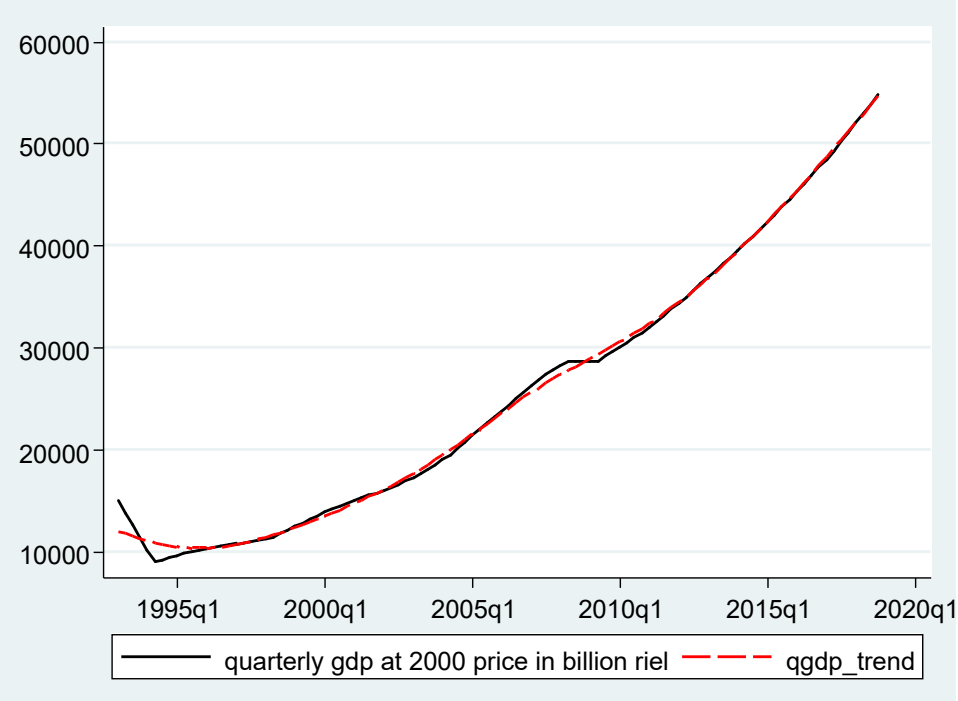
2. Share of growth capital formation to GDP was 17% in 1999, which later jumped to 23.4% in 2018 (World Bank's World Development Indicator, 2019).

3. Net Official Development Assistance (ODA) as percentage of capital formation was 46.4% in 1999 and 32% in 2009, while the figure in 2017 was 16.6%. Its average rate during the 2007-2017 period was 28.2% (World Bank's World Development Indicator, 2019).

Nevertheless, Cambodia is still faced with structural issues such as the narrow base of the economy (relying on a few industries, namely textile and garment, hotels and restaurants, construction, and real estate, as main sources of growth), limited institutional capacity and governance and high cost of infrastructural services, particularly electricity and transport. However, diversifying the base of the economy has also been under way as production has been expanded to include light manufacturing industries such as bicycle assembly and spare parts and agro-processing. Institutional reforms and governance enhancement programs have also been put in place as set out in the Government's National Strategic Development Program 2019-2023 (NSDP) and Rectangular Strategy Phase IV (RSP IV).

Against this backdrop, there is also a phenomenon of dollarization originally propelled by the huge inflows of U.S. dollar currency from the United Nations into Cambodia in early 1990s to finance its peace keeping forces and guarantee the success of the first multi-party democratic election in 1993. In the early days, the shares of foreign currency to broad money were 26.3 percent and 38.8 percent in 1992 and 1993, respectively, but increased to 51.8 percent in 1994 and 56.4 percent in 1995 (Baliño et al., 1999). Latest data of the same measure in July 2019 was 84.4 percent, which is considerably higher than the figure two decades ago (National Bank of Cambodia, 2019).

Figure 1
Cambodia's Gross Domestic Product in Billion Riel (LCU), at 2000 Price



Source: Author's estimation using data from National Institute of Statistics, 2019.

According to the traditional view, dollarization is viewed as an obstacle to the implementation of monetary policy, specifically by limiting the capacity of the transmission mechanism of monetary policy. This view is supported by the literature. Studies such as Acosta and Coble (2011); Mengesha, Shen and Lim (2017) ; Ize and Yeyati (2006); Dabla-Norris and Floerkemeier (2006); Isakova-Cerge-ei (2008); and, Alvarez-Plaza and Gracia-Herrero (2008), show that dollarization, financial in particular, restrains the capacity of monetary transmission mechanism, while others such as Armas and Grippa (2005); Rossini and Vega (2008); Leiderman et al. (2006); Billmeier and Banoto (2004); Reinhart et al. (2003); and, Quispe, (2000) find that dollarization does limit the monetary authority from implementing monetary policy, such as inflation targeting, to attain price stability goal.

Generally, monetary policy is transmitted through five channels, namely interest rate, exchange rate (both direct and indirect), credit, asset prices and expectation, to inflation which is the end goal. In the absence of an interbank and money market, particularly the market for government bonds, coupled with the high level of dollarization, attaining effective implementation of monetary policy has been a challenge for the Cambodian monetary authority. Stabilizing inflation through the nominal exchange rate anchor has been an effective tool of the Cambodian monetary authority, while other monetary policy instruments, such as reserve requirement, Negotiable Certificate of Deposits (NCDs) and Liquidity Providing Collateralized Operation (LPCO) have also been adopted to support the rapid development of the financial sector in Cambodia. However, such a high level of dollarization makes Cambodia's monetary policy strongly connected with changes in the U.S. Federal Funds Rate, and the evidence of such a relationship has been shown in Duma (2011) and Samreth et al. (2019). Findings in this study also corroborate with those in the aforementioned studies.

This study is conducted as part of the research project on the "Distributional Impact of Monetary Policy" focusing on income distribution and inequality in Southeast Asian countries, initiated by the South East Asian Central Banks (SEACEN) Research Training Centre. Limitation in the quarterly data on income distribution and the extremely high dollarization prevents this study from examining the aforementioned topic at length. Nevertheless, in contribution to the project, this study uses relevant and available data and provides a narrative of the development of monetary policy under high dollarization in Cambodia.

This study is, therefore, aimed at revisiting monetary policy tools that are in operation and their contribution to the stabilization of the Cambodian macroeconomic environment will be discussed, as reflected by the low and stable inflation and low volatility of the exchange rate and international reserves during the last two decades. It also looks at the responses of inflation, interest rate, exchange rate, output gap, and Cambodia-US trade balance to a shock of the U.S. Federal Funds Rate to see whether the responses differ from those in previous studies, particularly Duma (2011) and Samreth et al. (2019). This study is organized as follows. Section 2 reviews the literature on transmission channels of monetary policy and effectiveness of the transmission mechanism in dollarized economies. Section 3 describes the trends of income inequality in Cambodia. Section 4 presents Cambodia's macroeconomic conditions and monetary policy. Section 5 describes the empirical methodology followed by data collection in Section 6. Section 7 discusses empirical results. Finally, Section 8 concludes.

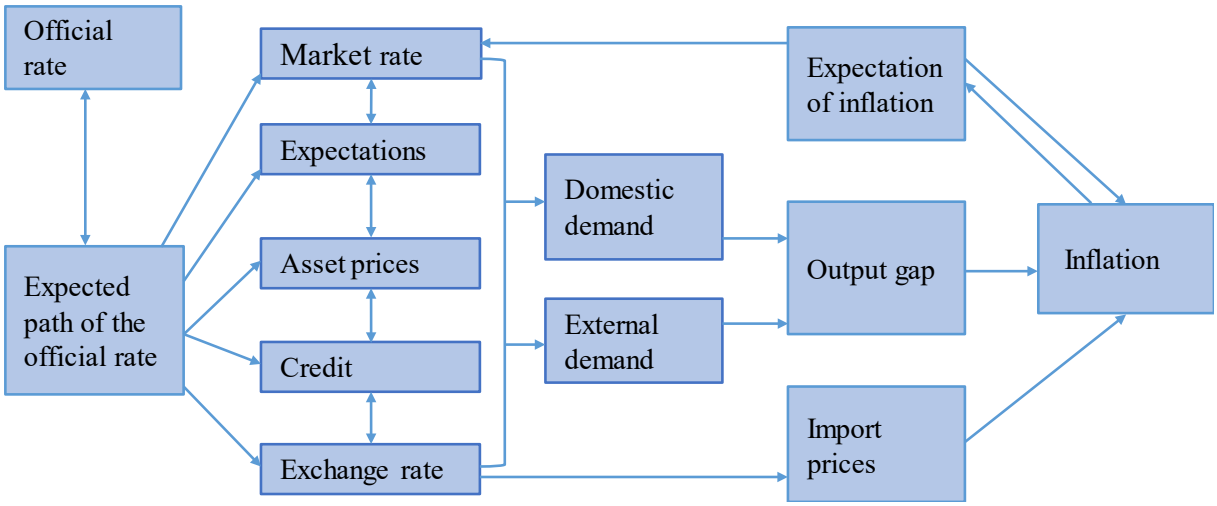
2. Literature Review

This section describes the basics of monetary policy transmission mechanism and discusses the effectiveness of the transmission mechanism in dollarized economies based on evidence from existing studies.

2.1 Monetary Transmission Mechanism

Generally, the primary objective or the overriding goal of the central bank is price stability, while other sub goals include potential output growth and full employment. The goal of stable price or low inflation is usually attained through the setting of its policy/official rate which is transmitted through a number of channels, namely interest rate, exchange rate, asset prices, credit (bank lending and balance sheet) and expectations, to affect inflation. Figure 2 below shows the details of the monetary policy transmission channels, each of which is not completely independent.

Figure 2
Monetary Policy Transmission Channels



Source: Adapted from Epstein and Tok, 2019.

The first transmission channel is interest rate, which runs from policy rate to market rate, and aggregate demand as measured by the change in firms' and households' investment. A change in aggregate demand would affect the output gap, resulting in a change of the price level. For instance, an increase in the official rate drives up the market rate, resulting in an increase in the cost of borrowing, which discourages households from spending on durable goods and firms from investing in productive assets. This affects aggregate demand and the output gap negatively, which leads to a decline in the price level. The second channel is the exchange rate which affects the output gap both directly and indirectly. For instance, a hike in the official rate causes the exchange rate to appreciate, leading to a drop in foreign demand for domestic goods (indirect effect) and a rise in the domestic demand for imported goods (direct effect). As a result, the aggregate demand and output gap are negatively affected, which pushes down the overall price level.

The third channel is asset price (wealth). An increase in the official rate makes household assets such as housing and stock less valuable; consequently, households cut back their spending on durable goods, which causes a decline in the aggregate demand as well as a drop in consumer prices. The credit channel works through either bank lending or the balance sheet. A rise in the official rate drives up the market rate because a contraction in money supply causes banks to cut back on their lending, discouraging households and firms from investing. The increase also reduces the prices of assets, which are often used by firms as collaterals for borrowing. This leads to firms' having difficulty in acquiring credit to cover spending on their working capital. Later, firms incur a decline in profit and can lead to a rise in non-performing loans that worsens banks' balance sheets. In such a situation, banks are inclined to cut down the supply of loans, which negatively affects firms' investment. These two events negatively affect aggregate demand and the output gap, as well as inflation.

Expectation is the last channel but is considered by some economists as the most important relative to other monetary policy transmission channels. It is referred to the expectation of private agents, namely households and firms, about the future policy of the monetary authority. This channel works through a change in the policy rate affecting expectations of different economic agents about the future path of important economic variables, such as income, interest rate and inflation. Their expectations over these variables usually have influence on their consumption and investment. Therefore, clear and predictable monetary policy frameworks establish confidence of private agents, i.e., households and firms for the monetary authority and could serve as a price stabilization tool.

2.2 Monetary Transmission Mechanism in Dollarized Economies

Conventional view on the association between dollarization and the monetary transmission mechanism is that dollarization limits the monetary transmission mechanism, therefore, restraining the monetary authority from attaining their goal of price stability. Whether dollarization hinders the transmission mechanism of monetary policy has long been debated, and there has yet to be a consensus on this. While some studies show that dollarization matters for the transmission mechanism, others by contrast, show that it does not.

Studies that find the transmission mechanism in dollarized economies less effective than that of non-dollarized economies include Acosta and Coble (2011), Mengesha, Shen and Lim (2017), Ize and Yeyati (2006), Dabla-Norris and Floerkemeier (2006), Isakova-Cerge-ei (2008) and Alvarez-Plaza and Gracia-Herrero (2008). Acosta and Coble (2011) look at the effectiveness of the monetary transmission mechanism in the non-dollarized economies of Chile and New Zealand and highly dollarized Peru and Uruguay. They show that the interest rate channel is effective in attaining the inflation target in non-dollarized economies, but not effective in dollarized economies, where the exchange rate channel appears more relevant. Mengesha, Shen and Lim (2017) extended the work of Acosta and Coble (2011) by increasing their study sample to six partially dollarized economies and six non-dollarized countries and applying monthly data over the 1999-2014 period to examine

the degree of response of output and inflation to a shock of the policy rate. They show that output and inflation are responsive in all non-dollarized economies, while only some of the dollarized economies exhibit significant responses of output and inflation to the shock of the policy rate.

Despite abundant studies showing the limitation of the monetary policy transmission mechanism created by dollarization, a number of studies, in converse, support the view that dollarization does not restrain the transmission mechanism of monetary authority from reaching its targeted goal (i.e., targeted inflation). The studies include Armas and Grippa (2005), Rossini and Vega, (2008), Leiderman et al. (2006), Billmeier and Banoto, (2004), Reinhart et al. (2003) and Quispe, (2000). Armas and Grippa (2005) show that high financial dollarization did not preclude Peru's monetary authority from maintaining low and stable inflation by the adoption of inflation targeting during the 2002-2004 period. This is supported by Rossini and Vega (2008), who surveyed the monetary transmission mechanism in Peru during the 1996-2006 period. Rossini and Vega (2008) show that there is evidence of an effect of financial dollarization on the the transmission capacity of monetary policy tools, but the phenomenon is not an obstacle to Peru's adoption of inflation targeting in 2002 to attain its targeted rate of inflation.

In addition, Leiderman, Maino and Parrado (2006) examine the efficacy of the transmission mechanism and types of money policy regimes in two highly dollarized economies (Peru and Bolivia) and two other economies with low levels of dollarization (Chile and Columbia) during the 1993-2005 period. The study shows that although dollarization clearly affects the transmission capacity of monetary policy instruments, it does not fully obstruct countries in the sample from using inflation targeting as a policy regime. Furthermore, a unique and interesting study by Billmeier and Banoto on the exchange rate pass-through in Croatia in 2004 shows that despite a high level of dollarization, the empirical investigation of the study does not detect evidence of high exchange pass-through in the country. Nevertheless, the study cautions that the policy drawn based on the result should be conditional on the endogeneity of the pass-through to the policy regime.

In sum, the literature on the efficacy of monetary transmission channels in dollarized settings tends to focus more on two key transmission channels, namely interest rate and exchange rate, and inflation targeting as the monetary policy regime. Although there are studies indicating the influence of dollarization, financial dollarization in particular, on the monetary transmission mechanism, such influence does not preclude dollarized economies, such as Peru and Bolivia from adopting inflation targeting to attain low and stable inflation and low volatility of the exchange rate. The literature also highlights the important role of the exchange rate in financial and real dollarized economies.

3. Trends of Income Inequality and Income Shares Held by Key Income Groups

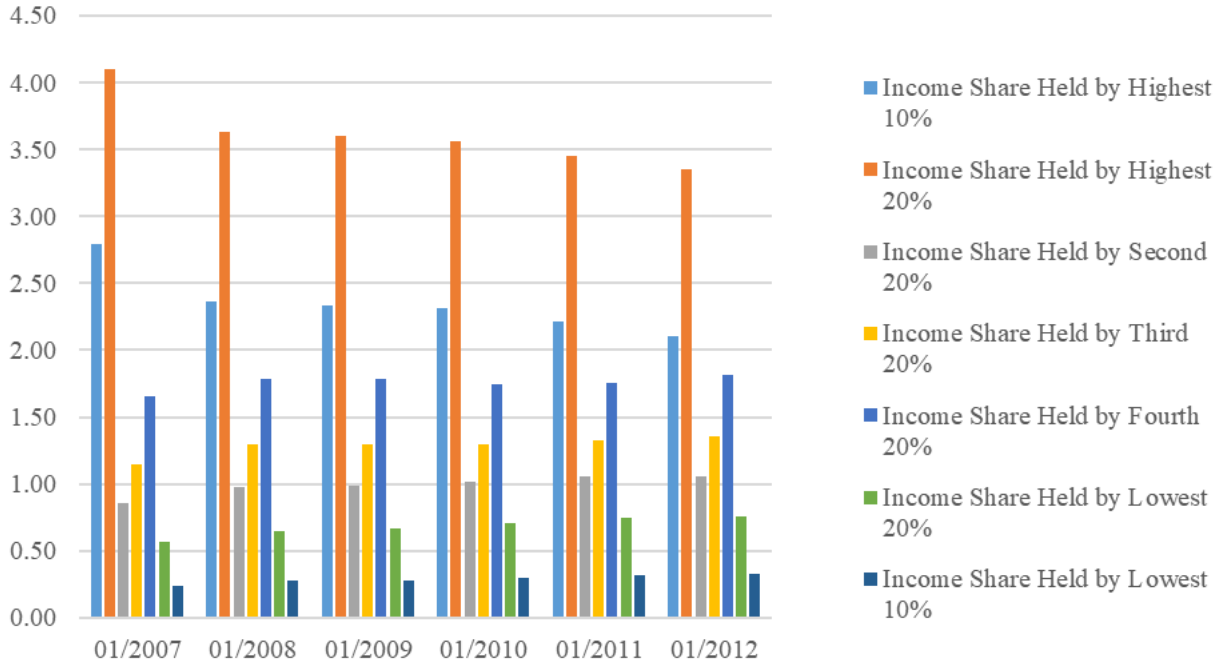
The topic of inequality in Cambodia gained attention from policymakers, development partners, researchers, and academia only after the first release of the World Bank's Equity Report in 2007 revealing significant growth (45 percent) of daily per capita consumption of the top 20 percent compared with a slim growth (8 percent) of that of the bottom 20 percent between 1997 and 2004 (World Bank, 2007). This inequality is concentrated primarily in the rural areas where villages that are better connected by roads tended to have better access to public services and markets than those in more remote areas although moderate income gaps were also observed in the urban areas. Considerable gaps in innate abilities, human capital (health and education status), endowment of land and other productive assets among households further exacerbate inequality among households in the rural communities in Cambodia. However, Figure 3 which is generated from the standardized world income inequality database compiled by Solt (2019), paints a completely different picture of the inequality trend in Cambodia over the same period of 1997-2004, while the downward trend of the Gini index measured at both market and disposable incomes extended into 2012, but at a gradual and slower pace. The contribution of monetary policy to this drop appears unlikely given the limited monetary capacity of the National Bank of Cambodia and the high level of dollarization during this period. Moreover, this is not clearly known as there has not been any assessment of the distributional impact of monetary policy given the limitation of data and dollarization issue.

Figure 3
Gini Index for Cambodia between 1997 and 2012

Note: Solid lines indicate mean estimates; shaded regions indicate the associated 95% uncertainty intervals.
Source: Standardized World Income Inequality Database V8.2 (Solt 2019).

Figure 4 provides, in part, the explanation for the downward trend of the Gini index between 2007 and 2012 as income shares held by the highest 10 percent and top 20 percent exhibited a moderate decline over the period, while the income shares held by other lower-income groups grew gradually and continuously over the same period. Nevertheless, the highest 10 percent and 20 percent groups still held substantial proportions of the national income over the 1997-2012 period, while shares of income held by the lowest 10 percent and 20 percent showed sluggish growth over the same period. Improved transportation infrastructures, along with the advance of modern information communication technology (ICT), may have helped facilitate the movement of low-skilled workforce in the traditional agricultural sector in rural areas to the labor-intensive-manufacturing industry, textiles and garments in particular, in urban areas, thus allowing these low-skilled workers to move up the income ladder. Productivity gains among low-skilled rural-urban migrant workforce resulting from the increase in the demand for non-tradable goods in urban cities is also likely a facilitating mechanism of the continued drop of the Gini index.

Figure 4
Share of Income Held by Key Income Groups between 2007 and 2012



Source: World Bank World Development Indicator, 2019

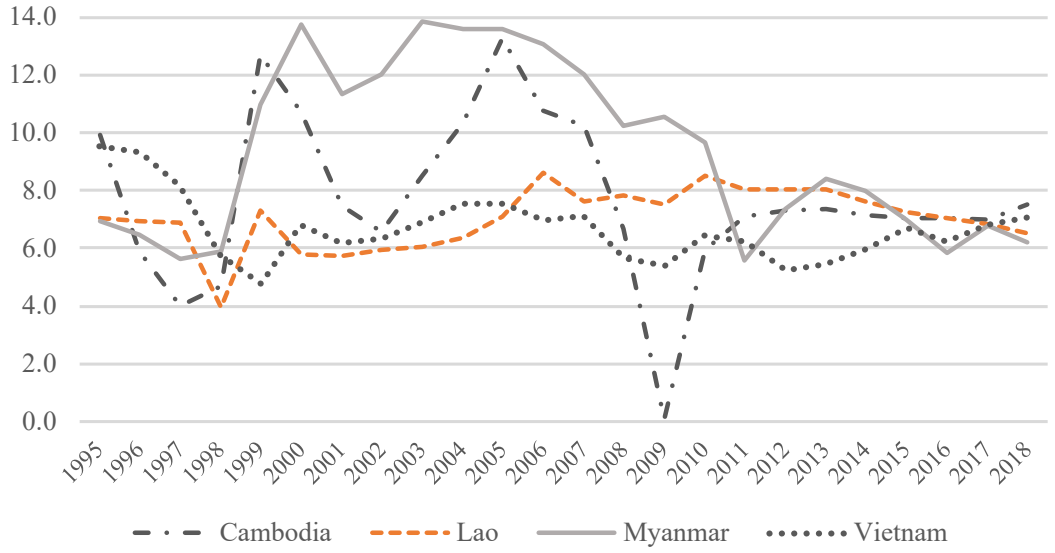
4. Cambodia's Macroeconomic Conditions and Monetary Policy

4.1 Macroeconomic Conditions

Cambodia showed a remarkable growth in its GDP during the last two decades, thanks to real and genuine peace fully restored in 1998 when the Khmer Rouge rebel soldiers were demobilized and reintegrated into the Royal Government Armed Forces. Figure 5 shows that growth in Cambodia was remarkable relative to its CLMV (Cambodia, Lao P.D.R, Myanmar, Vietnam) peers during the 1995-2018 period although Cambodia was hit hardest relative to other CLMV countries by the global economic crisis in 2009. The

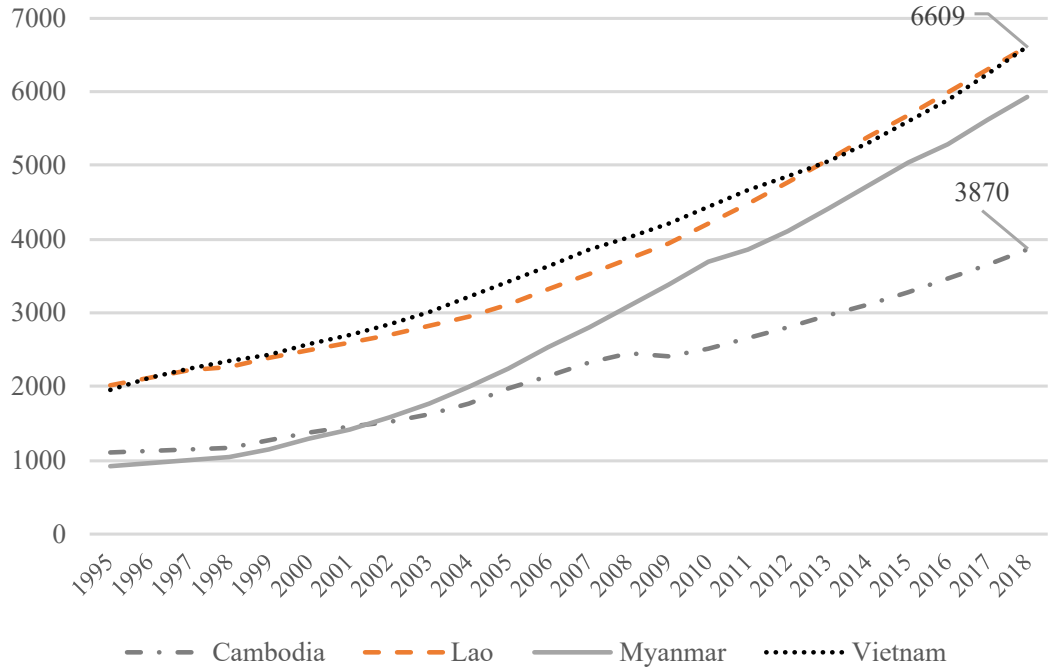
average GDP growth during the 1998-2009 period was 8.5 percent, higher than the growth rates of its neighboring Lao P.D.R. and Vietnam except Myanmar. After the crisis, growth stayed at around 7 percent during the last ten years, while its CLMV peers maintained the rate between 6 and 8 percent.

Figure 5
Annual Real GDP Growth, (1995-2018)



Source: World Bank World Development Indicator, 2019.

Figure 6
Per Capita GDP, PPP at 2011 US$

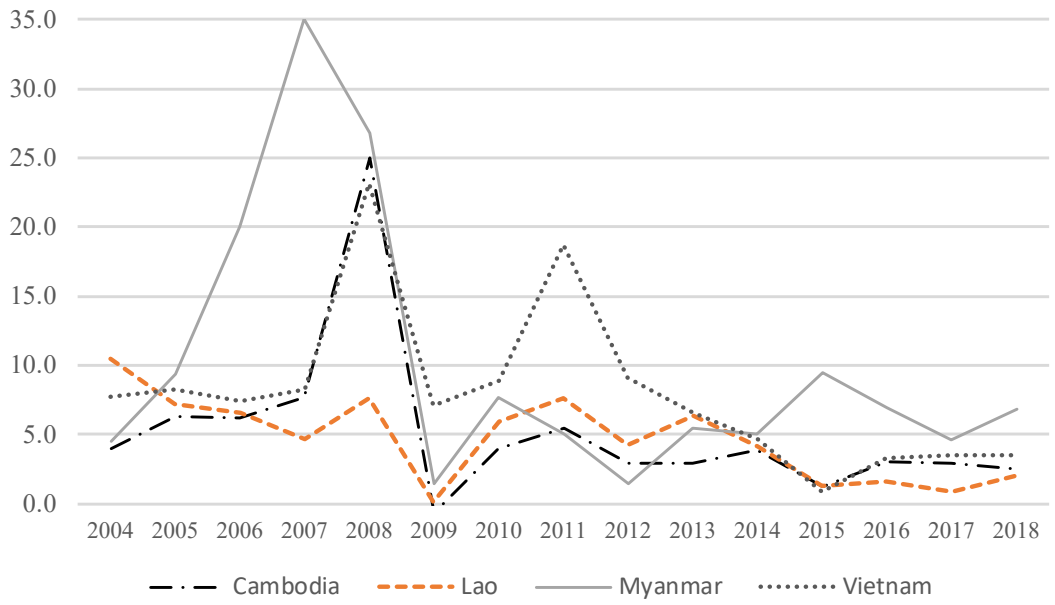


Source: World Development Indicator, 2019.
Note: PPP: Purchasing Power Parity.

Despite its high GDP growth relative to other CLMV nations, Cambodia's per capita GDP measured using purchasing power parity (PPP) at US$2011 was considerably lower than that of Lao P.D.R., Myanmar and Vietnam during the last decade (Figure 6). It is quite astounding that Myanmar's per capita GDP was below Cambodia's during the second half of the 1990s, but it overtook Cambodia's during early 2000s and by 2018, its per capita was around 53 percent higher than Cambodia's. However, we observe continued and gradual growth of per capita GDP for Cambodia, but the pace is less rapid than those of its CLMV peers.

The inflation rate in Cambodia has been kept well under control except for the global oil and food prices increase in 2008 that pushed inflation up to 25 percent, higher than those in Lao P.D.R. (7.6 percent) and Vietnam (23 percent), but slightly below that of Myanmar (26.8 percent). It is quite surprising that Lao P.D.R. was not hit by the global oil and food price shock. The average rate of inflation in Cambodia during the 2014-2018 period stood at 2.7 percent, which is quite close to the rate in Lao P.D.R. (2 percent) and Vietnam (3.2 percent) during the same period (Figure 7).

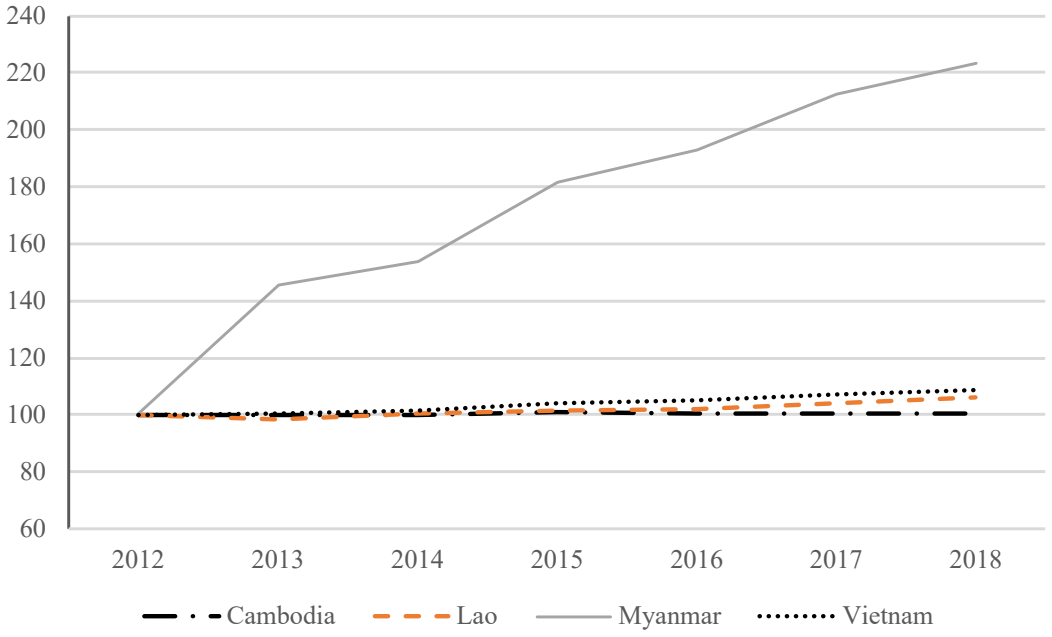
Figure 7
Annual Inflation Rate, (2014-2018)



Source: World Bank World Development Indicator, 2019.

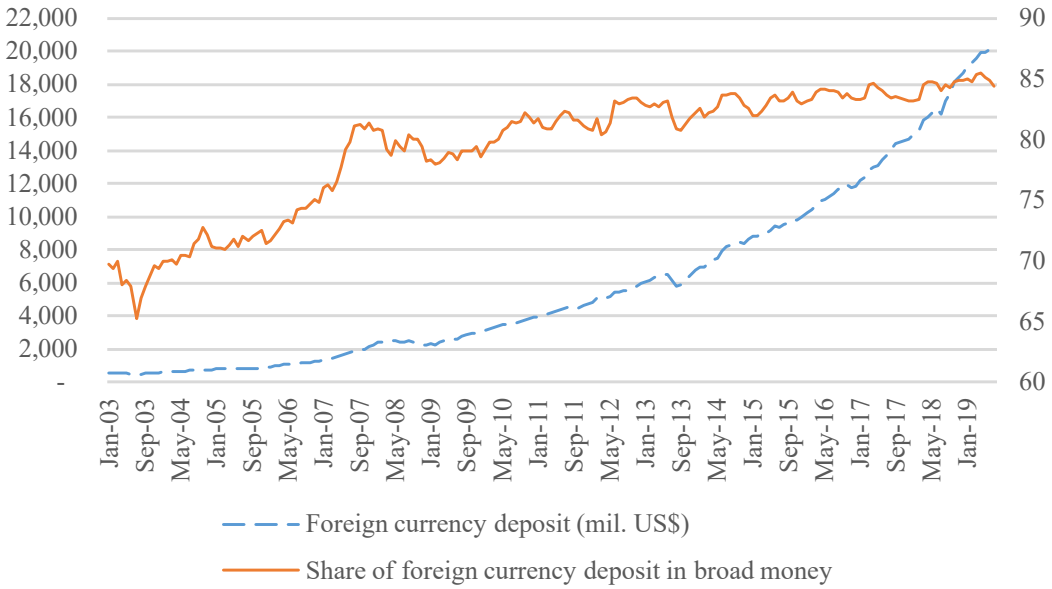
In addition to strong GDP growth and stable prices, the nominal exchange rate in Cambodia was also stable during the 2012-2018 period. The nominal exchange rate varied between -1 percent and +1 percent and stayed between 4,030 riel and 4,051 riel per US$. Lao P.D.R. and Vietnam except Myanmar were also able to stabilize their exchange rate during the same period (Figure 8). Substantial fluctuations in the nominal exchange rate in Myanmar reflected the floating exchange rate regime adopted by the country.

Figure 8
Foreign Exchange per US$, (2012=100)



Source: World Bank World Development Indicator, 2019.

Figure 9
Foreign Currency Deposit in Million US$ and Share in Broad Money



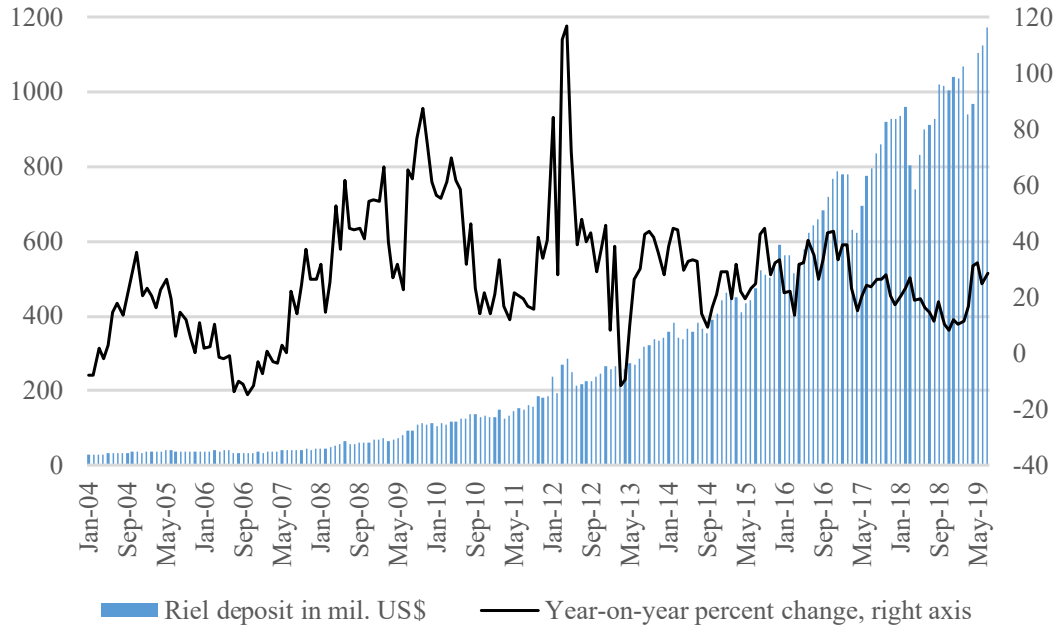
Source: Author's estimate using data from the National Bank of Cambodia, 2019.

In spite of favorable macroeconomic conditions categorized by robust growth and stable price and exchange rate, dollarization continues to be deeply rooted in the Cambodian economy. Foreign currencies, US dollars in particular, dominate the local currency across the three functions of money: medium of exchange, store of value and unit of account. Figure 9 shows the volume of foreign currency deposits and its share in broad money between January 2003 and July 2019. Foreign currency deposits in the banking system was only US$522 million in January 2003, but went up to around US$20 billion in July 2019. Meanwhile, its

share in broad money was 84.4 percent in July 2019, higher than the 70 percent in January 2003, suggesting a high level of dollarization, which is higher than level of dollarization in Lao P.D.R. at 49.4 percent in 2018 (IMF, 2019).

As indicated above, the share of foreign currency deposits in broad money for Cambodia was twice as large as the size of the same indicator for Lao P.D.R. in 2018. However, Figure 10 below shows the exponential rise in Khmer riel deposits between January 2004 (US$29 million) and July 2019 (US$1.1 billion), suggesting a gradual increase in riel use, although at a slower pace relative to the rise in US dollar deposits, over the period. This in effect implies that riel substitution for the US dollar has been extremely weak.

Figure 10
Riel Deposits in Banking System



Source: Author's estimate using data from the National Bank of Cambodia, 2019.

4.2 Monetary Policy Framework

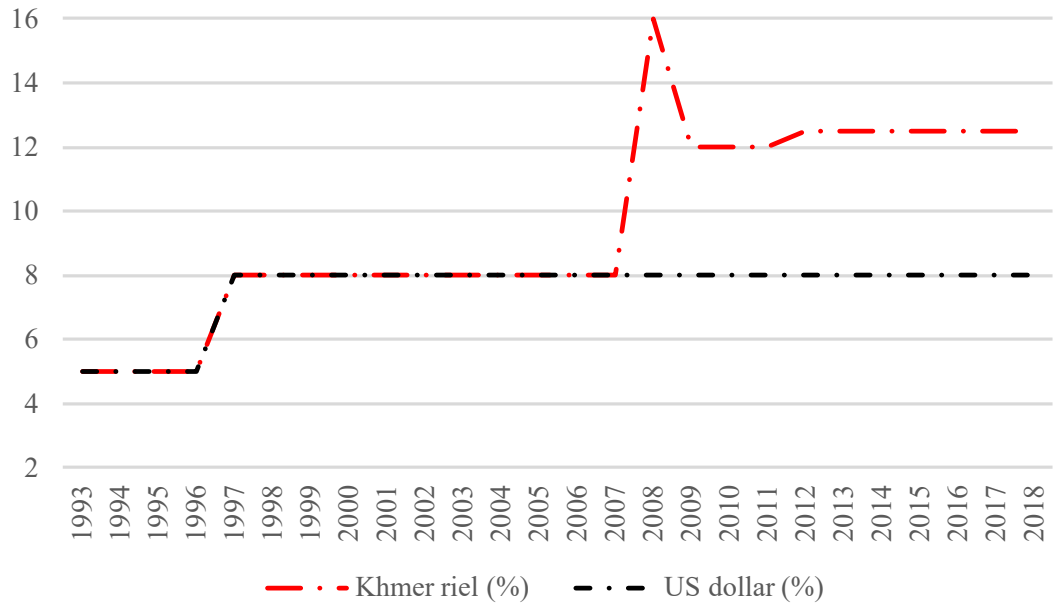
As indicated in Article 3 of the Law on the Organization and Conduct of the National Bank of Cambodia passed on January 26, 1996, the principal mission of the National Bank of Cambodia is to "determine and direct the monetary policy aimed at maintaining price stability in order to facilitate economic development within the framework of Cambodia's economic and financial policy." The current monetary policy framework of the National Bank of Cambodia is operated under the constraint of dollarization and the absence of a money market and the market for government bond.

At present, there are three monetary policy tools implemented by the National Bank of Cambodia, and they are reserve requirement (RR), Negotiable Certificate of Deposits (NCD), and Liquidity Providing Collateralized Operation (LPCO). The RR has been the Bank's traditional monetary tool, while the latter two have just been adopted in recent years. Meanwhile, the managed floating exchange regime is adopted by the National Bank to maintain price stability.

4.2.1 Reserve Requirement

Reserve requirement is the primary monetary policy tool that the National Bank of Cambodia uses to affect liquidity in the banking system. The rates had long been applied equally to both KHR and US$ deposits until 2008, when Cambodia was hit by the global financial crisis. The required reserves for US$ went up from 8 percent in 2008 to 16 percent in 2009, later dropping to 12 percent during the 2009-2011 period and 12.5 percent during the 2012-2018 period (Figure 11). Required reserves for KHR remained at 8 percent between 1997 and 2018. The hike in US$ reserve requirements was intended primarily to promote the use of the Khmer riel and discourage the use of US$ in the economy. The role of reserve requirements should not be underestimated in a dollarized economic environment since it has the potential to have significant effect on US$ liquidity in the banking system.

Figure 11
Reserve Requirement, 1993-2018



Source: National Bank of Cambodia, 2019.

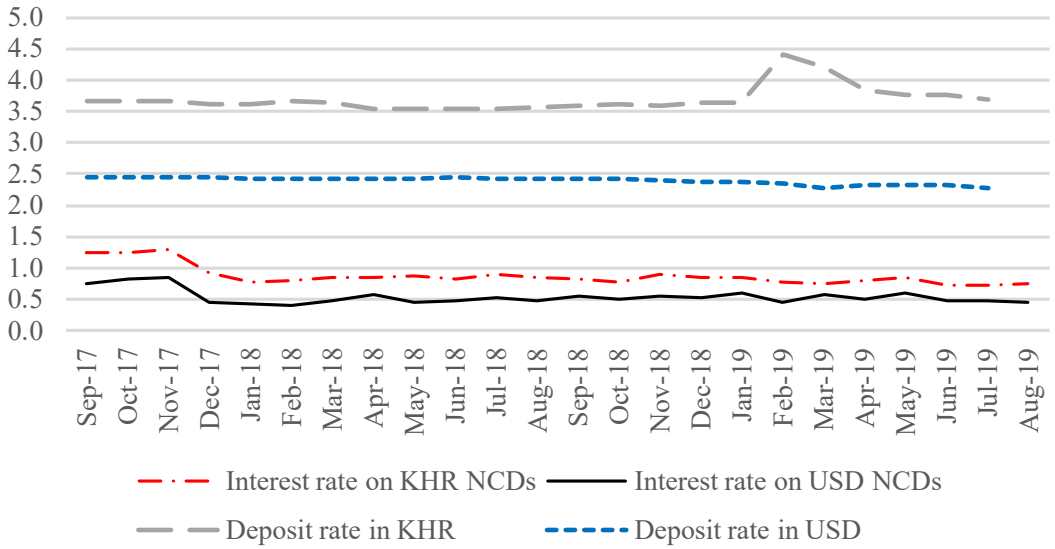
4.2.2 Negotiable Certificate of Deposits (NCDs)

The second monetary policy instrument is the Negotiable Certificate of Deposits which is a short-term interest-bearing debt issued by the National Bank of Cambodia. Its operation started in September 2013 following the Prakas on "the Issuance of Tradable Securities" issued on October 10, 2010. The primary objective of this instrument is to absorb idle excess liquidity in the banking system, while also aiming to promote the development of the money market and interbank lending on a secured basis.

The NCDs are issued in both Khmer riel and US$ so as to absorb excess liquidity of both currencies in the banking system. All financial institutions can make NCD purchase requests through either the NBC web platform known as NBCP, electronic email or over the counter. The minimum invested amount of NCDs is KHR200 million equivalent to around US$50,000. Maturities of KHR-denominated NCDs comprise 2 weeks, 1 month, 2 months, 3 months, 6 months, 9 months and 1 year, while the USD-denominated NCDs have maturities

similar to those of KHR-denominated NCDs except for the 9-month maturity. Financial institutions cannot return NCDs to the NBC prior to maturity, but can sell them to other financial institutions under the Repo Master Agreement guaranteed by the NBC.

Figure 12
Interest Rates on NCDs and Deposits in KHR and USD



Source: National Bank of Cambodia, 2019.

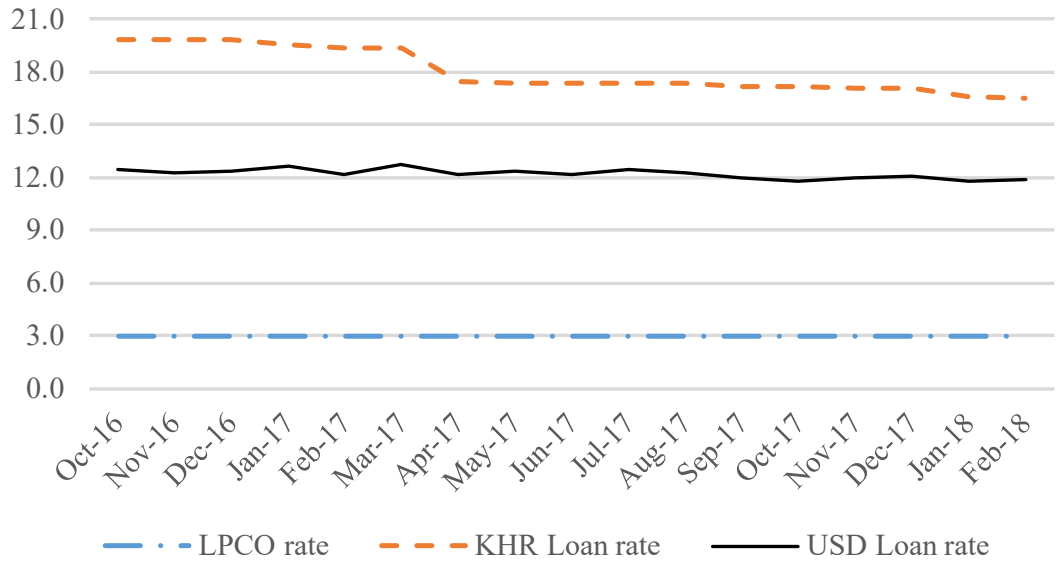
Figure 12 shows the average interest rates for all maturities (maximum of one year) on NCDs[4] and deposits at banks between September 2017 and August 2019. Rates on KHR- and US$-denominated NCDs are generally lower than those of deposits in KHR and US$ at banks, while rates on KHR-denominated NCDs are usually higher than those on US$-denominated NCDs. In 2018, interest rates on KHR-denominated NCDs varied from 0.53 percent (one week) to 2.25 percent (one year), while interest rates on US$-denominated NCDs stayed between 0.27 percent (one week) and 1.1 percent (one year).

4.2.3 Liquidity Providing Collateralized Operation (LPCO)

The third monetary policy instrument is Liquidity Providing Collateralized Operation which is a loan provided by the NBC in Khmer riel to financial institutions that are required to own NCDs and use them as collateral. Its operation has started since September 2019. LPCO has five main objectives: 1) promote the use of Khmer riel; 2) support agricultural sector; 3) promote interbank market development; 4) develop secondary market of NCDs; and 5) develop the Repo market. To acquire KHR liquidity from the NBC, eligible financial institutions have to participate in an open auction, which is intended to ensure transparency. The auction is conducted on a monthly basis. The appropriate haircut[5] is applied to US$-denominated NCDs to mitigate foreign exchange risks, which means financial institutions can use US$-denominated NCDs as collateral to acquire LPCO.

4. Interest rates for both KHR- and US$-denominated NCDs are applied rates, which are rates for NCDs purchased by financial institutions every month.
5. According to the Repo Master Agreement, haircut refers to "adjusted securities price" or overcollateralization at the initiation of the Repo transaction. The current rate is 5 percent.

Figure 13
Interest Rate on LPCO and Loan in KHR and USD



Source: National Bank of Cambodia, 2019.

Being able to use US$-denominated NCDs as collateral to obtain LPCO, financial institutions that are short of KHR liquidity, especially microfinance deposit-taking institutions (MDIs) and microfinance institutions (MFIs) that are main lenders to agriculture sector, can smooth out their liquidity shortage and provide KHR loan at lower interest rates. At present, these MDIs and MFIs obtain funds in US$; and therefore, they offer loans at high interest rates. The LPCO has emerged to help relax these high rates of interest. Figure 13 shows that the average interest rate on LPCO (3 percent) is far below that for loans in Khmer riel at around 16.6 percent, and the association between the two rates is extremely weak or negligible as far as the Figure 13 indicates.

4.2.4 Foreign Exchange as Monetary Policy Instrument

The last monetary instrument is exchange rate stabilization through the purchase and sale of currency in the foreign exchange market in order to maintain low and stable inflation. Such intervention in the context of high financial and real dollarization is also in line with suggestions made in the literature. For instance, Leiderman et al. (2006) postulate that the pass-through of exchange on prices in a financially dollarized economy categorized by high US$-denominated deposits and loans is usually higher than that in non-dollarized economy as the nominal anchoring role of the exchange rate is more important in a dollarized economy. In addition, Ize and Yeyati (2001) indicate that in an extreme case, if prices and wage are set in US dollar (real dollarization), monetary policy becomes ineffective. As a result, the targeting exchange rate is the only possible strategy (cited in Billmeier and Bonato, 2004).

Figure 14
Exchange Rate per U.S. Dollar, 1990-2019

Source: IMF's International Financial Statistics, 2019.

Foreign exchange market intervention has been undertaken during the last two decades as KHR/US$ has stabilized and so has the inflation rate (Figure 14). This suggests the presence of a pass-through effect from the exchange rate to domestic prices, which was confirmed by a study by the Bank of Korea in 2017, showing positive association between the exchange rate and inflation in Cambodia (BOK, 2017).

Overall, given the absence of a money market, i.e., government bonds, it does not allow the NBC to utilize the policy rate but rather four monetary policy instruments, which include reserve requirement, NCDs, LPCO and the nominal exchange rate anchor. Reserve requirement has not been the prime instrument because its rate has not been changed frequently. NCDs help absorb excess liquidity in the banking system, while LPCO helps channel KHR credit into MFIs that are short of KHR liquidity to smooth out their liquidity shortage and supply KHR loans to households and businesses in the agricultural sector at more favorable interest rates. While this indicates the limitation of monetary policy implementation, nevertheless, active foreign exchange intervention has helped stabilize the exchange rate and thereby achieve low and stable inflation, while dollarization continues to restrain the capacity of monetary transmission of the policy implementation by the NBC.

5. Empirical Methodology

As indicated in the previous sections, the absence of a money market prevents the National Bank of Cambodia from using a policy rate to affect a macroeconomic variable such as the money market rate to achieve its core monetary objective of price stability. This in effect limits the National Bank's monetary policy operations to the use of its current monetary policy instruments, of reserve requirement, Negotiable Certificate of Deposits, Liquidity Providing Collateralized Operation, and its foreign exchange policy of managed floating. Moreover, given the high level of dollarization in Cambodia, the country's monetary policy is influenced by U.S. monetary policy, specifically by a change in the U.S. Federal Funds rate.

Therefore, rather than examining the effect of the policy rate which is not relevant for Cambodia, we follow Duma (2011) and Samreth et al. (2019) by looking at the effect of the U.S. Federal Funds rate on Cambodia's key economic variables, namely, interest rates on loans, trade balance with the U.S., nominal bilateral exchange rate with US$, GDP gap and inflation. To examine this effect, we apply VAR-based impulse responses of the aforementioned variables to a shock of U.S. Federal Funds rate. Our model specification below is set up in line with those of Mengesha, Shen and Lim (2017) and Acosta-Ormaechea and Coble (2011) with the consideration of Duma (2011). In other words, the Vector Autoregressive (VAR) model is applied and the specification of VAR is expressed as follows:

$$G_t = A(L)G_{t-1} + B(L)X_t + u_t \quad (1)$$

where $A(L)$ and $B(L)$ are n by n and n by k polynomial matrices in the lag operator L, respectively, while G_t and X_t are vectors of endogenous and exogenous variables. In addition, u_t is a vector of error terms. Endogenous variables G_t comprises interest rate on loan (R_t), inflation rate (P_t), GDP gap (Y_t), nominal exchange rate (NER_t), broad money (BM_t), U.S. Federal Funds rate (FFR_t) and trade balance (TB_t) and is expressed as follows:

$$G_t = [\ Y_t\ P_t\ NER_t\ R_t\ BM_t\ TB_t] \quad (2)$$

Additionally, an exogenous variable X_t is added to the model to control for the external environment that may exert influence on the dynamics of the model as Cambodia is a small and open economy. Since the U.S. and EU are Cambodia's main trading partners, we add inflation in the U.S. (π_t), world commodity price index (WCP_t), interest rate in the Euro zone (EUR_t) and inflation rate in EU (EUP_t) to the model as exogenous variables and it can be expressed as follows:

$$X_t = [\pi_t\ FFR_t\ WCP_t\ EUR_t\ EUP_t] \quad (3)$$

Since severe econometric consequences may arise when using nonstationary series in the model specification above, it is therefore important to conduct the unit root or augmented Dickey-Fuller test, which is very common in time series econometric practice at the start of the analysis to detect stationarity of each series or variable. The procedure of the test is as follows. First, least square regression (OLS) is applied to estimation equation below:

$$\Delta y_t = \alpha + \gamma y_{t-1} + \sum_{s=1}^{m} a_s \Delta y_{t-s} + v_t \quad (4)$$

where $\Delta y_{t-1} = (y_{t-1} - y_{t-2})$, $\Delta y_{t-2} = (y_{t-2} - y_{t-3})$, etc. The number of these lagged first differenced terms is determined by examining the autocorrelation function (ACF) of the residuals v_t or the significance of the estimated lag coefficients a_s in order to ensure that autocorrelation in the errors is eliminated (Hill, Griffiths and Lim, 2018). It should be noted that y_t represents each variable considered in our model. The one-sided test hypothesis of non-stationarity of the variable is expressed as follows:

$$H_0: \gamma = 0$$
$$H_1: \gamma < 0$$

The null hypothesis is that y_t is nonstationary, which means if we do not reject the null hypothesis, y_t is a stationary process. More importantly, rejection is made when the τ statistics is smaller than the critical τ_c value, which is specifically determined to -3.43 at 1 percent, -2.86 at 5 percent and -2.57% at 10 percent significance levels, respectively[6] (Hill, Griffiths and Lim, 2018). It is important to keep in mind that when a series is stationary, it is said to have an integration of order zero **I(0)**. Non-stationary series that can be made stationary by taking the first difference is said to have an integration of order one **I(1)**.

6. Data Collection

We use quarterly data spanning over the period between first quarter of 1995 and fourth quarter 2018. Data are collected from various reliable sources. GDP is obtained from the National Institute of Statistic (NIS) of the Ministry of Planning (MOP), while the GDP gap which is the difference between actual GDP and potential GDP is obtained by using Hodrick-Prescott (HP) filter to extract the gap (cyclical components) from the actual GDP. Since GDP is measured on a yearly basis, we apply linear interpolation in order obtain quarterly GDP data before employing the HP filter. Inflation for Cambodia is obtained from the IMF and is a quarterly year-on-year percentage change of the consumer price index, while nominal exchange rate per US$ is from the National Bank of Cambodia. Cambodia's average lending rate is from the World Bank's World Development Indicator. These are endogenous variables as indicated in the model specification.

The quarterly data of the year-on-year percentage change in CPIs for the U.S. and the Euro areas are seasonally adjusted and retrieved from Federal Reserve Bank of St. Louis. The nominal interest rates for the U.S. (U.S. Federal Funds rate) and the Euro area (3-month interbank lending rate) are also collated from the Federal Reserve Bank of St. Louis, while the world commodity price index is from the IMF Primary Commodity Price System. These are controls for the external environment over the dynamics of the model under consideration.

7. Results and Discussion

This section describes the results of the stationarity tests for vectors of both endogenous and exogenous variables used in the analysis and presents findings of the effect of the shock of U.S. Federal Fund rate to the endogenous variables in the model. The former uses the Augmented Dickey-Fuller test method as described in the empirical methodology, while the later applies the VAR-based impulse response technique.

7.1 Augmented Dickey-Fuller Test

Table 1 shows the results of the Augmented Dickey-Fuller test for all variables included in the model. The GDP gap (Y_t), domestic inflation rate (P_t), U.S. inflation rate (π_t), Euro area inflation rate (EUP_t) and the nominal exchange rate (NER_t) have τ-statistics that are smaller than their respective τ critical values at 1 percent and 5 percent significance levels, suggesting that the variables are stationary. Since we reject the null hypothesis of non-stationarity of the nominal exchange rate at 5 percent level, we use the first difference of this

6. It is worthwhile noting that the actual critical τ values from our analysis vary slightly above or below these critical values based on the variable as well as the number of lags.

variable, while its unit root test shows that its null hypothesis is rejected at 1 percent level of significance (Table A1 in the Appendix).

Other variables that have τ-statistics larger than their respective τ critical values include the average interest rate on loan (R_t), broad money (BM_t) and trade balance with U.S. (TB_t), U.S. Federal Funds Rate (FFR_t), world commodity price index (WCP_t) and Euro area interest rate (EUR_t) indicating that first difference for the variables need to be taken to make them stationary. However, to ensure the stationarity of the first difference of this second group of variables, we further conduct the Augmented Dickey-Fuller test. The results confirm that all first-difference variables are stationary (Table A# in the Appendix). In sum, the former group of variables has an integration of order zero **I(0)**, while the latter group has an integration of order one **I(1)**. We also take first difference of the domestic inflation rate and the nominal exchange rate with US$ to ensure that all variables are stationary.

Table 1
Augmented Dickey-Fuller Test

Variables	τ statistics	Significance
GDP gap (Y_t)	-3.748	***
Domestic inflation rate (P_t)	-4.474	***
Nominal exchange rate (NER_t)	-3.456	**
Average interest rate on loan (R_t)	-0.291	-
Broad money (BM_t)	6.544	-
Trade balance with U.S. (TB_t)	-1.043	-
U.S. inflation rate (π_t)	-4.563	***
U.S. Federal Funds rate (FFR_t)	-2.304	-
World commodity price index (WCP_t)	-1.437	-
Euro area interest rate (EUR_t)	-2.45	-
Euro area inflation rate (EUP_t)	-3.554	***

Note: Significance at 1% (***), 5% (**) and 10% (*); not significant at any level (-).

In order to identify the maximum lag length of the variables, we apply the post-estimation lag order selection method (varsoc) and consider the lag order selection statistics of Akaike's Information Criterion (AIC) shown in Table 2 below. In our estimation, the AIC selection is a model with two lags as its lag order selection statistics is significant at 10 percent at lag order 2.

Table 2
Post-estimation Lag Order Selection Criteria

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-2611.35				2.10E+17	56.9322	57.328	57.9125
1	-2420.47	381.74	36	0.000	7.70E+15	53.6016	54.3933	55.5623*
2	-2365.97	109.01*	36	0.000	5.3e+15*	53.2036*	54.3912*	56.1447

Note: Significance at 1% (***), 5% (**) and 10% (*), LL: LR: Likelihood Ratio, df: degree of freedom, FPE: Final Prediction Error, AIC: Akaike's Information Criterion, HQIC: Hannan and Quinn Information Criterion, SBIC: Schwarz's Bayesian Information Criterion.

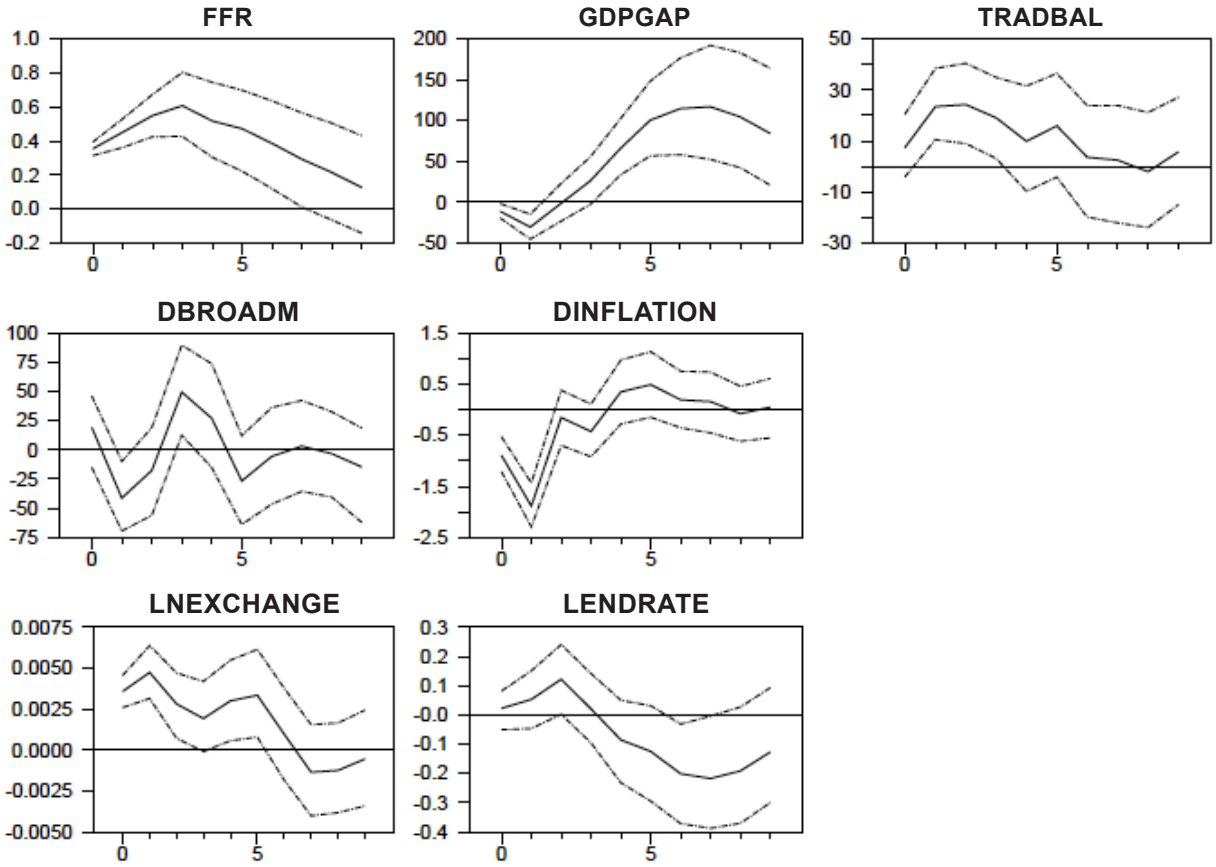
7.2 Results from Impulse Responses

This section provides results of the adjustment paths of the GDP gap, inflation, exchange rate, broad money, interest rate on loan and US-Cambodia trade balance to the shock (innovation) of a standard deviation (2.3 percent) increase in U.S. Federal Fund Rate. Figure 15 presents the time path of each of the endogenous variables over nine consecutive quarters.

Figure 15 shows that an initial one-quarter shock in U.S. contractionary monetary policy, meaning a standard deviation increase in the U.S. Federal Fund rate was followed by two consecutive quarters of contractionary monetary policy before it gradually converged to zero in the next six consecutive quarters implying the paths that the key macroeconomic indicators of Cambodia would take in response. Broad money reacted to the shock by exhibiting a negative gap in the first quarter, followed by two consecutive quarters of a positive gap of broad money as the U.S. contractionary monetary policy started to loosen before the gap began to converge to zero in the following quarters. Likewise, the nominal exchange reacted accordingly by showing a positive change in the logarithm of the nominal exchange before it started to approach zero in the sixth and following quarters. The first two quarters of the drop in money demand is consistent with the nominal exchange rate over the same quarters. However, the effect on the nominal exchange rate persisted over the next couple of quarters. This indicates the effectiveness of the exchange rate channel of monetary transmission mechanism that passes from the U.S. to Cambodia due to high dollarization (financial and real), implying the strong influence of U.S. monetary policy on the Cambodian exchange rate.

Cambodia's trade balance tended to benefit from the shock as it responded positively, which is also consistent with the depreciation of Cambodian riel against U.S. dollar. The positive effect persisted over the next five quarters before it began to converge to zero when U.S. contractionary monetary policy subsided. This clearly indicates that Cambodia has a strong bilateral trade and foreign exchange market linkage with the U.S. This adjustment path is also consistent with those shown in Duma (2011) and Samreth (2019). This demonstrates the effect of the direct and indirect exchange rate channel of U.S. monetary transmission mechanism on Cambodia-US trade balance.

Figure 15
Impulse Responses of One S.D. of U.S. Fed Funds Rate
(Period: Q3-1993 to Q4-2018)



Source: Author's estimation.

Note: D. denotes first difference. FRR: U.S. federal funds rate; GDPGAP: GDP gap; TRADBAL: Trade balance; BROADM: Broad money; INFLATION: inflation rate; LNEXCHAGE: logarithm of exchange rate, LENDRATE: Interest rate on loan.

For the domestic interest rate on loans, it responded positively to a standard deviation increase in the U.S. Federal Funds rate for three quarters before the rate turned negative for the next couple of quarters and began to converge in the ninth quarter. The shock pushed the Cambodian economy into contraction as the interest rate went up, limiting the availability of loans. The lending rate was later cut in the third and following quarters in response to the slowdown in economic activities. The fact that the Cambodian interest rate tended to move in tandem with the U.S. Federal Funds rate suggests that the Cambodian financial market is largely influenced by U.S. monetary policy implementation, due to the high dollarization. More importantly, it should be noted that the indirect interest channel is also at work as financial institutions in Cambodia, namely banks, microfinance deposit-taking institutions (MDIs) and microfinance institutions (MFIs), source significant proportions of their funding from offshore banks.

Lastly, we observe negative responses of both inflation and GDP gaps to the shock in the first quarter indicating that economic activities contracted, while the price level dropped. Interestingly, although both the Federal Funds rate and domestic interest rate continued to rise for the next two quarters, the output gap turned positive in the third quarter and gradually improved over the next couple of quarters. The inflation rate in turn started to increase only in the fourth quarter suggesting the stickiness of prices and it converged to zero after a couple of quarters as the U.S. contractionary monetary policy continued to loosen. Notably, although the U.S. contractionary monetary policy definitely slowed Cambodian economic activities, the pace of recovery was quite rapid as output turned positive in the third quarter, thanks to proactive responses of domestic financial institutions in cutting the interest rates (Figure 15).

Our results are consistent with those of Duma (2011) and Samreth et al. (2019), showing that U.S. contractionary monetary policy exerts influence on Cambodia's real and financial sectors, indicating that dollarization ties Cambodian monetary policy as well as real and financial sectors to U.S. monetary policy. This implies that the knot can possibly be untied only when dollarization retreats from the Cambodian economy. At present, there are only three active monetary policy instruments, namely reserve requirement, NCDs, and LPCO, along with foreign exchange interventions. There is also absence of an interbank and money market as well as a market for government bonds in particular. This along with dollarization restrains the NBC from fully implementing its monetary policy through adopting, for instance, a policy rate in addition to its current nominal exchange rate anchor. International experience of countries such as Peru which has high financial dollarization suggests that such a phenomenon does not preclude a country's monetary authority from adopting inflation targeting to achieve price stability. This experience could be a model that Cambodia could explore for its practicality as well as feasibility.

8. Conclusion

Cambodia has gone through decades of civil war starting from 1970 to 1998 when the last front of the Khmer Rouge rebel fighters was dismantled without bloodshed with the rebels demobilized and reintegrated into the Royal Government Armed Forces. Notably, the massive U.S. bombing campaign during the 1970-1973 and the genocide 1975-1979 had destroyed vast human and physical capital that took Cambodia almost two decades after the end of the genocide in 1979 to recover the stock of the capital to the 1970 level. Nevertheless, growth has been remarkable during the last two decades, but structural problems such as a narrow economic base, limited institutional and governance capacity, high costs of production, among others, continue to plague the economy. To tackle these problems, several steps have been outlined in policy documents such as the National Strategic Development Plan 2019-2023 (NSDP) and Government's Rectangular Strategy IV (RS IV).

Underlying this remarkable path of development is the dollarization phenomenon which started as early as 1990 when huge amounts of U.S. dollars flowed into the Cambodia through the United Nations' peace keeping force to support and secure the first multi-party democratic election in 1993. Dollarization, be it financial and real, is deeply rooted in the Cambodian economy as the share of foreign currency (U.S. dollar) deposits to broad money was 84.4 percent in July 2019. This has restrained monetary implementation of the NBC for decades.

Such a restraint is consistent with the traditional view that dollarization limits the capacity of the monetary transmission mechanism. However, there are two lines of arguments in the literature where dollarization could either restrain or have no influence on the implementation of monetary policy.

The absence of an interbank and money market as well as a government bond market in particular, has limited the NBC from adopting a policy rate to attain its price stabilization goal. Nevertheless, three monetary policy instruments including the reserve requirement, NCDs and LPCOs along with its foreign exchange market interventions have been implemented to achieve stable and low inflation and low volatility of foreign exchange. However, dollarization has tied the Cambodian real and financial sectors, as well as Cambodian monetary policy to U.S. monetary policy as indicated in previous studies.

To be sure, we should revisit this research area by using empirical VAR method to examine responses of the GDP gap, inflation, exchange rate, broad money, domestic interest rate on loans, and trade balance between U.S. and Cambodia. Our results corroborate with those in previous studies suggesting the connection between U.S. and Cambodian monetary policies. While U.S. contractionary monetary policy negatively affects Cambodia's GDP gap, inflation, broad money and nominal exchange rate, it positively affects interest rate and trade balance. This further confirms the connection between monetary policies of the two countries and suggests that the connection can be untied only when dollarization retreats from the Cambodian economy. Additionally, international experience of countries such as Peru, shows that dollarization need not restrain the monetary authority of a country from adopting inflation targeting to attain price stability. This could be a model that Cambodia should explore.

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Appendix

Table A1
Augmented Dickey-Fuller Test for First-differenced Variables

Variables	τ statistics	Significance
Average interest rate on loan ($D.R_t$)	-6.968	***
Domestic inflation rate ($D.P_t$)	-6.265	***
Broad money ($D.BM_t$)	-6.474	***
Trade balance with U.S. ($D.TB_t$)	-7.177	***
Nominal exchange rate ($D.NER_t$)	-5.281	***
US Federal Funds rate ($D.FFR_t$)	-3.671	***
World commodity price index ($D.WCP_t$)	-7.214	***
Euro area interest rate ($D.EUR_t$)	-4.882	***

Note: Significance at 1% (***), 5% (**) and 10% (*).

CHAPTER 3

DISTRIBUTIONAL IMPACT OF MONETARY POLICY THROUGH THE COMMERCIAL BANKS' BORROWER PREFERENCES: THE EMPIRICAL EVIDENCE FOR INDIA[1]

By

Priyanka Bajaj and Anoop K. Suresh[2]

1. Introduction

Monetary policy influences real economic activity through its impact on macro-economic aggregates. This has been investigated empirically in case of both advanced and emerging economies by innumerable studies. Monetary policy measures anchored by the central bank impacts various strata of the society. Therefore, distributional effects of policy actions initiated by the central bank assumes greater significance. To be precise, economists ascribe critical importance to the distributional effects of monetary policy principally for two reasons. Firstly, monetary policy being an integral part of macroeconomic policy, cannot remain isolated from the societal objective for which the distribution effect assumes a vital role. Standard monetary policy reaction functions such as Taylor's interest rate rule and McCallum's money rule are derived within the framework of optimization of welfare loss function. Secondly, from an operational perspective, modulating credit demand and supply side conditions better pursues the societal objective for achieving price stability, promoting growth and maintaining financial stability. Thus, the emphasis on the distribution effect of monetary transmission mechanism can contribute to the effectiveness of policy actions.

India is one among the emerging economies of the world. Unfortunately, it lags behind several countries in terms of human development and many other significant per capita indices. Distributional effects are a topical issue for a nation like India wherein higher inequality is a matter of serious concern. Hence, distributional impact of a significant policy measure such as monetary policy is an important topic to be researched in depth.

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The rest of the study comprises seven sections. Section 2 provides a narration of the genesis of India's monetary policy framework and also lists out the monetary policy instruments in the arsenal of the Reserve Bank of India (RBI) for attaining its desired targets. A brief on India's monetary policy transmission is provided in Section 3. Section 4 is a narration of existing literature on the disaggregated analysis of monetary policy transmission mechanism with a focus on specific literature on India. Section 5 is a description of the credit channel of monetary transmission mechanism along with some stylized facts. Section 6 outlines the theoretical underpinning, data and methodology for our empirical exercise. Section 7 presents the results of the empirical analysis while Section 8 summarizes the findings of the study in the light of policy implications.

2. Evolution of India's Monetary Policy Framework

India's monetary authority (central bank) is the RBI. It started functioning from April 1, 1935 as per the provisions of the Reserve Bank of India Act, 1934. Initially it was established as a private entity, however since its nationalization in 1949, RBI is fully owned by the Government of India. Indian monetary policy had evolved over the last seven decades in line with the changing character of its economy. Up to around 1980, the focus of monetary policy was on ensuring adequate flow of credit for various productive sectors of the economy. Monetary policy was also completely subservient to fiscal policy. During this period, apart from the traditional central banking role, RBI also performed various developmental roles in tune with the goals set up by the government. Interestingly, till the beginning of the 1980s, India's GDP growth was very low (often referred as the 'Hindu rate of growth'). However, since the early 1980s, the Indian economy started experiencing healthy rate of GDP growth and a higher rate of inflation. This healthy growth in GDP could be attributed to the measures adopted by Indian policy makers in the first three decades of post-Indian independence as well as the partial opening of the economy in the early 1980s. Since the early 1970s onwards, inflation had become a worry, led by supply side bottlenecks within the domestic economy as well as influenced by external factors such as the breakdown of the Bretton-woods system, India-Pakistan War (1971) and crude price shocks of 1973 and 1979 (Das, 2020).

The mid 1980s witnessed India adopting a monetary targeting framework for ensuring price stability. Under this approach, broad money (M3), reserve money (RM) and bank reserves acted as the nominal anchor, operating target and the operating instrument respectively. In the pre-monetary targeting period (till mid 1980s) and the monetary targeting period (from mid 1980s till late 1990s), monetary policy was implemented mainly through quantity instruments such as Cash Reserve Ratio (CRR)[3] and Statutory Liquidity Ratio (SLR).[4] During the early 1990s, the Indian economy underwent an economic catastrophe in the form of a severe balance of payment crisis. This event paved the way for Indian policy makers to adopt the Liberalisation, Privatisation and Globalisation (LPG) model of economic development. Thus, this resulted in the opening of the Indian economy to a large extent.

3. CRR is the minimum amount of funds that commercial banks have to maintain with the RBI at all times. If the CRR increases, it is a tight money policy of RBI.

4. SLR is the level of reserves (cash/gold/government securities) which the commercial banks are required to maintain always. Commercial banks can do business only with the rest of funds.

Consequently, the Indian economic structure was completely revamped. There were numerous reforms in financial, banking, external, fiscal and several other sectors of the Indian economy. Deregulation of interest rates was one of the prime reform measures. During the 1990s, market forces became the dominant factor in determining interest and exchange rates. In this changed dimension, the monetary approach adopted by RBI needed a rethinking. With huge inflows of capital in the post-liberalization period, there was substantial injection of liquidity which put pressure on price variables in the upward direction.

Until liberalization, several studies pointed out that India's money demand function was stable. However, in the post 1990s, after embracing financial sector reforms and opening up its economy to foreign investors, the predictive potential of money demand estimations had been eroded. Interest rates became the prominent factor in the decision to hold money and the interest rate channel emerged as the principal channel for monetary policy transmission. These changes called for a revision of India's monetary policy framework and RBI thus adopted the Multiple Indicator Approach (1998 onwards). Under the Multiple Indicator Approach, policy decisions were made utilizing data on several variables/indicators.

Since the late 1990s, as a resultant impact of the market reforms, the operational framework of India's monetary policy underwent significant changes. Consequently, reliance on direct instruments such as CRR and SLR was reduced and liquidity management in the financial system was exercised through Open Market Operations (OMOs)[5] and daily reverse repo[6] and repo operations[7] under the Liquidity Adjustment Facility (LAF).[8] The LAF enabled the RBI to set a corridor for the short-term interest rates consistent with the policy objectives. These operations were supplemented by access to the RBI's standing facilities.[9] Thus, changes in reverse repo and/or the Bank Rate[10] emerged as interest rate signals.

The Multiple Indicator Approach was followed till 2015 when it was decided by the RBI to adopt flexible inflation targeting (FIT). The inflation targeting framework was adopted in the context of rising inflation in India especially in the post-global crisis period. A need was also felt for making price stability as an explicit mandate for the RBI. Thus, a monetary policy memorandum was signed between the Government of India and the RBI on February 20, 2015 that formally adopted FIT in India. Under this framework, the RBI has the explicit mandate to achieve price stability, which was brought through a parliamentary amendment of the RBI Act 1934.

5. OMOs refer to the sale and purchase of government securities by the RBI. OMOs are undertaken by RBI to inject or absorb liquidity from the financial system.
6. Rate at which commercial banks park their funds with RBI on a short-term basis.
7. Rate at which RBI lends money to commercial banks on a short-term basis.
8. Tool used by RBI that allows commercial banks to borrow money through repo agreement or commercial banks to park their excess money with RBI through reverse repo agreement. LAF is used to manage liquidity pressures and helps in maintaining financial stability.
9. Tool of RBI to meet the short-term additional liquidity requirements of commercial banks.
10. Bank rate is the rate at which RBI provides funds to commercial bank for longer term (i.e., more than 3 months tenure).

Currently, monetary policy is announced by the RBI on a bi-monthly basis with the repo rate as the policy rate. The policy corridor comprises of MSF as the ceiling and the reverse repo rate as the floor. The weighted average call rate (WACR)[11] is considered as the operating target rate in the monetary policy framework. Liquidity operations are conducted using instruments such as LAF, MSF, OMOs, Market Stabilisation Schemes (MSS)[12] and CRR to keep the WACR (operating rate) close to the repo rate on a daily basis.

3. Monetary Policy Transmission Performance in India

In India, monetary transmission has been full and reasonably swift across various money market segments and the private corporate bond market. However, the transmission from policy rate change to bank lending rate has been continually slow and muted mainly on account of the deviation by the commercial banks from the methodology prescribed by RBI for computing lending rate. Empirical work points out that the impact of monetary policy on output and inflation in India happens with a lag of 2-3 quarters and 3-4 quarters respectively and the impact remains for around 8-12 quarters. The interest rate channel has been found to be the strongest channel for monetary policy transmission in India. However, it needs to be acknowledged that the Indian financial system remains bank dominated although the share of non-banking channels (commercial paper, equity, etc) has been going up. Therefore, the transmission of monetary policy in India depends on the extent and pace with which banks adjust their deposit and lending rate in tune with the change in the policy repo rate and to meet the economy's credit requirement (Acharya, 2017). Thus, monetary policy transmission through commercial banks' lending channel remains critically important in the Indian context.

4. Review of Literature

At the global level, there is ample amount of literature analyzing the distributional impact of monetary policy. The impact of monetary policy could vary for different strata of the economy such as households, firms, sectors, industries and regions. There exists rich literature focusing on the disaggregated analysis of monetary policy in relation to various strata of an economy. However, most of this literature is in the context of advanced economies.

In case of emerging economies, although there is a vast amount of literature empirically investigating the monetary transmission mechanism, we find relatively less literature on the distributional effects. This is quite surprising given that distributional effects of macroeconomic fluctuations in emerging market economies could be magnified given their relatively underdeveloped financial markets *vis-à-vis* advanced economies. With respect to India, there is very scant literature on distributional impact.

In this paper, we focus on the bank credit channel of monetary transmission mechanism and examines the distributional impact of monetary policy through the commercial banks' borrower preference for its customers. Bernanke and Gertler (1995) through their seminal work, discovered the inadequacy of monetary transmission mechanism at the aggregate level. They documented the differential impact of monetary policy on various components of GDP.

11. It is the rate prevailing in India's call money market.
12. Special bonds floated on behalf of the Government of India by the RBI for mopping up excess liquidity in the system when regular government bonds prove to be inadequate.

Ample literature is found spanning across advanced economies (mostly United States and Euro zone) investigating the distributional impact of monetary policy. These studies cover multiple aspects such as cross-country comparison, sector specific impact, changes in the consumption basket of various income groups within an economy and also the effect of a monetary policy shock on relative agricultural prices among several other aspects. A monetary policy shock can have differential impact on specific sectors of an economy (Dale and Haldene, 1994). Regarding the consumption pattern of households, it was found in the United States that those belonging to the higher income category consume sticky priced goods and thereby experience considerably lower overall inflation volatility than that faced by the middle-income households as a consequence to a monetary policy shock (Cravino et al., 2018). Investigating the impact of monetary policy shock on relative prices of agricultural commodities, it is found that prices of agricultural commodities adjust faster than prices of industrial products in response to monetary policy actions in the South African economy (Asafa and Jooste, 2007). This could lead to monetary policy having a less desirable impact on farmers and consumers, especially in the short-run. Angeloni, et al. (2004) provides a broad description of how monetary policy impacts the euro zone by investigating the role of interest rate as well as the credit channel in the transmission of monetary policy as well as its resultant distributional impact across different countries of the euro zone.

Since the focus of our exercise is on the behavior of commercial banks in response to monetary policy changes, we browsed for literature examining banks' behavior. Composition of bank's portfolios and monetary policy is found essential in order to explain interest rate differentials among large and small borrowers (Laudadio, 1963). In the Indian context, it is found that capital plays a crucial role in determining bank's lending behavior. Strengthening the capital positions of banks would help them in reducing the cost of funds which in turn can contribute to sustained credit growth by avoiding balance sheet stress (RBI Annual Report, 2018-19).

Coming to specific studies of India with regard to the differential impact of monetary policy, we find a few of them focuses on data at the industry and regional level as well as the consumption basket. Disaggregation of the monetary transmission mechanism among Indian states reveals that poor Indian states are likely to be more affected during a tightening of money policy. The impact of monetary policy was analyzed through the interest rate on the dispersion of credit to the states in the presence of other state specific explanatory variables such as state income, infrastructural development and commercial activity apart from the level of lendable resources of the banking sector, taking into account the role of key demand and supply-side factors affecting the loan market. Apart from the monetary policy effect, the level of economic progress, infrastructural development and the scope of commercial activity in a state was found to have a significant influence on bank credit dispersion across the Indian states (Dhal, 2009).

An analysis across the Indian industries reveals that myriad industries respond differently to a monetary tightening. This is attributed to variations in the intensity of working capital use, industry's size and the amount of interest cost. The financial accelerator and interest rate variables turn out to be significant in explaining the differential responses (Ghosh, 2009). Examination of the monetary policy effect on the five use-based industrial classification reveals that with a tight money policy, output growth could be more highly impacted in case of consumer durables and capital goods rather than non-consumer durables,

basic and intermediate goods. A transmission lag was visible in case of consumer non-durable goods and a comparatively reasonable transient reaction was seen in case of intermediate and consumer non-durable goods (Dhal, 2011).

Assessing the impact of monetary policy on food consumption is very important because of the indispensable role played by food in the survival of poor households in low income countries. Investigating the food price channel of monetary policy in India, it is found that an expansionary monetary policy could fuel relative food prices which would lead to a reduction in the subsistence consumption of poor households and would ultimately lead to increased inequality across households in food consumption (De, 2017).

With regard to assessing the impact of monetary shock on bank groups, it is found that big and small banks respond significantly differently to a monetary policy change. Small banks are more vulnerable to monetary policy shocks *vis-à-vis* larger banks. Small banks cut down their lending severely during a tight money policy regime. Large banks which have huge capital and resources at its disposal could protect itself from shocks emanating from contractionary monetary policies whereas small banks do not have much scope to buffer against the impact of such shocks. These findings infer that policy measures such as bank mergers and amalgamations, which could lead to the setting up of big banks instead of several small banks, would improve the efficiency of monetary transmission (Pandit et al., 2006) (Appendix Table A1).[13]

5. Credit Channel of Monetary Transmission Mechanism

From credit rationing (Bach and Huizenga, 1961) to asymmetric information and moral hazard problem in financial markets (Stigliz and Weiss, 1981) to the credit view (Bernanke and Gertler, 1995, Kashap and Stein, 2000), a generalized perspective is that the distributional impact of monetary policy across various banks and bank dependent borrowers can provide crucial insights into the credit channel of monetary transmission. According to Bernanke and Getler (1995), the existence of credit channel can 'amplify' monetary impact on inflation and economic activity. In other words, in the presence of the credit channel, expansion (contraction) in economic activity due to easy (tight) money policy could be sharper than that is desired by the authorities.

India is a bank dominated economy. Its financial and capital markets are yet to be fully developed to be on par with advanced nations. Therefore, banks have a greater role to play in meeting the aspirations and dreams of teeming millions who reside mostly in the rural and semi-urban parts of India. The unique feature of the Indian banking industry is its enormous size and its scope for further expansion. Several commercial bank branches have been opened in the rural and semi urban parts of the country providing its citizens access to financial services. This aspect of Indian banking is highly lauded all over the world and serves as a role model for financial institutions in Africa and Latin America. Thus, the bank credit channel of monetary transmission mechanism assumes tremendous importance in India. Nevertheless, it needs to be mentioned that a huge proportion of the Indian population is still left out of formal sources of financing despite several initiatives undertaken by the Government of India.

13. Detailed literature review indicating the data/method/period as well as scope, focus and findings of each study is provided in Appendix Table A1.

During the last seven decades since Indian independence from the British, several policy actions were launched by the Government of India to improve the provision of financial services through formal sources. A few major initiatives includes - (a) nationalization of major Indian commercial banks in 1969 and 1980[14]; (b) ensuring mandatory credit flow from commercial banks towards certain portfolios identified as 'priority sectors'[15]; (c) establishment of regional rural banks (RRBs) in the mid-70s with the primary objective to provide banking facilities to rural and semi urban areas; (d) introduction of the self-help group bank linkage program in the early 1990s for providing banking services to the weaker and unorganized sector; and, (e) promoting financial inclusion and financial literacy through mass programs suh as *Pradhan Mantri Jan Dhan Yojana*[16].

In the Indian context, the 'credit view' provided the dominant perspective for monetary and financial policies until the early 1990s, broadly reflected in the approach to nationalization of the banking sector, massive branch expansion in rural areas and the stipulations for lending to the priority sector. Post-1990s, in the wake of reforms, with the quest for financial market development and strengthening price discovery process for efficient allocation of resources to productive sectors, the credit channel gave in to the interest rate channel. The operating framework of the policy embraced a shift in emphasis from direct instruments of monetary control and intermediate monetary target to interest rate instrument and multiple indicator approach for monetary management. Accordingly, the CRR was brought down from a high of 15 percent to around 4 percent in the mid-2000s and stands currently at 4 percent whereas the SLR requirement was brought down from the high of 38 percent in the early 1990s to 25 percent by the mid-1990s[17]. Of late (in 2015), we adopted the inflation targeting regime within a strong liquidity management framework having several monetary instruments in the RBI's arsenal. However, it is interesting to note that the credit view still remains relevant for India spurred by greater scope for 'inclusive growth'[18] and 'financial inclusion'[19](Appendix A2)[20].

6. Theoretical Underpinning, Data and Methodology

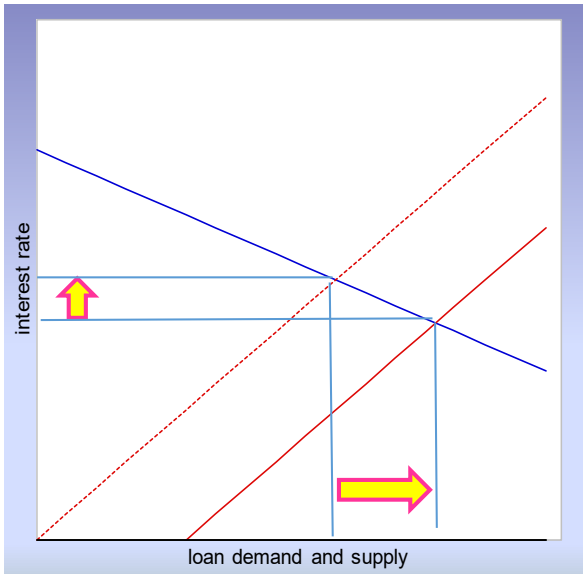
The loan demand curve (downward sloping) and loan supply curve (upward sloping) interacts at equilibrium to determine the quantum of loan/credit at a specific interest rate. Across borrower groups, commercial banks normally exhibit a preference for large and mid-sized borrower's *vis-a-vis* small borrowers. There could be various reasons for these asymmetric preferences. One of them could be the elasticity of the loan demand curve. If the loan demand curve is more elastic, *ceteris paribus*, a given contraction (expansion) in monetary policy would lead to a smaller (larger) increase in interest rate compared to a larger (smaller) increase when loan demand is relatively less inelastic (Chart 1). Small

14. 14 major Indian private banks were nationalized in 1969. In 1980, 6 more private banks were nationalized.
15. Small and marginal agricultural farmers, micro, small and medium enterprises (MSMEs), export credit, social infrastructure, housing for poor people, educational loans, promoting renewable energy usage and targeting low income and weaker section of the society.
16. A national level program in ensuring access to financial services.
17. Currently, SLR stands at 18.25 percent.
18. Percolation of benefits of economic growth towards all section of the society.
19. Policy aimed at ensuring accessibility to financial services for all sections of the society.
20. Charts and tables on India specific stylized facts are given in Appendix A2.

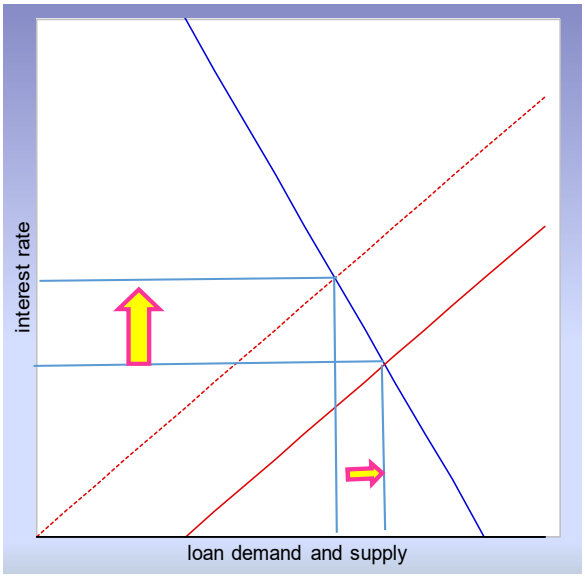
borrowers' loan demand curve generally tends to be more inelastic relative to mid-sized or large borrowers. Apart from this, the availability of higher collateral in case of large and mid-sized borrowers makes them more trustworthy in the eyes of banks. Banks being risk-averse, would always prefer to maintain better relations with large and mid-sized borrowers. Banks give greater priority to these categories of borrowers. Also, the transaction cost for the banks when dealing with mid and large sized accounts tends to be low. Thus, all these factors result in an asymmetric preference in commercial bank lending to different sizes of borrower groups.

Chart 1
Elasticity of Loan Demand

Elastic Loan Demand Curve



Inelastic Loan Demand Curve

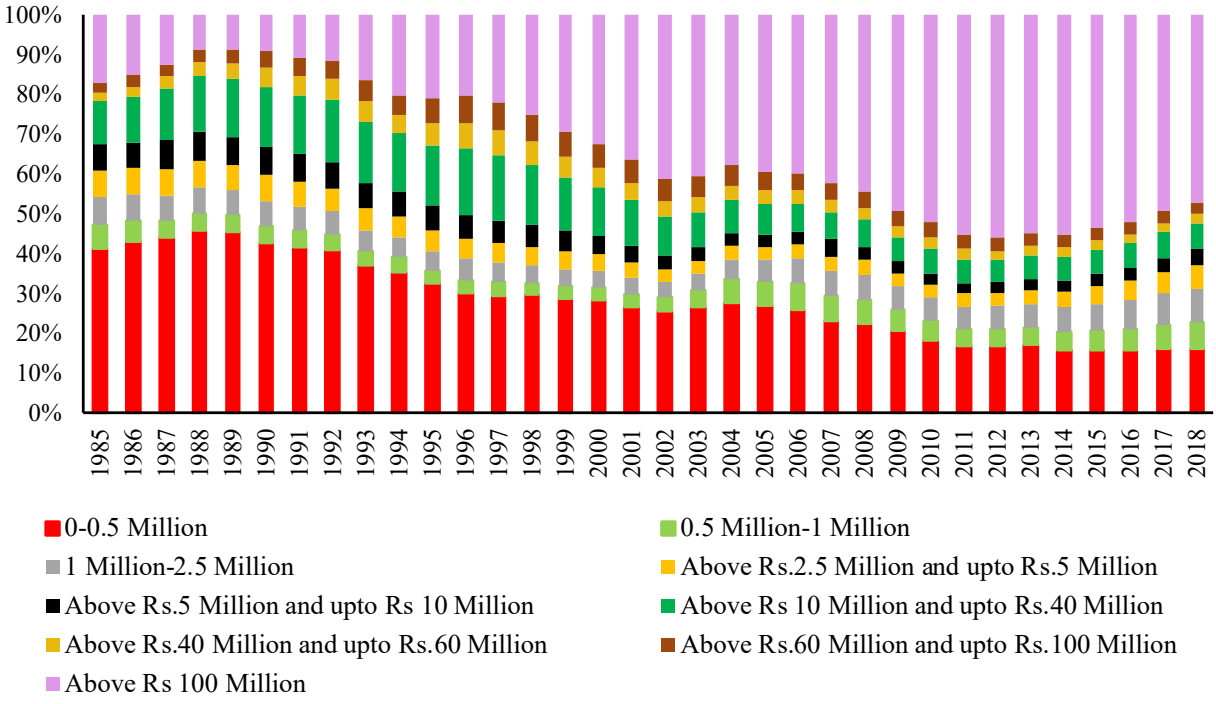


The empirical exercise is attempted using the commercial banks' borrower accounts data classified based on their credit limit. This data has been published by the RBI in the form of various analytical tables in its report on Basic Statistical Returns (BSR) since 1972 on an annual basis. We also recognize that the analytical information on the cross-section of borrower accounts can be highly valuable for gauging the credit channel of transmission. We categorize the entire borrower data based on credit limit into 9 groups and three categories viz., small, mid-size and large, consistently for the period 1985 - 2018. 'Small' categories borrowers are subdivided into four groups as per the credit size limit varying from 0-0.5 million, 0.5 – 1 million, 1- 2.5 million and 2.5 - 5 million, respectively. The 'mid-size' category of borrowers comprises of 3 groups with the credit size limit varying between 5 – 10 million, 10 - 40 million, and 40 – 60 million, respectively. Lastly, the 'large' borrower group is subdivided into two categories with a credit size limit of 60 – 100 million and those above 100 million (Appendix A3).

Preliminary evidence from this data reveals that over the last two decades, the share of large and mid-sized borrowers has been on the rise whereas the share of small borrowers seems to be coming down (Chart 2). This has to be seen in the backdrop of the credit boom witnessed by India since 2003-04. Between 2003-04 and 2007-08, the outstanding credit of commercial banks expanded enormously. This expansion continued further between 2007-08 and 2011-12 unperturbed by the influence of global financial crisis. This momentum was sustained from 2011 and 2015. However, from 2015-16 onwards, the credit momentum started slowing down. This period also witnessed stress in the Indian banking system in the form of accumulation of a mammoth amount of Non-Performing Assets (NPAs).

Interestingly, Chart 2 shows that the share of small borrowers have marginally increased from 2015 onwards. This can be attributed to the initiatives undertaken by the Government of India for greater formalization of the economy through focusing on financial inclusion, opening of the *Jhan Dhan* accounts among several other populistic measures. The medium-sized borrower group had also witnessed a marginal increase during the same period. However, in the case of large group borrowers, there has been a decline in credit allocation by commercial banks post-2015. This could be linked to the accumulation of huge NPAs with respect to the accounts of several big industrial conglomerates in India. As a response to these challenges, commercial banks tightened their lending policies towards these giants. Policies measures such as Asset Quality Review (ACR), Insolvency and Bankruptcy Code (IBCC) were brought in to prevent the ever greening of loans. Giving due weightage to the seriousness of the issue, the RBI also placed several banks under Prompt Corrective Action (PCA) so that these commercial banks could clean up their balance sheet in order to undertake new lending activities in future.

Chart 2
Percentage Share of Loan Outstanding Across Borrower Groups



7. Empirical Results

The empirical analysis of the study revolves around bank credit allocation to various borrower groups led by the interaction of demand and supply factors as well as the monetary policy indicator. Using an equilibrium approach, we consider L_d to represent loan demand function and Ls to represent loan supply function. We have defined the loan demand function (L_d) as:

$$\mathbf{L_d = F\ (R_L, P, Y)\ \ldots\ldots\ldots\ldots\ldots\ (1)}$$

where R_L, P, Y represents interest rates, profit mark-up (taken as ratio of Consumer Price Index (CPI) to Wholesale Price Index (WPI)) and real Gross Domestic Product (GDP), respectively. L_d apart from having an inverse relation with interest rates also depends on two key factors - economic progress and profit mark-up [equation (1)]. The impact of economic progress which can be measured by real GDP is likely to capture the scale effect for the demand for bank credit. Higher economic progress is expected to increase demand for credit in the economy. Another factor that can impact loan demand is profit mark-up. A higher profit mark-up can suggest lower loan demand as it could mean greater source of self-funding (for industrial sector and business) or higher market prices which lowers demand (in case of individuals).

Similarly, we have defined the loan supply equation as:

$$\mathbf{Ls = F\ (R_L, G_y, D_r)\ \ldots\ldots\ldots\ldots\ldots\ldots\ (2)}$$

The cost of funds and opportunity costs of lending are two key factors that determine loan supply other than interest rates - which positively influence the loan supply function [equation (2)]. The cost of funds can be accounted for by the deposit rate of interest (D_r) while the opportunity cost of funds can be represented by yield on government securities (G_y).

The lending or market interest rate is taken as function of monetary policy rate assuming partial or full monetary policy transmission.

$$\mathbf{R_L = F\ (MI)\ldots\ldots\ldots\ldots\ldots\ldots\ (3)}$$

The equilibrium allocation of credit [equation (4)] therefore is taken as a function of monetary policy rate, economic progress, profit mark-up, deposit rate of interest and yield on government securities.

$$\mathbf{Equilibrium:\ L_d = Ls = Lo\ (R_L, Y, P, G_y, D_r) = Lo\ (MI, Y, M, G_y, D_r)\ \ldots\ldots\ldots(4)}$$

As part of our empirical exercise, we are using an Autoregressive Distributive Lag (ARDL) model to estimate the response of commercial bank credit allocation in response to monetary policy changes for the period 1985-2018 for all the nine different borrower groups. The ARDL (p, q) model is given by equation below:

$$\Delta B_t = a_i + \sum_{i=1}^{p} b_i * B_{t-i} + \sum_{i=0}^{q} c_i * MI_{t-i} + \sum_{i=0}^{q} d_i * I_{t-i} + \sum_{i=0}^{q} e_i * P_{t-i} + \varepsilon_{it}$$

where the variables B, MI, I and P represents log of credit outstanding for each borrower group (1 to 9), monetary indicator (MI1 or MI2), log of real GDP and profit mark-up in the economy. D_r and G_y are taken as fixed regressor in the ARDL model (lagged value is not expected to influence current period borrowings).

The model takes two different forms with respect to alternative measures of monetary policy indicator (MI1 and MI2), which will be called here Case (i) and Case (ii) respectively. MI represents the monetary policy condition in the economy. As discussed in section 2 earlier, monetary policy in India has transitioned through different phases and so have the policy tools (instruments) being used. In this paper, we are considering two indicators - MI1 and MI2 as measures of monetary policy stance to appropriately capture both quantity and price-based instruments. The two-composite indicator of policy instruments are constructed using the geometric mean of the repo rate, CRR and SLR in MI1 and the geometric mean of WACR, CRR and SLR in MI2. The size and sign of the coefficient c_i would be critically important to ascertain the favorable or adverse effect of monetary policy condition on different borrower groups.

The ARDL model can be used when the variables under consideration are I(0), I(1) or a combination of both, but not I(2). We begin our analysis by ensuring that no time series variable under consideration is integrated of order 2 or higher. The order of integration was tested using the Augmented Dickey-Fuller (ADF) unit root test. The null hypothesis is that the series is non-stationary or I(1). The results of the ADF test are shown in Table 2. This suggests that the null hypothesis of the unit root for all variables except two (B7 and B8) is not rejected at levels but are, however, rejected at first difference with 5 percent significance level. Therefore, the variables turned out to be a combination of I(0) and I(1).

Table 2
Results of Unit Root Tests on the Series Using ADF Test

Variables	ADF without trend	
	Test Statistic	
	At level	1st difference
B1	-0.48	-3.16**
B2	-0.20	-2.64*
B3	0.43	-3.53**
B4	2.45	-3.73***
B5	0.22	-6.46***
B6	-1.83	-4.14***
B7	-3.99***	-3.84***
B8	-3.41**	-4.64***
B9	-0.87	-3.37**
MI1	-0.19	-4.41***
MI2	-0.82	-5.54***
I	1.92	-4.98***
P	1.72	-3.65**
G_y	-1.36	-3.89***
D_r	-1.21	-4.88***

*, ** and *** indicate the rejection of the null hypothesis of non-stationary at 1%, 5% and 10% significant level, respectively.

The Akaike information criterion was used to select the best out of various models evaluated. The lag length selected across the nine models based on AIC is listed in Appendix Table A4. Since we are interested in comparing only the long-run coefficients of the model across the borrower groups, the difference in lag length selection across groups should not be an issue. Nevertheless, as a robustness check, we replicated the model with fixed lag length selection across groups. However, that does not change the broad conclusion and interpretation of our model.

In the second step, the existence of a long-run co-integration relationship for the variables is investigated by computing the F-bound test statistic. The lower bound (upper bound) critical values presumed that the explanatory variables were integrated of order zero, or I(0) (integrated of order one, or I(1)). The null hypothesis of no long-run relationship between the variables cannot be accepted when the computed F-statistic is greater than the upper critical bound value and thus in this case, there exist a long-run relationship between the underlying variables. The converse is true when the computed F-statistic is smaller than

the lower critical bound value. However, if the computed F-statistic lies between the lower and upper bound values, the results turn out to be inconclusive. The results of the F statistics for both Case (i) and Case (ii) are shown in Table 3. The F statistic exceeds the upper bound of the I(1) critical value band for all borrower groups [except for group B5 in Case (ii)], thus suggesting that a long-run relationship exists between the variables of interest for all borrower groups.

Table 3
Results of F Bound Cointegration Test

F bound test		
Borrower groups	**Case (i)**	**Case (ii)**
B1	5.99***	5.93***
B2	11.21***	9.54***
B3	9.72***	5.49***
B4	5.08***	5.17***
B5	3.91*	3.74
B6	8.38****	8.66***
B7	6.4**	13.42***
B8	6.96****	6.81****
B9	7.16***	7.58*

*, ** and *** indicate the rejection of the null hypothesis of non-stationary at 1%, 5% and 10% significant level, respectively.

Having rejected the null hypothesis of no long-run cointegrating relationship between the variables, we present the long-run ARDL estimates for the two cases – Case (i) and Case (ii) in Table 4 and 5 respectively. The coefficient of the error correction term (ECT), an indicator of the speed of adjustment, turns out as expected (negative and significant at 1 percent), implying that the series is not explosive, and that long-run equilibrium will be attained.

The size and sign of all the explanatory variables are on the expected line. Broadly, if we look and compare the sign and size of the monetary policy (MI) coefficient across the borrower groups, we can conclude that there exists evidence of monetary policy having asymmetric effect across small, medium and large borrower groups. There is a high and inverse relationship between monetary policy action and credit to small borrower groups (credit limit of 0-0.5, 0.5-1 and 1-2.5 million) and positive relationship with the mid-size and large borrower groups (credit limit-above 5 million). This can also be interpreted as saying that risk-averse commercial banks tend to reduce (increase) lending to small borrowers in response to tighter (softer) monetary policy.

The other explanatory variables show the expected sign of the coefficient. Credit outstanding respond negatively and significantly to profit mark-up (profitability) for most of the borrower groups. Log GDP impact credit outstanding positively and significantly for all the borrower groups.

Table 4
Long-run Coefficient of the ARDL Model [Case (i)]

Dependent Variables: B_t	MI1	P	I	ECM_{t-1}
B1	-0.03***	-0.88***	2.54***	-0.52***
B2	-0.12***	-0.23	2.48**	-0.27***
B3	-0.12***	-0.50***	2.71***	-0.28***
B4	-0.13	0.24	2.09***	-0.15***
B5	0.05***	0.12	2.43***	-0.79***
B6	0.06***	-0.32***	2.53***	-1.04***
B7	0.05***	-1.53***	2.77***	-0.34***
B8	0.129***	-2.23***	3.19**	-0.21***
B9	-0.01	-2.12***	4.49***	-0.72***

Table 5
Long-run Coefficients of ARDL Model [Case(ii)]

Dependent Variables: B_t	MI2	P	I	ECM_{t-1}
B1	-0.04***	-0.65***	2.42***	-0.43***
B2	-0.18***	0.98	1.85***	-0.13***
B3	-0.13***	-0.03	2.49***	-0.18***
B4	-0.03	0.56*	2.35***	-0.20***
B5	0.02**	0.07	2.40***	-0.67***
B6	0.05***	-0.58**	2.50***	-0.67***
B7	0.05**	-1.64**	2.85***	-0.43***
B8	0.12***	-2.05**	3.24***	-0.18***
B9	-0.03**	-1.82***	4.26***	-0.53***

7.1 Diagnostic Tests

The models were also subjected to several diagnostic and robustness tests. These include tests for heteroscedasticity (Breusch-Pagan-Godfrey), serial correlation (Breusch-Godfrey Serial Correlation LM Test), normality (Jarque-Bera) and stability (CUSUM tests). The results of these tests (provided in the Appendix Tables - A5 and A6) confirmed that the model's residuals were normally distributed, devoid of significant presence of serial correlation or heteroskedasticity and that the model is largely stable.

For a robustness check, we have tried the following different alternatives of the model.

(i) Using fixed lag length selection across groups (the results of f bound test and long- run model estimates are given in Appendix Table A6).

(ii) Using different model specification as well as using a more parsimonious model by excluding P (mark-up) as an explanatory variable or excluding the fixed regressors (yield on government securities and deposit rates) from the model.

The observations and conclusions remain the same even after taking these robustness checks into consideration and the evidence of asymmetric preferences of commercial banks towards small, mid and large - sized borrowers are clearly evident.

8. Conclusion and Policy Implication

Through an empirical investigation into the distributional effects of the credit channel of monetary transmission on various groups of borrowers of commercial bank classified according to the size of credit limit, the study finds that monetary policy has an asymmetric impact on small, mid-sized and large borrower groups during 1985-2018. The asymmetric impact of monetary policy primarily arises from the asymmetric behavior of commercial banks towards their different groups of customers. Commercial banks have a preference for large and mid-sized borrowers due to lower transaction costs, balance sheet factors and are also from the motivation of maintaining a healthy relationship with their prime customers whereas they incur higher transaction costs in dealing with small borrowers and who are also considered risky from the view point of profit making. Therefore, in response to a tight money policy adopted by the central bank, commercial banks tend to accommodate medium and large borrower groups. Risk averse behavior of commercial banks tends to reduce (increase) lending to small borrowers in response to tighter (softer) monetary policy.

The conclusions drawn from our empirical findings are in line with the existing literature assessing the distributional impact of monetary policy in the Indian context. With a huge unorganized segment in India, loans to small borrowers are very crucial. Therefore, the findings of this study advocates for supportive measures from the authorities in sustaining the activities undertaken by small borrowers. As commercial banks seem to have preferred internal benchmarking for its loan pricing mechanism, it has turned out to be less transparent and non-uniform across banks. This not only hinders monetary policy transmission but also amplifies distributional consequences. Regulatory authorities may issue directions and advisories to the commercial banks that would lead to an appropriate loan pricing mechanism

and eventually improve monetary transmission. The recently announced initiative by the RBI linking certain categories of loans (all new floating rate personal or retail loans and floating rate loans to MSMEs) to an external benchmark effective from October 1, 2019 is a right step in this direction. This would strengthen the existing monetary transmission mechanism and can be a panacea for the asymmetric preference of commercial banks towards its various types of borrowers. Going forward, it would be worthwhile to undertake a similar empirical exercise at the micro level after incorporating social, demographic and economic characteristics of the individual account holders.

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Appendices

Appendix Table A1: Literature Review

Study	Scope	Period/Data/Method	Focus	Findings
Leonard Laudadio (1963)	Size of bank, size of borrower and rate of interest	• 1955-57 • Analysis takes into account the size of loan, borrower, bank and portfolio structure of the bank	Investigates the hypothesis – Does market imperfection explain part of the large borrower-small borrower interest rate differential	Composition of bank's loan portfolio and monetary policy is essential to explain interest rate differential among large and small borrowers
Dale and Haldane (1994)	Impact of monetary policy shock on specific sectors of the economy	• UK Economy • 1974:06 to 1992:10 • Vector Auto Regressive (VAR) model	Simulating the effects of a monetary policy shock on asset prices, bank balance sheet variables and prices	Monetary policy can have differential impact on various sectors of the economy
Bernanke and Gertler (1995)	Credit channel of monetary transmission	• 1959-1995 • GDP and its components; price level & federal funds rate • VAR Framework	Documents the responses of GDP and its components to a monetary policy shock and explains how credit channel helps in describing the phenomenon	Finds evidence for effect of monetary policy shock on real economy through the credit channel mechanism
Angeloni, I., A. Kashyap and B. Mojon (2003)	Monetary transmission mechanism in the Euro Area	• 1980-1998 • Analysis across the Euro Zone • Output, Prices, Interest Rate, Exchange Rate • VAR Framework	Role of interest rate in the monetary policy transmission mechanism	Plausible euro-area wide monetary policy responses for prices and output

Study	Scope	Period/Data/Method	Focus	Findings
Asfaha and Jooste (2007)	Effect of monetary change on relative agricultural prices	• January 1995 – June 1995 (monthly data) • Agriculture price index, industrial price index, exchange rate and money supply • Johansen Co-integration test and VECM	Investigates the short-run and long- run impact of monetary policy changes on relative agricultural prices in South Africa	Agricultural prices adjust faster than industrial prices to monetary changes, affecting real agricultural prices in the short-run. Monetary policy may have less desirable impact on farmers and consumers, especially in the short-run.
Cravino, Lan and Levchenko (2018)	Distributional consequences of monetary shock	• 1978-2015 • Construction of percentile level expenditure weights, constructing income percentile specific • FAVAR Model	Prices of the goods consumed by high income households are stickier and less volatile than those goods consumed by middle income households	Monetary policy can have distributional consequences by affecting the relative prices of goods Households at the top of the income distribution consume more sticky-priced goods and face substantially lower overall inflation volatility.
B.L.Pandit, Ajit Mittal, Mohua Roy and Saibal Ghosh (2006)	Transmission of monetary policy through the bank lending channel: Analysis and evidence for India	• 1993-94 to 2002-03 • RBI banking publications • Structural VAR • Panel Data Analysis	Addresses three questions: (a) monetary policy transmission mechanism and effectiveness of monetary policy instruments (b) response of bank lending to changes in monetary policy (c) Asymmetry between large and small banks' lending behavior under a monetary policy change.	Small banks would be more acutely affected by contractionary monetary policy when compared with big banks. Small banks would be curtailing their lending more sharply *vis-s-vis* large banks.

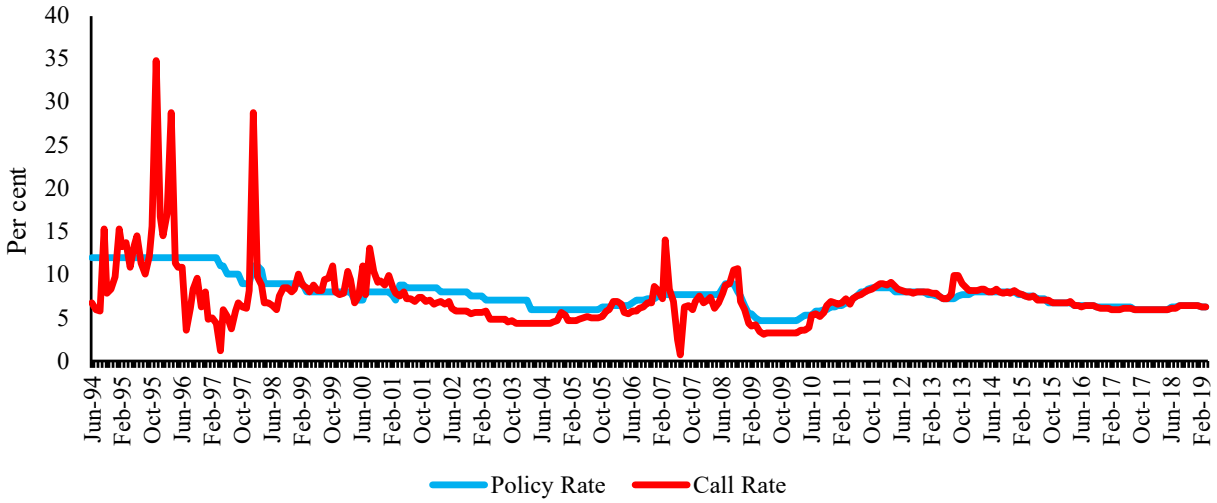
Study	Scope	Period/Data/Method	Focus	Findings
Sarat Dhal (2009)	Impact of monetary policy through the interest rate on dispersion of credit to Indian states (20 states)	• Covers 20 Indian States (1982-2009) • Bank credit, real GSDP, indicator of infra development & indicator of commercialization of economic activities • Standard pooled cross section least square regression technique	Change in policy variables such as interest rate could have differential state specific effects	Poor states are likely to be more affected during a tight monetary policy
Saibhal Ghosh (2009)	Investigates the impact of monetary shock on Industries	• Annual Survey of Industries (ASI), real GDP growth, real lending rate & WPI (1981 – 2004) • VAR framework	Importance of monetary policy for industrial output	Industries respond quite differently to a monetary tightening-related mainly to differences in size of the industry, its intensity of working capital use and the proportion of interest cost
Sarat Dhal (2011)	Monetary policy transmission effect on Indian Industries	• ASI, call money rate & WPI • Monthly Data (April 1993 – October 2011) • VAR framework	Effect of monetary transmission mechanism on 5 use-based industries	With a tight monetary policy, output growth could be affected more for capital goods & consumer durables than basic intermediate and non-consumer durables
Kuhelika De (2017)	Food price channel of monetary policy transmission	• Household Survey Data (1996Q1- 2013 Q4) • FAVAR framework	Subsistence food consumption of poor households and inequality	Expansionary monetary policy – increases relative food prices – reduces subsistence consumption of poor households – increases inequality

Appendix A2: Stylized Facts on India

Chart 1: Rate Movement in India (in Percent Terms)

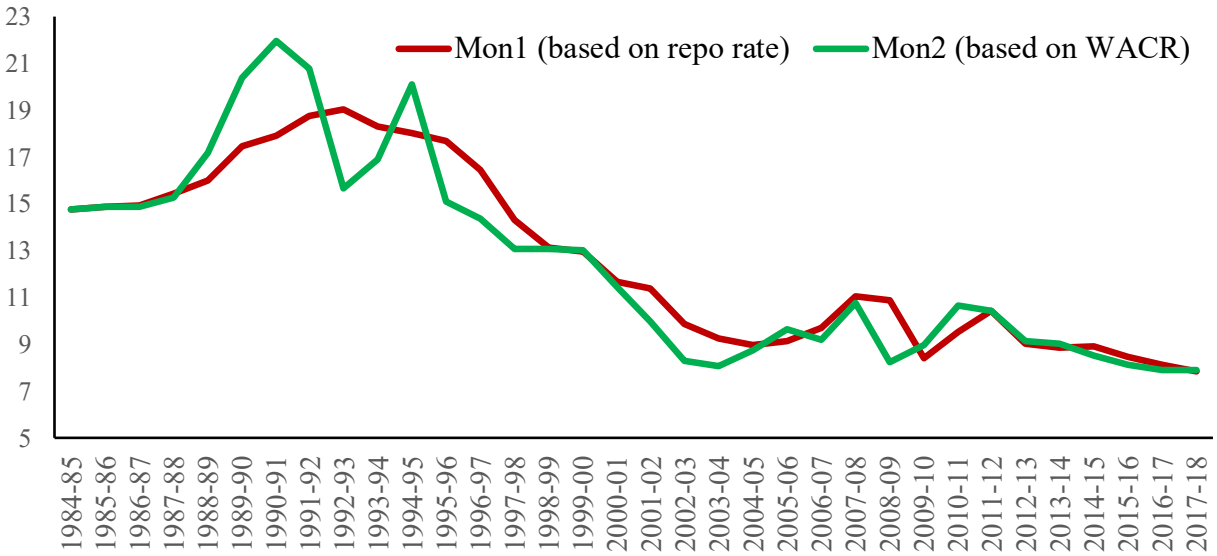
Source: Database on Indian Economy (DBIE), RBI.

Chart 2: Policy Rate (Repo Rate) Vs Operation Rate (Call Rate)



Source: DBIE, RBI.

Chart 3: Different Measures of Monetary Policy Indicators (Percent)



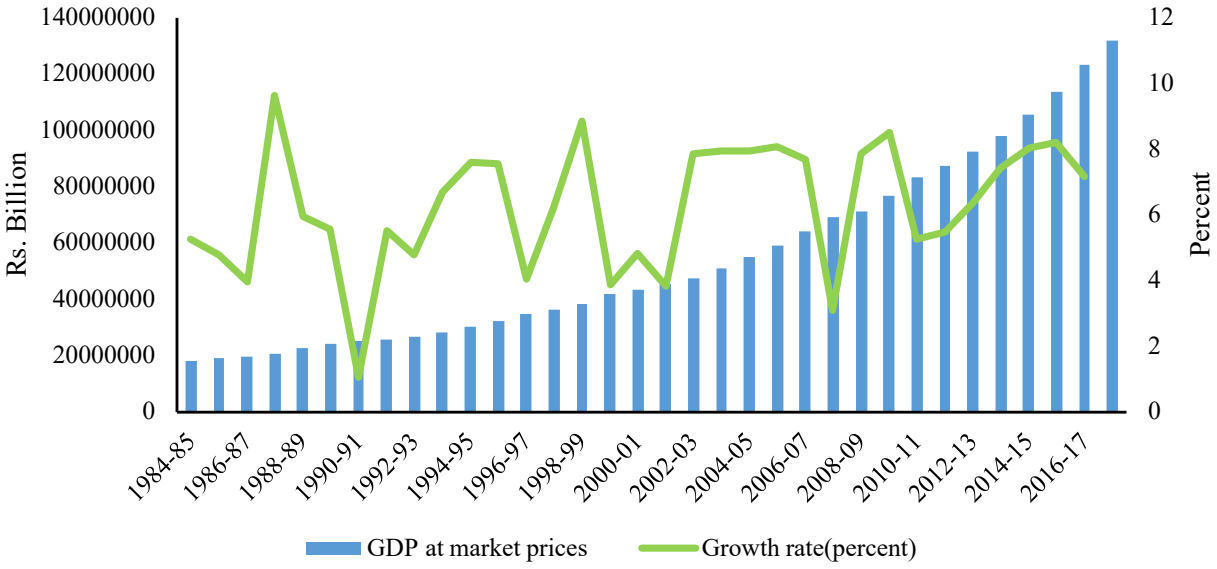
Source: DBIE, RBI.

Note: Monetary Policy Indicator

Mon 1: Monetary indicator based on geometric mean of index using repo rate, CRR and SLR.

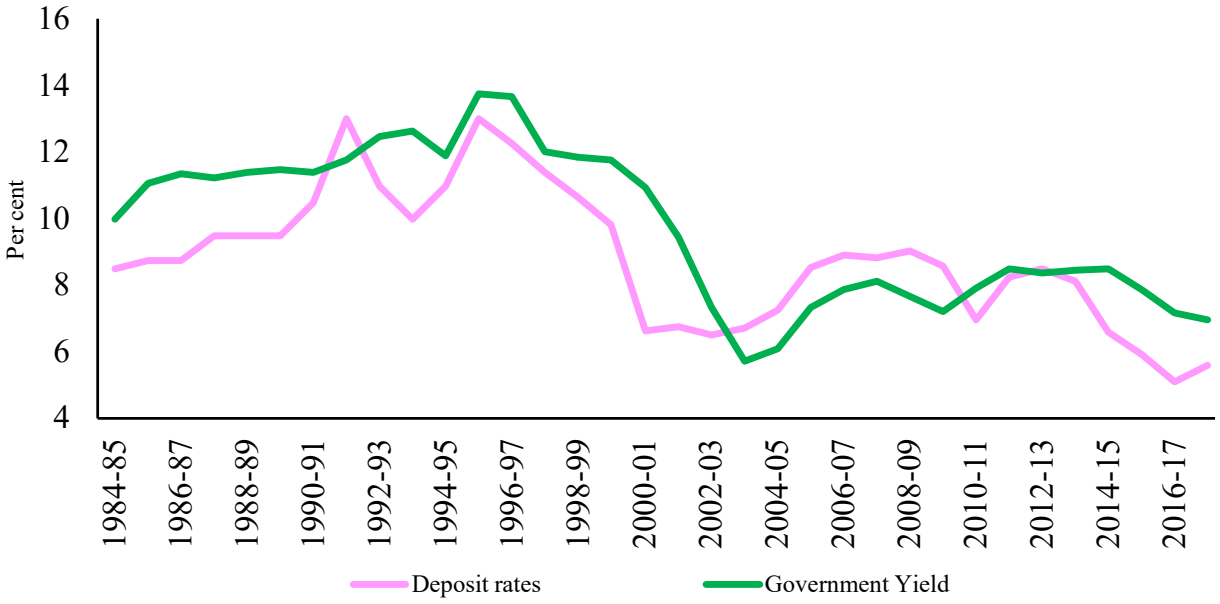
Mon 2: Monetary indicator based on geometric mean of index using WACR, CRR and SLR.

Chart 4: GDP at Constant Market Price (2011-12) Base



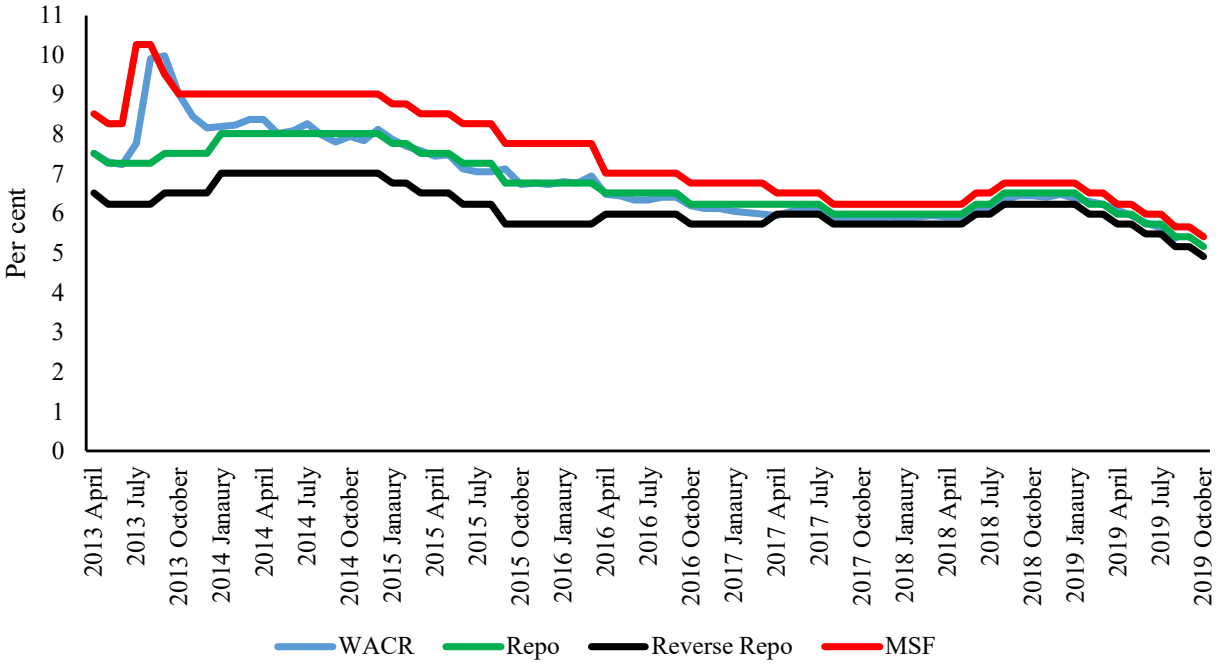
Source: DBIE, RBI.

Chart 5: Commercial Banks' Deposit Rates and G-Sec Yield



Source: DBIE, RBI.

Chart 6: Weighted Average Call Rate (WACR) and Policy Corridor



Source: DBIE, RBI.

Table 1: Share of Rural Households in Total Debt (in Percent)

Source	1951	1961	1971	1981	1991	2002	2012
Formal Sources	7.2	14.8	29.2	61.3	64	57.1	56
of which, Commercial Banks	-	0.4	2.2	28	33.7	24.5	25.1
Informal Sources	92.8	85.2	70.8	38.7	36	42.9	44
of which, Money Lenders	72.6	60.8	36.9	17.1	17.6	29.8	33.2

Source: Chavan (2015), "Bank Credit to Small Borrowers: An Analysis based on Supply and Demand Side Indicators", *Reserve Bank of India Occasional Papers*, 35 & 36 (1&2).

Appendix Table A3: Categories of Borrower Groups

Borrower Group		Credit Size Limit
B1	**Small**	0-0.5 Million
B2		0.5 -1 Million
B3		1 -2.5 Million
B4		Above Rs.2.5 and upto Rs.5 Million
B5	**Mid-size**	Above Rs.5 and upto Rs 10 Million
B6		Above Rs 10 and upto Rs.40 Million
B7		Above Rs.40 and upto Rs.60 Million
B8	**Large**	Above Rs.60 and upto Rs.100 Million
B9		Above Rs 100 Million

Appendix Table A4:

I. Lag length Selection Based on AIC		
	Case (i)	**Case (ii)**
B1	(2,1,1,2)	(3,2,0,2)
B2	(3,2,0,3)	(3,3,2,3)
B3	(1,3,0,3)	(3,3,0,3)
B4	(2,3,0,2)	(3,1,0,0)
B5	(1,0,0,0)	(1,0,0,0)
B6	(2,3,3,3)	(2,3,1,2)
B7	(3,0,1,2)	(3,1,1,2)
B8	(3,0,3,3)	(2,2,3,2)
B9	(3,3,1,2)	(3,0,0,2)

Appendix Table A5: Empirical Test Results

I. Normality Test: Jarque Beta

Case (i)		
Null Hypothesis: Data is Normally Distributed		
	Jarque Beta Statistics	P-value
1	1.34	0.5
2	7.5	0.02
3	0.58	0.74
4	0.96	0.61
5	111	0
6	0.49	0.78
7	18.14	0
8	9.21	0
9	0.96	0.61

Case (ii)		
Null Hypothesis: Data is Normally Distributed		
	Jarque Beta Statistics	P-value
1	1.04	0.59
2	0.53	0.76
3	1.03	0.59
4	0.14	0.92
5	112	0
6	0.98	0.61
7	2.78	0.24
8	2.02	0.36
9	0.46	0.79

II. Heteroscedasticity Test: Breusch-Pagan-Godfrey

Case (i)		
Null Hypothesis: Homoskedasticity		
B1	Prob. F(11,20)	0.16
B2	Prob. F(13,17)	0.69
B3	Prob. F(12,18)	0.27
B4	Prob. F(12,18)	0.22
B5	Prob. F(6,26)	0.43
B6	Prob. F(16,14)	0.75
B7	Prob. F(11,19)	0.80
B8	Prob. F(14,16)	0.39
B9	Prob. F(14,16)	0.77

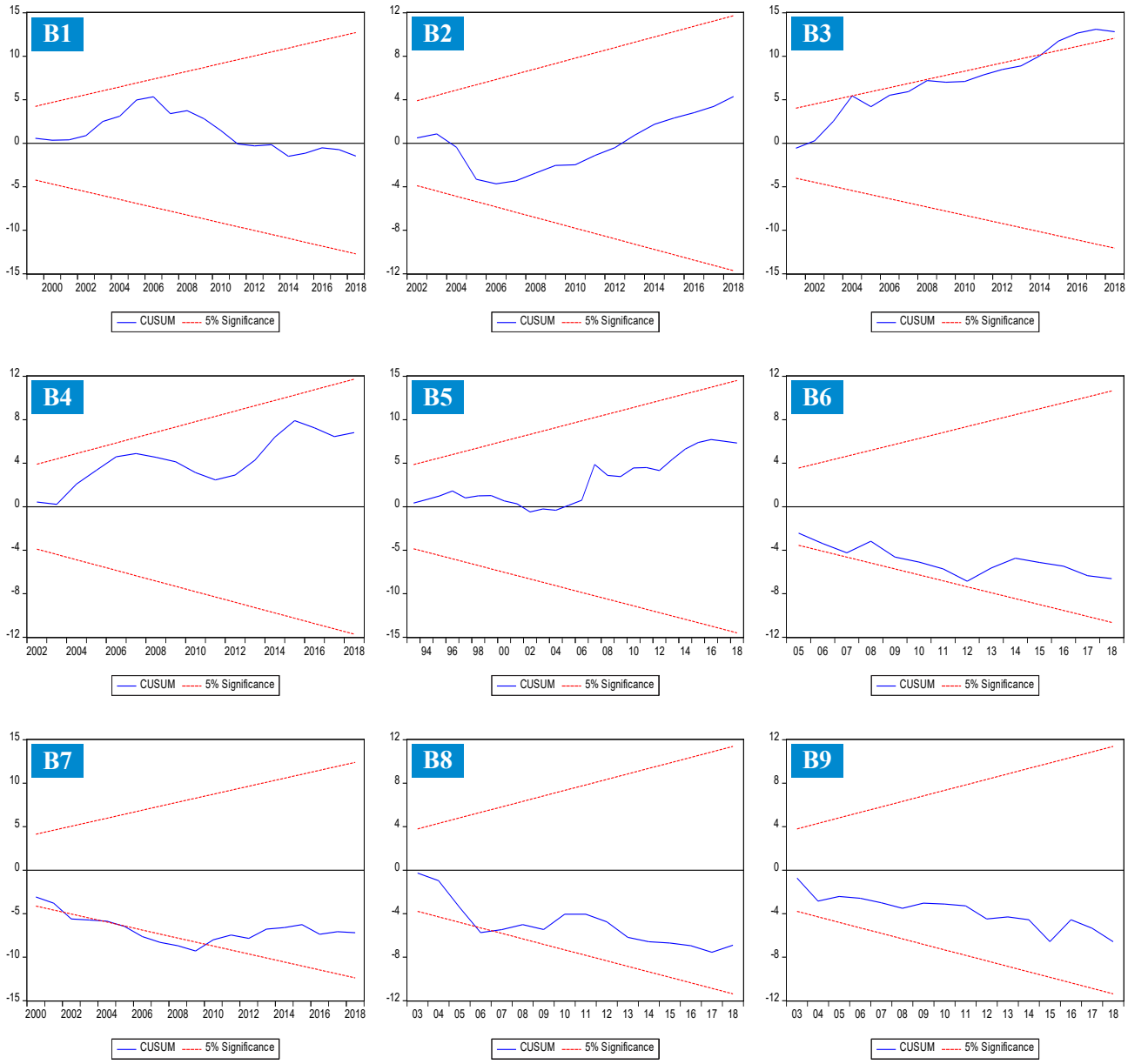
Case (ii)		
Null Hypothesis: Homoskedasticity		
B1	Prob. F(12,18)	0.74
B2	Prob. F(16,14)	0.58
B3	Prob. F(14,16)	0.59
B4	Prob. F(9,21)	0.04
B5	Prob. F(6,26)	0.44
B6	Prob. F(13,17)	0.91
B7	Prob. F(12,18)	0.85
B8	Prob. F(14,16)	0.28
B9	Prob. F(10,20)	0.39

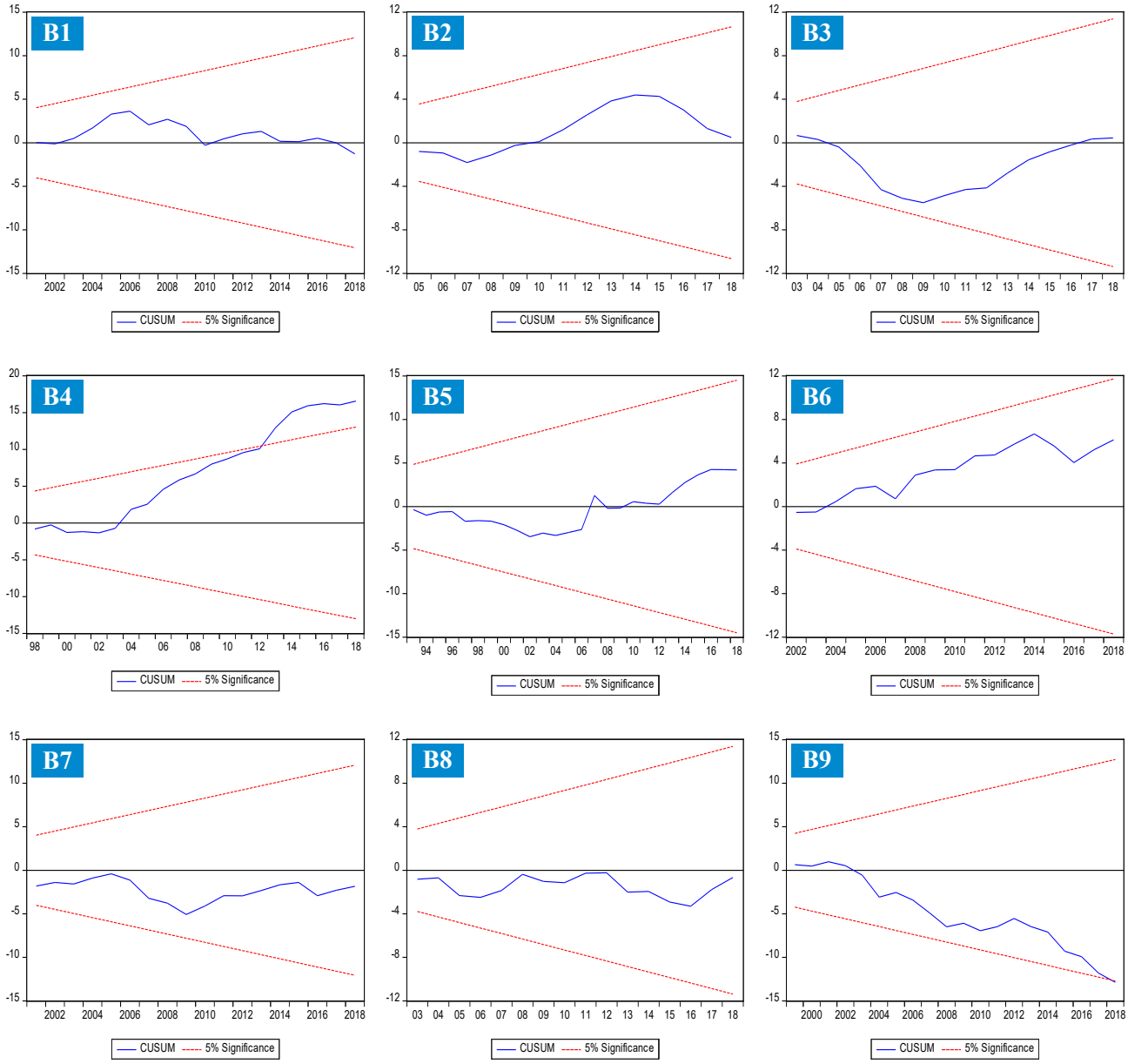
III. Breusch-Godfrey Serial Correlation LM Test

Case (i)		
Null Hypothesis: No Serial Correlation at up to 3 lags		
	Prob (F-stat)	Prob (chi-square)
B1	Prob. F(3,17)= 0.17	Prob. Chi Square(3)= 0.05
B2	Prob. F(3,14)= 0.54	Prob. Chi-Square(3)= 0.23
B3	Prob. F(3,14)= 0.10	Prob. Chi-Square(3)= 0.01
B4	Prob. F(3,15)= 0.41	Prob. Chi-Square(3)= 0.15
B5	Prob. F(3,23)= 0.64	Prob. Chi-Square(3)= 0.52
B6	Prob. F(3,11)= 0.07	Prob. Chi-Square(3)= 0.00
B7	Prob. F(3,16)= 0.09	Prob. Chi-Square(3)= 0.02
B8	Prob. F(3,13)= 0.16	Prob. Chi-Square(3)= 0.02
B9	Prob. F(3,13)= 0.06	Prob. Chi-Square(3)= 0.01

Case (ii)		
Null Hypothesis: No Serial Correlation at up to 3 lags		
	Prob (F-stat)	Prob (chi-square)
B1	Prob. F(3,15)= 0.10	Prob. Chi Square(3)= 0.01
B2	Prob. F(3,11)= 0.94	Prob. Chi-Square(3)= 0.80
B3	Prob. F(3,13)= 0.04	Prob. Chi-Square(3)= 0.00
B4	Prob. F(3,18)= 0.92	Prob. Chi-Square(3)= 0.85
B5	Prob. F(3,23)= 0.42	Prob. Chi-Square(3)= 0.33
B6	Prob. F(3,14)= 0.26	Prob. Chi-Square(3)= 0.06
B7	Prob. F(3,15)= 0.36	Prob. Chi-Square(3)= 0.11
B8	Prob. F(3,13)= 0.41	Prob. Chi-Square(3)= 0.11
B9	Prob. F(3,17)= 0.85	Prob. Chi-Square(3)= 0.72

IV: Test for Stability: CUSUM
CUSUM Test (Case (i))




B1
B2
B3
B4
B5
B6
B7
B8
B9
CUSUM
5% Significance

Appendix Table A6: ARDL Model with Fixed Lag Length Selection (3,2,2,2)
Long-Run Coefficients of ARDL Model (Case(i))

Dependent Variables: LB_t	MI1	P	I	F-bound test statistics	ECM_{t-1}
B1	-0.03***	-0.85***	2.47***	4.97**	-0.61***
B2	-0.15***	0.11	2.17***	5.75***	-0.18***
B3	-0.16	-0.55	2.48***	4.11*	-0.18***
B4	0.35	-0.27	3.63	2.21	0.05***
B5	0.04***	-0.02	2.45***	2.64	-1.59***
B6	0.05***	-0.45***	2.53***	7.30***	-0.74***
B7	0.05***	-1.37***	2.83***	5.90***	-0.41***
B8	0.11**	-2.6***	3.50***	3.97*	-0.23***
B9	-0.02	-1.82***	4.29***	4.25*	-0.54***

Long-Run Coefficients of ARDL Model (Case(ii))

Dependent Variables: LB_t	MI2	P	I	F-bound test statistic	ECM_{t-1}
B1	-0.03***	-0.68***	2.43***	4.14*	-0.45***
B2	-0.25**	2.08	0.91	4.89**	-0.09***
B3	-0.18	0.24	2.12***	4.36**	-0.13***
B4	-0.17	1.82	1.73	2.13	-0.06***
B5	0.03**	-0.07	2.44***	1.92	-1.12***
B6	0.04***	-0.68***	2.50***	4.08*	-0.52***
B7	0.05***	-1.62***	2.85	7.08***	-0.45***
B8	0.12***	-3.15***	3.56***	4.42**	-0.22***
B9	-0.02	-1.81***	4.24***	4.17*	-0.50***

Chapter 4

MONETARY POLICY REDISTRIBUTION CHANNEL: CASE OF MONGOLIA

By

Munkhchimeg Sukhee[1], Enkhzaya Demid[2], Tsenddorj Dorjpurev[3] and Batbold Narmandakh[4]

1. Introduction

Monetary policy is changing around the world, and with it, the tools we employ is evolving in order to address the contemporary issues. Among many things, income inequality has been highlighted as one of the issues that need to be taken in consideration when conducting monetary policy. The great recession and what came afterwards not only showed us the inadequacy of existing models but also called for broader perspectives from central banks.

As recently as 2018, Bank of Mongolia has added macro-prudential measures to its toolbox to cope with its partial responsibility for financial stability. As a support, the Economic Research and Training Institute at the Bank of Mongolia has conducted a nationwide survey that has successfully concluded the first ever attempt of a household balance sheet. This is to complement the already existing household survey conducted by the National Statistics Office every quarter, albeit with a much wider sample. This research paper investigates the monetary policy transmission mechanism for various levels of households, differentiated basically by income and also categorically characterized by their financial position.

The purpose of this study is to contribute to the literature by identifying the role of the redistribution effects of the monetary policy transmission mechanism based on evidence from Mongolian micro level data. For this, we will see how different marginal propensity to consume and the distribution of household income and wealth affects monetary policy. In order to do this, we have used the perfect-foresight general equilibrium model (Auclert, 2019). In determining the effects of monetary policy, this model, in addition to reflecting the effects on aggregate income and substitution channels, which are considered in the traditional model with a representative agent, the indirect redistribution channel that depends on income differences, unexpected price changes and real interest rates changes are included. We have calculated the marginal propensity to consume (MPC) for each income group based on 2016-

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2018 survey data from the Mongolian Household Social and Economic Survey (HSES), compiled by the National Statistics Office. The Bank of Mongolia's Household Financial Condition Survey (HFCS) was used to calculate the net nominal position (NNP) and the unhedged interest rate exposures (URE) of the households.

The study consists of the following sections: Section 2 presents the stylized facts on Mongolia while Section 3 summarizes the literature review. Section 4 describes the methodology and the model employed and Section 5 delves into the sources and calculations of quantitative data. Section 6 presents the results of estimation and Section 7 concludes.

2. Stylized Facts

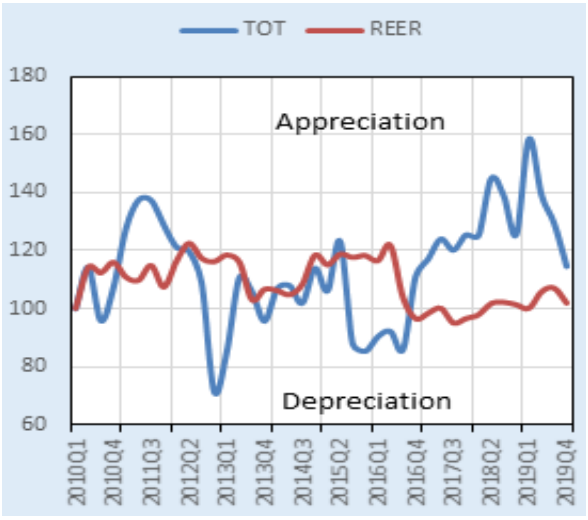
The Mongolian economy which is highly dependent on mining exports, experienced severe episodes of commodity price boom-bust cycles in the last decade. Naturally, the commodity cycle brought with it fluctuations in the economic growth as well as in the real exchange rate which affected asset prices including housing prices. Monetary policy, in these times, has demonstrated a counter cyclical stance, i.e., tightening during the boom period and loosening when the economy has slowed down.

There is an exception in monetary policy stance between 2012 and 2016 when Bank of Mongolia conducted so-called unconventional monetary policy. It increased the size of the balance sheet by holding mortgage backed securities (MBS) and other corporate-issued bonds both with heavily subsidized rates. This was reflected in the cumulative loss of the banks and acted as quasi-fiscal expenditures. As a result, the decline in growth and household income and expenditure has been smoothened compared with the sharp decline in commodity price.

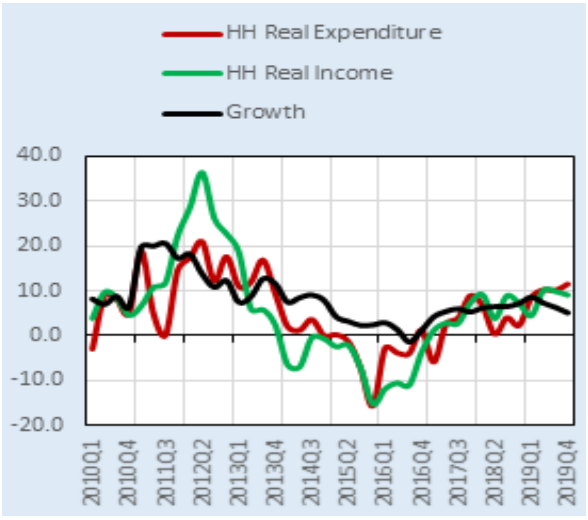
It also changed the dynamics of the housing market, creating a hump like price increase during the period while the stock market showed a flat figure. Even though the monetary condition index showed a tightening episode in 2015 and 2016, it was actually compensating for the quasi-fiscal activities it conducted. One could say from the figure that the real monetary condition index and the Gini index, except for 2015 and 2016, show that there is a relation between inequality and monetary policy stance.

In recent years, the favorable external condition indicated by the terms of trade has allowed for real increases in economy as well as household income (and expenditure). It is also reflected in the stock market but not in the housing market, which is only calming after the subsidized mortgage credit rush. During this time, Bank of Mongolia under the Extended Fund Facility program which was agreed upon with the IMF in May 2017 has halted, by law, its quasi-fiscal activities. Also within the agreement, international reserves were to be accumulated which, in turn, has kept the real exchange rate at low levels and contributed to the real monetary condition being in the negative territory. However, the slight upward movement in the monetary condition was accompanied with an increase in inequality for 2018.

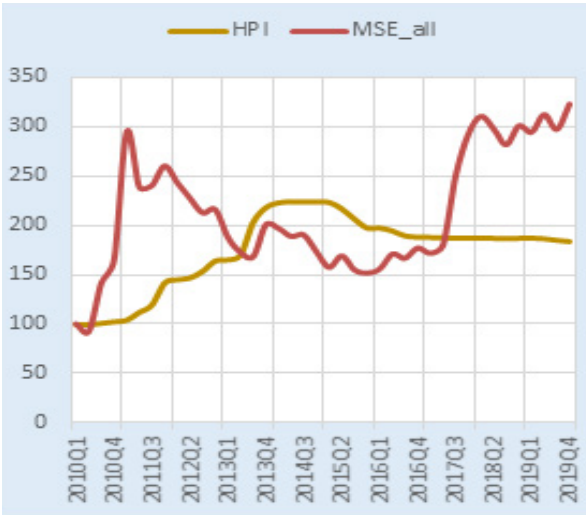
Figure 1
Economic Background



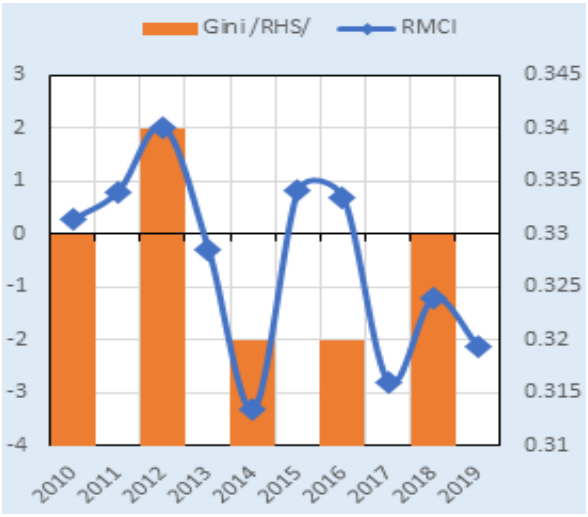
a. ToT vrs REER, 2010Q1=100



b. Growth vrs HH Income and Expenditure (YoY)



c. Housing Price vrs Stock Market Index (2010Q1=100)



d. Gini Coefficient vs Monetary Condition Index (RMCI)

Source: Bank of Mongolia, National Statistic Office.

This snapshot of the last decade shows how monetary policy is acting together with inequality in response to different economic factors, especially, how the central bank's targeted actions such as MBS purchases affects different asset classes. The overall picture here suggests that inequality has moved downwards and upwards resembling the movements in the stock exchange rate, while the housing price hump is corresponding to the decrease in inequality as well as the period of falling stock prices. These does not clearly tell us how monetary policy affects inequality, but begs the question of the transmission of this effect via household balance structure.

3. Literature Review

In the standard Representative Agent New Keynesian (RANK) models, response of aggregate consumption to a change in interest rate is described by the Euler equation, which shows strong intertemporal substitution effect and weak income sensitivity of consumption. For instance, a representative household consumes a permanent-income and faces an intertemporal budget constraint. Hence, its consumption is highly sensitive to changes in interest rates but not responsive to temporary changes in income. In detail, the model shows that the direct response to changes in interest rate accounts for more than 95 percent of the consumption response to monetary shocks, while indirect effect due to changes in income makes up less than 5 percent. Thus, the effect of monetary policy on consumption is mainly driven by the intertemporal substitution effect in the RANK models.

In recent years, however, the growing inequality of income and wealth and the rising asset prices have been among key factors in the impact of monetary policy on the economy. Therefore, researchers have developed a Heterogeneous Agents New Keynesian model (HANK) that reflect a more realistic representation of consumption behavior and distributions of household income and wealth. The HANK models explain how monetary policy effects may vary across income and wealth groups with different marginal propensities to consume. For instance, expansionary monetary policy benefits households with high amounts of debt, whereas tight monetary policy tends to favor households with savings. Thus, monetary policy might have redistributive effects on the economy and can cause inequality in the short-run. There are recent papers, including (Kaplan, Violante, & Moll, 2016) and (Auclert, 2019), which explain the importance of the heterogeneous agent model to understand the transmission of monetary policy in the economy.

In particular, (Kaplan, Violante, & Moll, 2016) developed the HANK model, which explains the heterogeneous impact of monetary policy shocks on consumption, taking into account the differences in household wealth and marginal propensity to consume. In this model, monetary policy affects consumption primarily through indirect effects that arise from a general equilibrium increase in labor demand. The study finds a weak intertemporal substitute effect of consumption. They argue that hand-to-mouth households who consume entire current income are highly sensitive to labor income shocks but are not sensitive to interest rate changes. Even wealthy households may not increase consumption in response to an interest rate cut due to the negative income shocks. These are likely to lower the direct impact of monetary policy. The empirical evidence shows that the direct effects of interest rate shock on consumption are relatively small (roughly one-thirds of the total impact), while the indirect effects can be significant (roughly two-thirds of the total impact) based on the U.S. households survey data. Therefore, the HANK model suggests that the indirect effect through changes in income can be the key determinant of the consumption response to monetary shocks.

(Auclert, 2019) identifies the HANK model emphasizing the role of redistribution in the transmission mechanism of monetary policy onto consumption. This model defines the three channels of monetary policy redistribution that affect aggregate spending; (i) an earning heterogeneity channel, (ii) a fisher effect channel, and (iii) an interest rate exposure channel. These channels show that monetary policy shock can have differential effects across the

household's consumption, depending on the differences in the household balance sheet and consumption behavior. According to this model, monetary policy can affect income distribution through changes in interest rates, asset prices, and capital gains. The paper shows analytically that households' heterogeneity may amplify or dampen the effects of monetary shocks on aggregate consumption. Applying micro data including a 2010 Italian Survey, 1999-2013 U.S. Panel Survey of Income Dynamics, and 2001-2002 U.S. Consumer Expenditure Survey, the study concludes that all three channels are likely to amplify the effects of monetary policy in both economies.

Table 1
Review of Empirical Studies

	Papers	Methods	Samples	Main findings
1	(Coibion, Gorodnichenko, Kueng, & Silvia, 2012)	VAR	U.S. 1980-2008	Contractionary monetary policy shocks lead to an increase in income and consumption heterogeneity.
2	(Mumtaz, 2017)	VAR	United Kingdom 1969 - 2012	Contractionary monetary policy raises income inequality. It negatively impacts on low-income households.
3	(De, 2017)	FAVAR, DSGE	India, China 1996- 2013	Monetary policy shocks have a different impact on the consumption of a different group of households. The expansionary monetary policy reduces income inequality.
4	(Cravino, Lan, & Levchenko, 2018)	FAVAR	U.S. 1978-2008	Monetary Policy can have distributional consequences on different income groups by affecting the relative prices of goods.
5	(Davtyan, 2017)	Panel VAR	U.S. 1979-2012	Tight monetary policy raises income inequality.
6	(Furceri, Loungani, & Zdzienicka, 2018)	Panel VAR	32 advanced and emerging market countries 1990-2013	Tight monetary policy raises income inequality. Contractionary monetary policy shocks increase income inequality, on average. The effect varies over time.
7	(O'Farrell, Rawdanowicz, & Inaba, 2016)	Simulations	OECD survey data 2010-2012	Income inequality plays a small role in the monetary policy transmission mechanism. Found mixed results for the euro area countries.
8	(Gornemann, Kuester, & Nakajima, 2012)	DSGE	U.S. 1984-2008	While households in the top 5 percent of the wealth distribution benefit from a contractionary monetary policy shock, the bottom 5 percent lose in the U.S. households.

Another group of studies considers a simple Two Agent New Keynesian (TANK) model (Debortoli, Gali, & others, 2017). The TANK model simplifies the HANK model considering two types of households, Ricardian and Keynesian, but does not consider the effect of wealth distribution. Ricardian consumers are assumed to have no constraint in the financial markets, thus are highly responsive to interest rate changes. On the contrary, Keynesian consumers are assumed as "hand-to-mouth" spenders who do not hold assets and consume their entire income every period so that they do not respond to interest rate changes. The model emphasizes the differences in the average consumption between constrained and unconstrained households in financial markets. A common feature of the HANK and TANK models missing in representative agent models is that a certain part of the households face a borrowing constraint and do not have access to financial markets, thus they do not adjust their consumption in response to changes in interest rates. It implies that the economy's response to monetary policy shocks may differ from the standard New Keynesian model with a representative agent.

In addition to the HANK model, some studies that have investigated how monetary policy shocks affect income inequality using methods such as VAR, FAVAR, Panel VAR, and DSGE. These studies show mixed results on the distributional impact of monetary policy for both cases in single country and cross countries studies. But in most cases, tight monetary policy tend to increase income inequality (Table 1).

For the case of Mongolia, there are some empirical studies related to the transmission mechanism of monetary policy. For instance, Demid (2011) studied the bank lending channel of monetary policy transmission in Mongolia using a structural VECM approach for the period between 2004Q1 and 2011Q1. The findings suggest that the transmission of central bank bill rates to bank credit supply operates through the bank's reserve and equity rather than lending rate and concludes that the bank lending channel is effective in Mongolia. Doojav and Batjartgal (2014) studied the cost channel of monetary policy transmission in Mongolia using a Bayesian Dynamic Dtochastic General Equilibrium approach for 2000.Q1-2013.Q4 data. The paper concludes that incomplete pass-through of the money market rate to the bank lending rate weakens the cost channel of monetary policy transmission. Furthermore, Bayarsaikhan et al. (2015) examined monetary policy transmission mechanisms using VAR and OLS models for the sample period from 2002Q1 to 2015Q2. The study found that the interbank market rate has a 1-2 quarter lagged effect on bank lending rate and concludes that bank lending is the most significant channel of monetary transmission for price and output.

The existing studies on monetary policy transmission are concerned with aggregate macroeconomic data, but its redistribution channel has not yet been investigated in Mongolia. This paper contributes to the literature by highlighting the distributional effects of monetary policy shock on different income groups based on micro-level data of households in Mongolia.

4. Model Description

4.1 Modeling

We replicate an existing model by Auclert (2019) that incorporates the monetary policy and its redistribution channels. The model is constructed as follows:

Households: There is a closed economy with I types of heterogeneous households. Each agent type i has its own discount factor β_i, utility functions u_i and v_i. We assume that there is a mass 1 of individuals within each type i, each in an idiosyncratic state $s_{i,t} \in S_i$. The cross-sectional average of any variable $z_{i,t}$ is $E_I(z_{i,t})$, taken over individual types I and idiosyncratic state S_i. For example, aggregate consumption per capita C_t is equal to average individual consumption $E_I(c_{i,t})$. Each agent i solves the following discrete time consumer problem with the budget constraint.

$$\begin{aligned} &max \sum_t \beta_i^t (u_i(c_{i,t}) - v_i(n_{i,t})) \\ &s.t. P_t c_{i,t} = P_t y_{i,t} + W_t n_{i,t} + B_{i,t}^{t-1} + \sum_{s\geq 1} Q_{t+s}^t (B_{i,t+s}^{t-1} - B_{i,t+s}^t) + \\ &P_t b_{i,t}^{t-1} + \sum_{s\geq 1} (q_{t+s}^t) P_{t+s} (b_{i,t+s}^{t-1} - b_{i,t+s}^t) \end{aligned} \quad (1)$$

Here, each agent i in state $s_{i,t}$ has a stochastic endowment of $e_{i,t}(s_{i,t})$ efficient units of work, and receives a wage of $w_{i,t} = e_i(s_{i,t}) w_t$ per hour, where w_t is the real wage per efficient hour. By choosing n_{it} hours of work, the agent earns the earned income $w_t e_{i,t} n_{i,t}$. The agent is also endowed with with real unearned income $y_{i,t}$, here $y_{it} = d_{it} - t_{it}$ is total dividends on the firms he owns $d_{i,t}$ net of taxes from the government $t_{i,t}$. Thus, the agent's overall gross-of-tax income is:

$$Y_{i,t} = w_t e_{i,t} n_{i,t} + d_{i,t} \quad (2)$$

There is a fixed supply of aggregate capital K, and a set of N trees that constitutes claims to those firms' profits and capital stock. Each of those trees distributes dividends which, in the aggregate, add up to the sum of aggregate capital income and profits $E_I d_{i,t} = \rho_t K + \pi_t$. The agents also trade nominal government bonds with supply of B_t, and a set of $J - 1$ additional assets with zero net supply that can be nominal and real. Each agent i also trades a subset N_i of the trees, and a subset J_i of the other assets. If both N_i and J_i are empty, agents of type i live hand-to-mouth. In other cases, it is assumed that trading is subject to a type-specific borrowing constraint D_i. To keep the problem well-defined, we assume that the prices of nominal and real bonds prevent arbitrage profits. This leads to a Fisher equation for the nominal term structure:

$$Q_{t+s}^t = (q_{t+s}^t) \frac{P_t}{P_{t+s}}, \forall t, s \quad (3)$$

Firms: There exists a competitive firm producing the unique final good in this economy, in quantity Y_t and nominal price P_t, by aggregating intermediate goods with constant-returns to scale technology. A unit mass of firms j uses the production functions $X_{j,t} = A_{j,t}F(K_{j,t}, L_{j,t})$. Markets for inputs are perfectly competitive, so firms take the real wage w_t and the real rental rate of capital ρ_t as given. These firms sell their products under monopolistic competition and their prices can be sticky. Firm j, therefore, sets its price $P_{j,t}$ at a markup over the marginal cost and it makes real profits $\pi_{j,t}$. Summing across firms $j \in J$, aggregate production is equal to aggregate income:

$$Y_t = E_J[\frac{P_{j,t}}{P_t} X_{j,t}] = w_t E_J[L_{j,t}] + \rho_t E_J[K_{j,t}] + E_J[\pi_{j,t}] \quad (4)$$

Government: A government has nominal short-term debt B_t, spends G_t, and runs the tax-and-transfer system. Its nominal budget constraint is therefore:

$$Q_t B_{t+1} = P_t G_t + B_t - P_t E_I[t_{i,t}] \quad (5)$$

where $Q_t = \frac{1}{R_t}\frac{P_t}{P_{t+1}}$ is the one-period nominal discount rate. There is a simple rule in which the government targets a constant real level of debt $\frac{B_t}{P_t} = \bar{b} > 0$ and spending $G_t = \bar{G} > 0$. Also, the government balances its budget at the margin by adjusting all transfers in a lump-sum manner.

Market clearing: In equilibrium, the markets for capital, labor, and goods all clear, this implies that at all times t:

$$E_J[K_{j,t}] = KE_I[e_{it}n_{it}] = E_J[L_{jt}]E_I[Y_{it}] = Y_t = C_t + G_t \quad (6)$$

Equilibrium also implies market clearing in all $J + N$ asset markets.

Aggregation result: We focus on the response of the consumption to the a perturbation of this environment in which individual gross incomes ∂Y_i, nominal prices ∂P and the real interest rate ∂R change at t=0 only. Therefore, this is convenient to analyze the effect of no persistent and unexpected shock on the consumption. Here $\partial Y = E_I[\partial Y_i]$. At the market clearing for nominal assets, all nominal positions net out, except for that of the government as follows:

$$E_I[NNP_{i,t}] = \bar{b} = -NNP_{g,t}, \forall t \quad (7)$$

and market clearing for all assets implies that:

$$E_I[URE_{i,t}] = Y_t - E_I[t_{i,t}] + \frac{B_t}{P_t} - C_t = G_t + \frac{B_t}{P_t} - E_I[t_{i,t}] = -URE_{gt} \quad (8)$$

where NNP_{gt} and URE_{gt} are the net nominal position and the unhedged interest rate exposure of the government. Equations (7) and (8) are crucial restrictions from general equilibrium as the agent's asset is another liability and net nominal positions and interest rate exposures must net out in a closed economy.

4.2 Definitions of Re-distributional Channels of Monetary Policy

Using the model defined in the previous part, we consider redistribution channels of monetary policy in the total consumption. It leads to partial impact in response to change in income, interest rate and price on the consumption. Following the theorem defines the response of consumption to overall income, price and interest rate's changes.

Theorem 3. To first order, in response to ∂Y_i, ∂Y, ∂P, and ∂R, aggregate consumption changes by:

$$\partial C = E_I[\frac{Y_i}{Y}\widehat{MPC}_i]\partial Y + Cov_I(\widehat{MPC}_i, \partial Y_i - Y_i\frac{\partial Y}{Y}) - Cov_I(\widehat{MPC}_i, NNP_i)\frac{\partial P}{P}$$
$$+(Cov_I(\widehat{MPC}_i, URE_i)) - E_I[\sigma_i(1-\widehat{MPC}_i)c_i])\frac{\partial R}{R} \quad (9)$$

Theorem 3 holds no relationship of the underlying model generating MPCs and different types of exposures at the micro-level, as well as the relationship between ∂Y, ∂P, and ∂R at the macro level. The cross-sectional moments are measurable in the household-level data, which are informative about the economy's macroeconomic response to a shock, no matter the source of this shock. The coefficients of Theorem 3 illustrates the following:

- $E_I[\frac{Y_i}{Y}, \widehat{MPC}_i]$, *Aggregate income channel* indicates that in response to an expansionary monetary policy, the aggregate income increases, so do the incomes for each group's income.

- $Cov_I(\widehat{MPC}_i, \partial Y_i - Y_i\frac{\partial Y}{Y})$, *Income re-distributional channel* indicates that lower-income households have higher MPCs, and it is likely that monetary expansions increase aggregate consumption due to their endogenous effect on income distribution. Away from separable preferences, an additional complementary channel of monetary policy can arise, even with a representative agent, when preferences are such that increases in hours worked to increase the MPC.

- $Cov_I(\widehat{MPC}_i, NNP_i)$, *Price channel (Fisher effect)* indicates that net nominal borrowers have higher MPCs than net asset holders. This also has an endogenous outcome that shows monetary policy can increase in aggregate consumption via a Fisher channel.

- $Cov_I(\widehat{MPC}_i, URE_i)$, *Interest rate exposure channel* indicates that households with unhedged borrowing needs have higher MPCs than households with unhedged savings requirements. This has an endogenous outcome that the aggregate consumption responds more to real interest rates than the situation with inter-temporal substitution alone.

- $E_I[\sigma_i(1-\widehat{MPC}_i)c_i]$, *Substitution channel* indicates the standard interest rate channel. Here σ_i ith household income group's discount and we simplify it by giving a value of 0.5 constantly for all the different income groups as in .

5. Data

The key cross-sectional moments described above are derived from income, consumption, assets and liabilities. Here, the Household Socio-Economic surveys (NSO-HSES, 2016-2018) is used to calculate the marginal propensity to consume for each income group. Due to the lack of data on the household balance sheet, we had to integrate the Household Financial Condition survey (BOM-HFCS 2018) by the Bank of Mongolia, in particular, to compute the net nominal position (NNP) and unhedged interest rate exposure (URE) variables. This information about the households was applied in this work as summarized in the Table 2.

Aggregate income for each group Y is computed as the sum of all income sources including two wage sources, pension, income from sales of livestock and related goods or crop production in net of the costs occurred, income from the social insurance and welfare and government's other transfers, rents, sale of fixed asset, receivables, interests, withdrawals from deposits, dividends, gambling gains, and other incomes. C is a sum of all types of expenditures of households, including food, non-food, energy, rents and interest payments, as well as durable goods. We only include a part with share of ϵ (for the benchmark case $\epsilon = 0.75$) of durable goods expenditure in the total household expenditure calculation.

The URE is measured as the total resource flow that the household needs to invest over the first period of this consumption plan, thus A and L represents, respectively, assets and liabilities that mature over the period, over and above the amounts already included Y and C. Net nominal position (NNP) is computed as the difference between directly held nominal assets (deposits and bonds) and directly held nominal liabilities (mortgages and consumer credit).

Table 2
Mapping Model to Data Objects

Variable	Description	Source
	Unhedged interest rate exposure	$URE_i = Y_i - T_i - C_i + A_i - L_i$
Y_i	Gross income (excluding non-agricultural business)	NSO-HSES
T_i	Taxes net of transfer	Assumed to be zero
C_i	Non-durable + Durable (share ϵ)	NSO-HSES
A_i	time and current deposits	BoM-HFCS 2018
L_i	time liabilities	BoM-HFCS 2018
	Net nominal position (NNP)	
Nominal assets	Deposits+Bonds	BoM-HFCS 2018
Nominal liabilities	Mortgages+Consumer debt	BoM-HFCS 2018

5.1 Household Socio-Economic Surveys

The Household Socio-Economic Survey (HSES) has been conducted by the National Statistical Office of Mongolia since 1989. It covers 14 sets of questions on different attributes of households in Mongolia, in particular general demographic information (education, health and employment), income sources (livestock breeding and crops, non agricultural production, trade, services and social protection), main expenditure sources (food, energy, durable goods, and non-food expenditure) and brief information on savings and loans. The surveys of 2016-2018 are applied to estimate the marginal propensity to consume for different income groups.

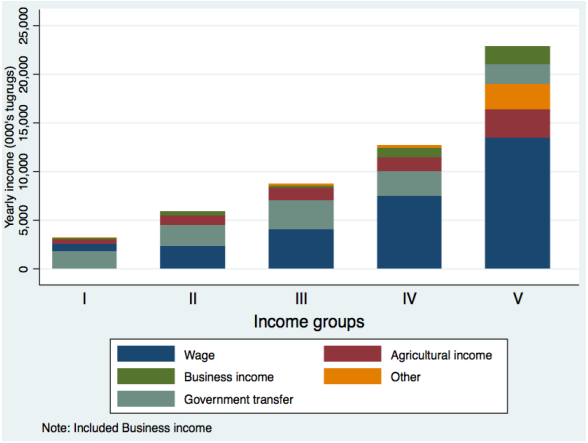
Table 3
NSO-HSES: Descriptive Statistics (000's MNTs)

Year	Statistics	N	Mean	Sd	Min	p5	p25	p50	p75	p95	Max
2018	Income	16,361	11,148	10,128	22	2,570	5,246	8,429	13,823	27,220	253,580
	Consumption	16,361	10847	9,050	81	3,096	5,697	8,800	13,273	24,974	259,922
2017	Income	11,172	10,148	8,999	30	2,456	4,800	7,948	12,708	24,680	228,720
	Consumption	11,172	11,536	9,757	3	2,860	5,696	8,931	14,143	28,396	188,899
2016	Income	16,341	8,959	8,061	31	1,995	4,212	7,140	11,312	21,250	244,570
	Consumption	16,341	8534	6587	175	2,486	4,662	7,164	10,483	18,869	197,957

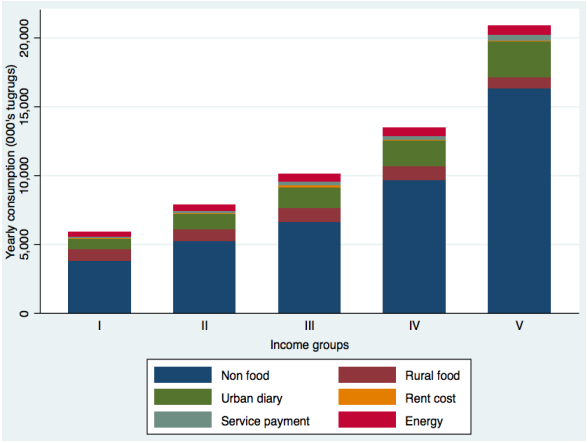
Source: National Statistical Office.

Table 3 reports basic descriptive statistics on household income and expenditures for 2016-2018. In the latest of these surveys for 2018, the average household income and consumption was MNT 11.4 million and MNT 10.8 million respectively. The household income for the bottom 5 percent was around MNT 2.6 million, significantly lower than that of the top 5 percent (MNT 27.2 million) where consumption is 8 times that of the bottom 5 percent. Overall, the median household income has increased from 2016 to 2018, with an average nominal growth rate of 9.0 percent per annum. Simultaneously, median household consumption increased by about MNT 1.6 million between 2016 and 2018. Interestingly, the average household consumption in 2018 was slightly lower than that in 2017. Nominal cross-sectional variation for household's income tends to increase as economy expands expansion.

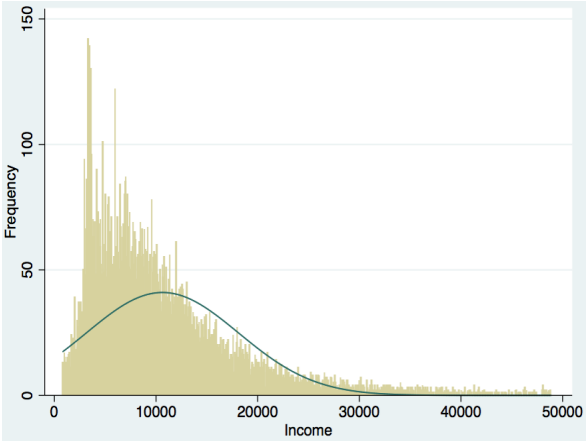
Figure 2
NSO-HSES 2018: Household Income and Expenditure



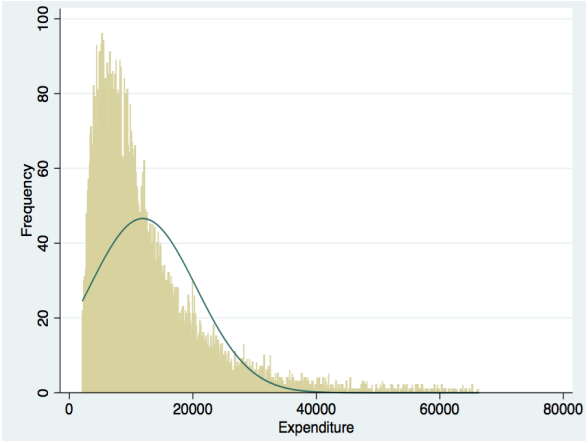
a. Household Income by Contributions



b. Household Expenditure by Contributions



a. Distribution of Household Income



b. Distribution of Household Expenditure

Source: National Statistic Office.

Figure 2 above illustrates the types of income sources and main categories of expenditures for five income groups as of 2018. The average household income for the lowest 20 percent was around MNT 4.0 million and the main source of their income was receipts from government transfer making up 57.2 percent of total household income. Other major sources of income were wages and salaries (23.7 percent), and agricultural income (14.5 percent). The average income for the top 20 percent was about MNT 23.0 million. For this group, wages and salaries is the most important component and accounts for 51.5 percent of household income, followed by agricultural (13.1 percent) and business incomes (13.1percent). Besides, other income such as income from interest, dividends, and others form 11.8 percent of household income for the higher-income groups.

There is a similar pattern for components of household expenditures across the income groups. Among expenditure categories, the share of non-food spending was about 61.0-83.0 percent of the households' total expenditures. Rural-sourced food was also among the major expenditures for the lower two groups of income, making up about 11.0-14.0 percent of their

total expenditures. The households in all groups spend around 10.0-15.0 percent of their expenditures on the urban diary. The remaining consumption comprises of rent and service payments.

The lower panel of the Figure plots the histogram of income and expenditure. The shape of the distribution for both variables is right-skewed indicating that the mass of households is clustered at the bottom half of the median, i.e., a relatively higher proportion of households gets low levels of income, whereas a small part of households earns a higher income in Mongolia.

5.2 Household Financial Condition Survey

The Household Financial Survey (HFCS) has been conducted annually by Bank of Mongolia since 2018. The 2019 data was not made available at the time of this study, hence the decision to merge it with NSO's data was made in order to conduct the necessary analysis for this paper. As mentioned above, this survey was first ever attempt in Mongolia to construct a household balance sheet.

Table 4 summarizes information on the household balance sheet of the survey. It shows evidence of considerable households' heterogeneity in asset and liabilities, despite the income and consumption. Furthermore, URE and NNP are varied widely across households. For example, households in the bottom 25 percentile have noticeably lower levels of assets and net nominal position, compared to those in the top 5 percent of the distribution. In particular, there are negative maturing assets, URE and NNP, as well as no assets and liabilities for the lowest 5 percent of the households. Moreover, the top 5 percent of the distribution holds a considerably higher level of assets and liabilities compared to the median level.

Table 4
BoM-HFCS 2018: Descriptive Statistics (000's MNTs)

Stats	N	Mean	sd	min	p5	p25	p50	p75	p95	max
Net income	2,779	11,925	7,311	480	3,600	7,200	10,200	14,830	25,080	54,000
Consumption	2,779	7,531	4,408	1,095	2,400	4,360	6,520	9,600	16,100	31,100
Maturing assets	2,736	6,038	12,103	-25,100	-5,280	808.5	4,386	8,720	21,320	250,840
Debt repayment	2,736	5,127	32,412	0	0	0	2,568	6,000	12,660	1,206,288
URE	2,736	911	34,154	-1,172,988	-12,060	-2,600	1,201	5,520	17,060	250,840
Asset	2,736	47,360	54,813	0	0	11,000	35,004	70,000	130,000	1,010,000
Liability	2,736	13,549	80,245	0	0	0	3,000	15,000	56,000	4,017,992
Net Nominal Position	2,736	33,811	94,268	3,935,991	-11,700	4,000	24,001	55,000	113,000	999,000

Source: Bank of Mongolia.

6. Estimation Results

6.1 Marginal Propensity to Consume

The first step in evaluating the distributional impact of monetary policy on consumption is to compute the marginal propensities to consume for different groups. Theoretically, the MPC reflects the change in consumption as household income increases by one unit. For this paper, the marginal propensity to consume for each different income group is calculated by same method used in Auclert (2019).

For each year, households are divided into thousand subgroups indexed as j by their incomes to match the different households in the three different years to each other. At the same time, it is also divided into five main groups, with each representing one type of income group of households indexed as i. We found that the household income and expenditure in Mongolia vary significantly by demographic differences, including house's location and marital status, education and age variations of household head, as shown in Figure 2-3 in the Appendix. These differences must be controlled before calculation of the MPCs to precisely define those changes in the consumption in response to income changes. Therefore, for each subgroup, we run regressions for dependent (y) and independent (c) variables, both in log terms with several dummy variables that represents variations of the location of households, marriage status, and pension status of household heads for each subgroup. The median residuals of these regressions represent each subgroup j's income and consumption for each and are applied to further calculation procedures of the MPC. Finally, the following equations are applied to compute the MPC for each main income group (i):

$$\phi_i = \frac{Cov_i(c_{j,t}, y_{j,t})}{Cov_i(y_{j,t}, y_{j,t+1})} \tag{10}$$

$$MPC_i = \frac{E_i(c_j)}{E_i(y_j)} * \phi_i \tag{11}$$

The results of the MPC calculation differ by our assumption on what share of durable consumption is included in the total consumption computation. Some suggest that durable consumption must be excluded from the MPC calculation. However, finds that inclusion of durable consumption does not change the conclusions of the re-distributional impact on the total consumption. Table 7 in the Appendix summarizes the calculations of MPCs for all five groups with different (ϵ), as well as those coefficients of re-distributional channels on consumption. Our result also suggests there are no significant differences across the different assumptions on the share of durable goods consumption, which is included in the total consumption computation. Having considered this, we assume the share of durable consumption $\epsilon = 0.5$ as our benchmark calculation.

Table 5 compares and summarizes, for the five different income groups, the calculated MPCs using the HSES Survey, and normalized household incomes, unhedged interest rate exposures (URE) and net nominal positions (NNP) by average consumption in 2018 using the HFCS Survey.

Table 5
Main Variables by Different Income Groups

#	Indicator	I (lowest)	II	III	IV	V (Highest)
1	MPC ($\epsilon = 0.5$)	0.16	0.43	0.61	0.20	0.19
2	Normalized income	0.61	1.03	1.37	1.82	3.04
3	Normalized URE	-0.38	-0.35	-0.11	0.20	1.04
4	Normalized NNP	3.64	3.95	4.38	4.43	5.71

Source: Authors calculation.

Except for the highest income group (V), the income gaps between the remaining groups are relatively constant around 0.35 and the average normalized income varies from 0.61 to 1.82. The largest income group, however, earns five times higher than the lowest income group, calculated as 3.04 in normalized term by average consumption in 2018, as well as two times higher than the second largest income group (IV). This suggests that the income distribution of Mongolian households is highly skewed for the highest income group, so that very few households earn a large share of the total income in Mongolia.

Generally, it is expected that the lower income households or "hand to mouth" households tend to have higher MPCs because they consume all of their income while higher income households tend to have lower MPCs since they rather save most of their additional income. However, Mongolian household data reveals a very small MPCs for the lowest income groups (I and II) calculated as 0.16 and 0.43 respectively. This might be because these households are highly indebted - negative normalized UREs are computed as -0.38 and -0.35 respectively, shown in Table 5. It means that their interest-bearing liabilities exceed assets. Mongolia traditionally has experienced relatively high interest rates, so that the interest costs make up a considerable share of household expenditures. Thus, the households with lower incomes may not be able to increase consumption following the increase in income due to their debt pressure. The households data in 2018 shows that 7.0 percent of the total income is for debt repayment for the lowest income group (I), while 2.3 percent for the highest income group.

The largest income group households in Mongolia have relatively small and similar MPCs at 0.20 and 0.19 respectively. This is in line with the theoretical prediction that high income households seem to have lower MPCs. Not only with the high income, they also have positive normalized UREs amounting to 0.20 and 1.04 respectively. Furthermore, these households in the middle income group (III) have the highest MPC of around 0.61 among the various groups. Similarly, this is because these households tend to have relatively balanced URE at -0.11 or less indebted compared to the two lowest income groups.

Finally, we find that except for the largest income group (V), there is not a large variation in the normalized net nominal positions across the remaining four groups. In particular, there is a only slight increase between groups I and II, and groups III and IV, and they are computed as 3.64, 3.94, 4.38, and 4.43, respectively. These indicators lead us to predict a smaller re-distributional effect of monetary policy through the Fisher effect which is induced by the asset price change.

6.2 Redistribution Channel

To assess the redistribution impact of monetary policy for Mongolia, we modify Theorem 3 which is specified in the Section 3 in the following equation to compute the partial elasticity coefficients of aggregate consumption due to a temporary change in (i) aggregate income, (ii) price, and (iii) interest rate as (Auclert, 2019) does. The result is summarized in Table 6, where the elasticity coefficient for United States (US) data are presented here for comparative purposes. Here, ϵ_Y, ϵ_P and ϵ_R are redistribution elasticity fo Y, P and R respectively. In addition, $\hat{S}$, γ and $\mathcal{M}$ are the Hicksian scaling factor, income weighted MPS and elasticity of agent i's to relative income respectively.

$$\frac{\partial C}{C} = (\mu + \gamma\epsilon_Y) * \frac{\partial Y}{Y} - \epsilon_P * \frac{\partial P}{P} + (\epsilon_R - \sigma S) * \frac{\partial R}{R} \tag{12}$$

Table 6 shows the seven cross-sectional moments that determine the changes in consumption expressed by Theorem 3 in the equation (9). The two exceptional coefficients are the elasticity of inter-temporal substitution σ_i, which needs to be obtained from other sources, and $dY_i - Y_i\frac{dY}{Y}$, which, in general, depends on the driving force behind the change in output. These include: the income redistribution elasticity ($\epsilon_y < 0$) in Mongolia which was estimated at -0.05. Furthermore, the relative sensitivity (γ) of given groupâ€™s income to aggregate income was negative for some groups, positive for some, and on average, it was negative (-0.40). These facts suggest that the inequality of income in Mongolia amplifies the effect of monetary policy on the total consumption by changing aggregate income. However, it is significantly lower compared to the one in the United States, reflecting lower income inequality in Mongolia than the US. According to the World Bank data, the GINI coefficients for Mongolia and the US were respectively 32.3 and 41.4 in 2016.

Table 6
Seven Cross-sectional Moments that Determine Consumption

	Formula	Mongolia	US (CES)	Description	Channel
ϵ_Y	$Cov_I(MPC_i, \frac{Y_i}{E_I[c_i]})$	-0.05	-0.25	Redistribution elasticity for Y	Earnings heterogeneity
$\hat{S}$	$E_I[(1 - MPC_i) * \frac{c_i}{E_I[c_i]}]$	0.69	0.65	Hicksian scaling factor	Substitution
ϵ_P	$Cov_I(MPC_i, \frac{NNP_i}{E_I[c_i]})$	-0.03	-0.15	Redistribution elasticity for P	Fisher
ϵ_R	$Cov_I(MPC_i, \frac{URE_i}{E_I[c_i]})$	-0.04	-0.59	Re-distributional elasticity for R	Interest-rate exposure
$\mathcal{M}$	$E_I[\widehat{MPC}_i * \frac{Y_i E_I(c_i}{)}$	0.46	0.51	Income-weighted MPC	Aggregate income
γ	$\gamma_i = \frac{\partial(\frac{Y_i}{Y}-1)}{\frac{Y_i}{Y}-1}\frac{Y}{\partial Y}$	-0.40 (mean)		Elasticity of agent i's to relative income	

Source: Authors Calculation.

Furthermore, the negative price redistribution elasticity ($\epsilon_p < 0$) for Mongolia, which is -0.03 also shows that unequally distributed income and wealth in Mongolia lead to a higher impact of monetary policy on the economy by changing nominal price. Similarly, in the case of Mongolia, the coefficient is much less than in the United States which was calculated as -0.15.

Finally, the interest rate redistribution elasticity ($\epsilon_r < 0$) was negative (-0.04) for Mongolia, which is low compared to the US. Negative value here suggests the amplifying effect of monetary policy tightening on aggregate consumption due to heterogeneity of household income.

Taken together, all these sensitivity coefficients are consistent with the results from theoretical and other empirical research, suggesting that heterogeneity in household income and wealth in Mongolia may have an amplifying effect of monetary policy on aggregate consumption. However, the elasticities we have calculated are relatively small in the absolute sense in Mongolia compared to those calculated for the US. It may be due to the relatively high-income inequality in the US than Mongolia. The signs of the effects are consistent in these countries.

7. Concluding Remarks

This study investigated the redistribution channels of the monetary policy transmission mechanism in Mongolia using a simple heterogeneous-agent model for household-level income, expenditure and balance sheet data. The main finding of this study is that the monetary policy in Mongolia, depending on the level of financial and capital positions, has a different impact on the consumption of various income groups. This is due to different marginal propensities to consume (MPC).

Results show that monetary policy tightening tends to increase the vulnerability of the poor and highly indebted households. This, in turn, reduces aggregate incomes as well as increases the interest expenditure of these families. In this worsened situation, the households borrow more to sufficiently finance their living costs which later increases their interest rate pressure on their financial positions even further. At the same time, the borrowing rate, which is currently over 20 percent in Mongolia, is pushing these households to have a relatively small MPC due to the high substitution cost. This fact is unique for Mongolia as the MPC is usually high in lower income families in general cases.

Conversely, besides the lower MPC or higher tendency to save, the high-income households have higher positive net interest-bearing assets. This helps them to earn higher interest income in response to strict monetary policy although there is reduced aggregate income in the economy. Thus, monetary policy tightening tends to have a relatively less negative effect for these households.

We also find that heterogeneity of household income, interest bearing asset and wealth amplifies the monetary policy effect on the Mongolian economy through the redistribution channel. However, this channel is not as strong as the United States. The redistribution channel composes three different components, including the interest rate, price and income channels.

In particular, the small and negative correlation between MPC and unhedged interest rate exposure suggests that monetary policy tightening tends to reduce aggregate consumption more than the case of no heterogeneity in the household interest-bearing assets. Additionally, there is a negative and small relation between the MPC and the NNPs or household nominal wealth, which is likely to increase the impact of the Fisher effect. Finally, due to the small negative relation between household income and the MPC, there is a tendency for the effects of monetary policy shock to be slightly amplified when high heterogeneity in the household income occurs.

In conclusion, income and wealth inequality has a significant impact on the monetary policy transmission mechanism. Monetary policy tightening is redistributing resources from the group with low income to the group with high income through the redistribution channel. Finally, we also conclude that it is necessary to use heterogeneous-agent models for studying monetary policy and their transmission mechanisms for Mongolia. In particular, the monetary policy authority should take this fact into account when it increases its policy rate, considering its redistribution effect and biased impacts on different income groups.

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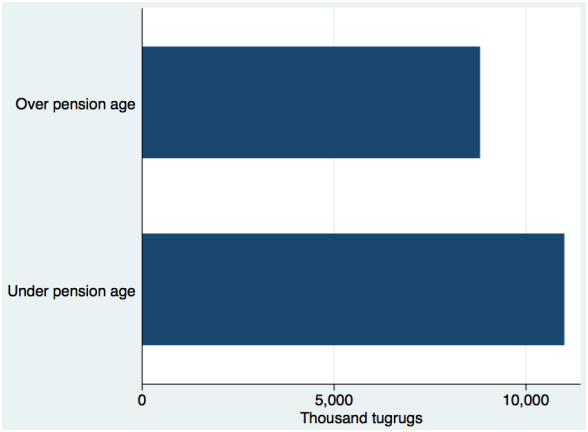
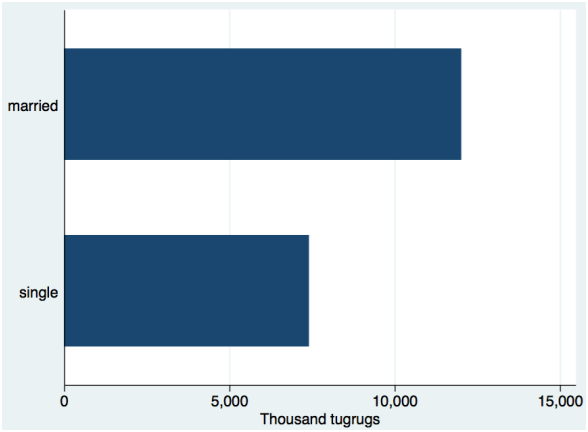
Appendix

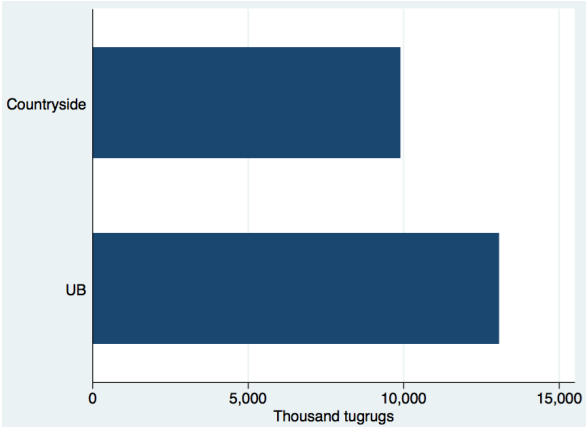
Figure 3
NSO-HSES 2018: Household Income by Factors



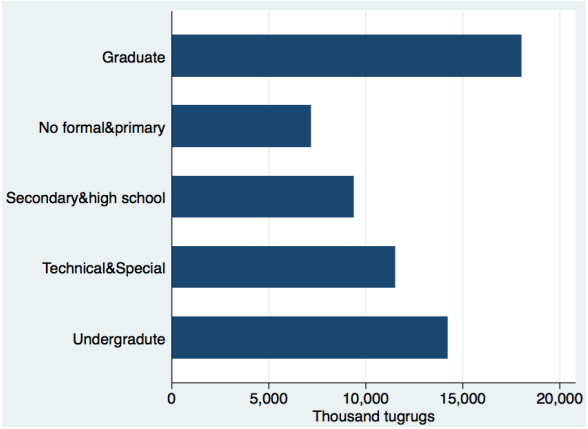
a. by Pension Status of Household Head



b. by Marital Status

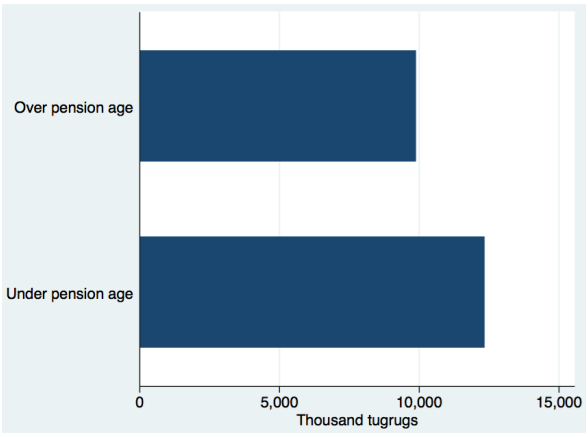


c. by Location

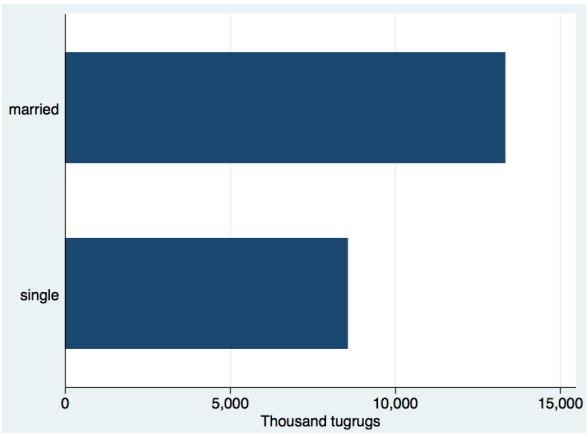


d. by Education

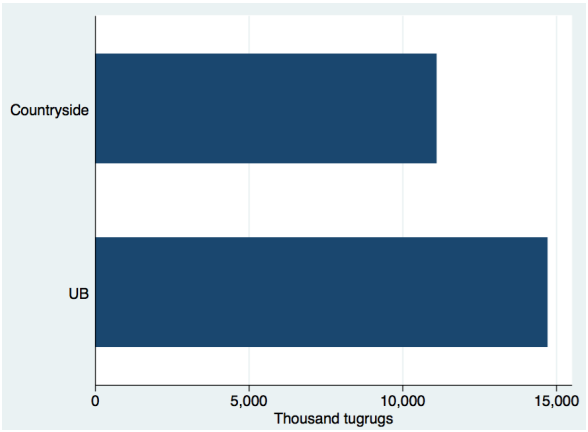
Figure 4
NSO-HSES 2018: Household Expenditure by Factors



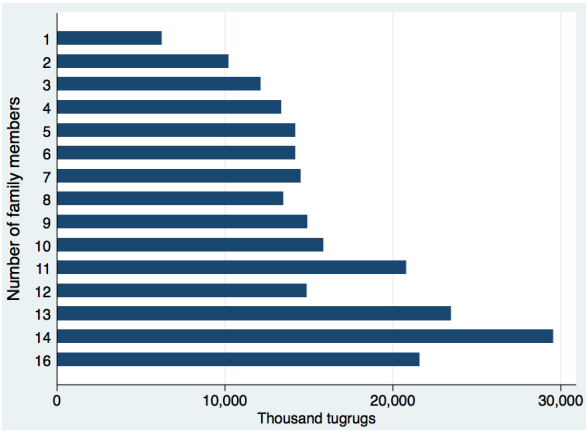
a. by Pension Status of Household Head



b. by Marital status



c. by Location



d. by household size

Table 7
MPC and Elasticities' Calcuations (ϵ)

Indicator	$\epsilon = 0.00$	$\epsilon = 0.25$	$\epsilon = 0.50^{*}$	$\epsilon = 0.75$	$\epsilon = 1.00$
Marginal propensity to consume					
Group 1	0.17	0.17	0.16	0.17	0.15
Group 2	0.44	0.44	0.43	0.46	0.47
Group 3	0.68	0.61	0.61	0.60	0.66
Group 4	0.24	0.21	0.20	0.20	0.20
Group 5	0.30	0.24	0.19	0.21	0.19
Redistribution channels and coefficients					
Income weighted MPC $\mathcal{M}$	0.57	0.50	0.51	0.48	0.49
Elasticity of agent i's to relative income γ	-0.43	-0.40	-0.40	-0.21	-0.32
Hicksian factor $\hat{S}$	0.63	0.67	0.69	0.68	0.67
ϵ_y	-0.01	-0.03	-0.05	-0.05	-0.05
ϵ_p	-0.004	-0.02	-0.03	-0.03	-0.03
ϵ_r	-0.02	-0.03	-0.04	-0.04	-0.05

Source: Authors calculation.

CHAPTER 5

DISTRIBUTIONAL IMPACT OF MONETARY POLICY: EVIDENCE FROM THE PHILIPPINES[1]

By

Nickson J. Cabote[2] and Justin Ray Angelo J. Fernandez[3]

1. Introduction

Inequality is a long-standing issue that has attracted significant attention of both policymakers and academics across disciplines. There exists a wealth of literature that explores the drivers and implications of inequality. In general, these studies associate inequality with structural factors such as 1) the emergence of skill-biased technologies (Bound and Johnson, 1992); 2) increased global trade (Feenstra and Hanson, 1996); and, 3) change in labor market institutions (Card, 2001).

However, the advent of unconventional policies by the central banks has led to a resurgence of interest in reviewing the role of monetary policy in driving inequality. In their commentary entitled "Who Captured the Fed," Acemoglu and Johnson (2012) suggested that expansionary monetary policy primarily benefits financiers and high-income clients.[4] At the same time, the emergence of a new paradigm in macroeconomic theory that integrates market frictions and heterogeneity among households has allowed the joint study of how monetary policy shocks affect inequality and vice versa. For instance, Heterogenous Agent New Keynesian (HANK) models, have exhibited multiple possible channels of the distributional impact of monetary policy (Kaplan, Moll, and Violante, 2018).[5] According to these models, heterogeneity in terms of preference and sources of income, among others, could potentially cause households to respond differently to a specific monetary shock. This results in monetary policy having a differentiated impact on households.

This paper contributes to the literature by examining the distributional impact of monetary policy on household income in the Philippine context. In particular, the paper attempts to assess the impact of changes in the Bangko Sentral ng Pilipinas' (BSP) Reverse Repurchase (RRP) rate, its primary policy instrument, on the income of Filipinos belonging to different income groups.

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1. The views expressed in this paper are solely those of the authors and do not necessarily represent the views of Bangko Sentral ng Pilipinas. This paper also benefitted from the valuable insights from Dr. Maria Tereza Punzi (The SEACEN Centre) and Ms. Eloisa T. Glindro (Bangko Sentral ng Pilipinas).
2. Bank Officer V, Center for Monetary and Financial Policy, Bangko Sentral ng Pilipinas.
3. Bank Officer V, Department of Economic Research, Bangko Sentral ng Pilipinas.
4. Acemoglu, D. and S. Johnson, (2012). "Who Captured the Fed?," The New York Times. 29 March 2012.
5. Kaplan, G.; B. Moll and G. Violante, (2018). "Monetary Policy According to HANK," *American Economic Review*, 2018.

The paper then employs a quantile regression analysis on individual income data derived from the Family Income and Expenditure Survey (FIES) in the Philippines. A quantile regression (Koenker and Gilbert, 1978) allows exploration of the potential asymmetric impact of monetary policy at different household income distributions.[6] Specifically, we run a quantile regression on the lower end of the income distribution (.01, .05, .10, and .25 quantiles) and the upper end of the distribution (.75, .90, .95, .99 quantiles). This is to test whether asymmetry of the impact is stronger with more heterogeneity.

The results indicate that the changes in the BSP's monetary policy stance through the adjustments of the RRP could potentially generate different impacts across different income groups. Specifically, the impact of higher interest rates is negative and more substantial for higher-income quantiles. The said result suggests that the heterogeneity in income level and sources is a potential channel of the distributional impact of monetary policy in the Philippines. Nonetheless, it was noted that the magnitude of impact via this channel appears to be small. Further, regression results also show that inflation could potentially have different effects on different income groups. In particular, most of the adverse consequences of higher inflation are felt by households belonging to the lower-income quantiles. The impact is highly significant across income groups and is robust to different specifications. These observations substantiate the importance of the inflation channel of the distributional mechanism of monetary policy in the country.

This paper is organized as follows: Section 2 provides a brief background on the monetary policy framework and household income trends in the Philippines. Section 3 surveys existing literature on the interaction between monetary policy and inequality. Section 4 describes data and methods, including a discussion on quantile regression and its merits. Section 5 presents the main empirical finding. Lastly, section 6 concludes.

2. Literature Review

The traditional approach employed by the government in addressing the welfare concerns such as poverty and inequality is through targeted programs centered on the development of the citizenry's well-being and viewed mainly under the purview of fiscal policy. The analyses of income inequality are then ascribed mostly through the lens of public economics, where income redistribution is implemented through taxation and government spending.

However, a growing body of literature has emerged that looks into the distributional impact of monetary policy. This is connected to the primary objective of most central banks in achieving low and stable inflation. Erratic and high inflation environment in an economy is deemed undesirable as it leads to heightened uncertainty and expectation of an upcoming instability of macroeconomic fundamentals. Further, high inflation can disrupt the financial markets and potentially result in distortionary economic policies (Romer and Romer, 1998). Also, empirical pieces of evidence such as that of Bulir (2001) and Albanesi (2007) suggested that elevated inflation at present tends to result in higher income inequality in the succeeding periods.

6. Koenker, R. and B. Gilbert, (1978), "Regression Quantiles," *Econometrica,* 46 (1), 33–50.

The literature on the distributional impact of monetary policy has just started growing. Nonetheless, several studies were already published, which looked at how monetary policy affects income and inequality with varying results. One of the recent cross-country evidence on the distributional impact of conventional monetary policy is that of Furceri et al. (2018), which found evidence that expansionary monetary policy tends to lower-income inequality in 32 advanced and emerging economies. This result mirrors the study of Guerello (2016), which reported a decline in income inequality in the euro area following an expansionary monetary policy stance from the European Central Bank. In the same way, O'Farrell and Rawdanowicz (2016) offered evidence that expansionary monetary policy reduces income inequality in Canada and the USA, while it increases inequality in the UK. O' Farrell and Rawdanowicz (2016), however, found mixed results for euro area countries.

In the case of single-country studies, the distributional effects of conventional monetary policy are also mixed. Coibion et al. (2017) supplied evidence that contractionary monetary policy increases economic inequality in the USA. Meanwhile, Dolado et al. (2019) suggested that expansionary monetary raises labor income inequality in the USA. Villarreal (2014) found that contractionary monetary policy reduces income inequality in Mexico. For the UK, Mumtaz and Theophilopoulou (2017) find that tight monetary policy raises economic disparities. Some studies also examined the impact of unconventional monetary policies such as that of the Bank of England (2012) and Saiki and Frost (2014).

Also, recent literature that focused mostly on the distributional impact of monetary policy is based on general equilibrium models characterized by market frictions and heterogenous agents such as the so-called HANK models.

According to standard literature, monetary policy affects households or individual agents via three main effects. First is income effect, as monetary policy directly affects interest rates, which, in turn, have immediate partial equilibrium effects on income. Second is the wealth effect stemming from the changes in values of assets such as stocks, bonds, and real properties triggered by the change in interest rates. Third, there is also a substitution effect as changes in interest rates alter current and future prices, hence, change households' preference in the timing of consumption.

The interaction of these effects, along with heterogeneity among households, results in transmission channels of monetary policy that potentially generate different household responses from a particular monetary policy shock, which results in the distributional effects of monetary policy. The response varies depending on the degree of heterogeneity. These channels are referred to as distributional channels (Colciago et al., 2018).[7]

7. Colciago, A.; A. Samarina and J. de, Haan, (2019), "Central Bank Policies and Income and Wealth Inequality: A Survey," *Journal of Economic Surveys*, 33: 1199-1231.

2.1 Distributional Channels of Monetary Policy

The following distributional channels of monetary policy have been identified in the literature. First is the inflation channel. Higher inflation can reduce the real value of debt, which puts borrowers in a favorable situation but puts savers at a disadvantage. Doepke and Schneider (2006) also found that inflation affects households based on the maturity structure of their assets and liabilities. Since wealthy households hold more of the long-term assets, they are hurt by inflation more. Conversely, Erosa and Ventura (2002) argued that increases in expected inflation disproportionately wear down the purchasing power of households that depend more on cash to conduct their transactions. Lower-income households are more likely to use more cash as a percentage of their total expenditures, thus are hurt more by inflation.

In the Philippines, Mapa (2017) examined the disproportionate impact of higher consumer price inflation on the poor following the government's policy to increase excise taxes on domestic fuel. In detail, Mapa (2017) found that higher inflation affects the poor approximately ten times more than the non-poor and noted that the uptick in inflation due to tax rate hikes could significantly increase the number of poor households in the country.[8]

Literature also identifies the savings redistribution channel. Changes in interest rates affect interest payments on the debt as well as earnings on deposits. Thus, an expansionary monetary policy could hurt savers more by lowering households and favor borrowers more. To the extent that affluent households have more savings means that they are more adversely affected by the tightening of monetary policy.

Households receive their incomes from different sources, each of which may react differently to changes in monetary policy. This channel is called the income composition channel. At the lower end of the income distribution, households tend to depend more on transfer income, while households close to the median reply more on labor income, and those at the upper tail of the income distribution rely relatively more on business and capital income. Following an adjustment to the monetary policy stance by the central bank, the effects on inequality stemming from this channel are not very clear. A fall in interest rates is viewed to stimulate economic activity. Expansionary monetary policy is viewed to weigh down inequality as higher interest rates could drive higher wages and lower unemployment in the lower end of the distribution. Concomitantly, a cut in nominal interest rates can potentially reduce interest income (mostly accruing to wealthier households), and inequality amongst more affluent households could fall.[9]

There is also the interest rate exposure channel. According to Auclert (2016), this channel explains how redistribution is done stemming from real interest rate adjustments. When real interest rates fall, financial asset prices move up to the point that the interest rate

8. Mapa, C.D.S., (2017), "The Effect of Diesel Excise Tax on Inflation and Poverty: Evidence from Econometric Analysis," BSP-UP Professorial Chair Lecture Series 2017, Bangko Sentral ng PIlipinas.

9. Gornemann, Kuester and Nakajima (2012) consider the importance of the earnings and income composition channels in the context of a model in which households differ in their employment status, earnings, and wealth. They find that the redistributive effects of monetary policy are such that contractionary monetary policy shocks increase inequality. The unemployed, in particular, are made worse off by monetary policy tightening, as a contractionary shock tends to prolong their unemployment spell, as firms reduce labor demand.

is used to discount future dividends reductions. Nevertheless, it is essential to examine both assets and liabilities and, also, equally important, their respective tenures.

The rarnings heterogeneity channel explains monetary policy affecting labor earnings. According to Heathcote, Perri, and Violante (2009), households whose earnings are at the top of the distribution are primarily affected by adjustments in hourly wages. Meanwhile, those whose earnings are at the bottom of the distribution are influenced mainly by fluctuations in hours worked and the unemployment rate.

It should be noted that these channels are interrelated and are not mutually exclusive. Likewise, the direction and magnitude of the distributional impact of monetary policy also depend on the degree of heterogeneity. Dolado et al. (2018), argued that the same monetary policy could have had different and potentially offsetting effects. Thus, the overall distributional impact of monetary policy is ambiguous a priori.

3. Stylized Facts: Monetary Policy and Household Income in the Philippines

3.1 Economic Growth, Household Income, and Inequality

During the 1980s up until the end of the 1990s, the Philippine economy exhibited a boom and bust growth pattern. The country's erratic growth trajectory stunted economic development while its Asian neighbors were reaping the gains of the so-called Asian growth miracle. The Philippine economy grew by only 2 percent in the 1980s and tallied marginal improvement of 2.8 percent in the 1990s.

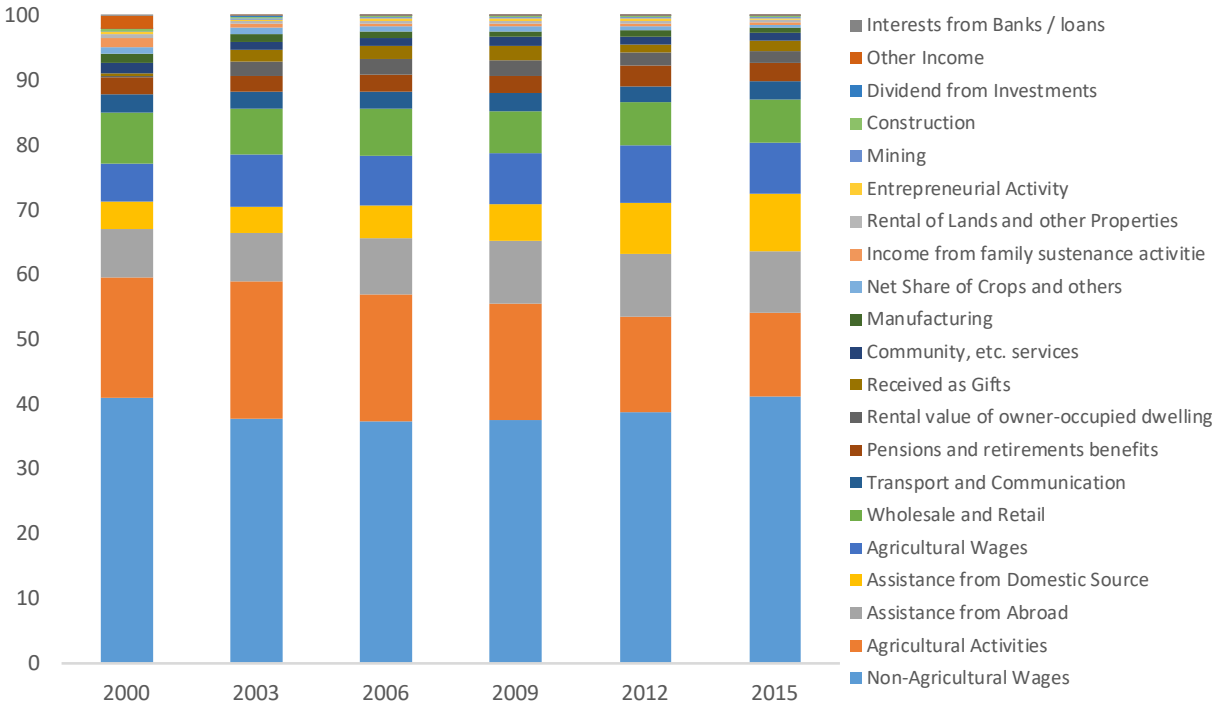
Nonetheless, the country slowly recovered following several structural economic reforms in the 2000s. Growth accelerated and registered a 10-year average of 4.5 percent from 2000-2009. The Philippines continued to exhibit robust growth to become one of the fastest-growing emerging economies in the region, with average quarterly growth of 6.3 percent from 2010-2019.

In terms of income source (Figure 1), most of the Filipino households draw their income from non-agricultural salaries and wages (about 40 percent from 2000 to 2015), followed by earnings from agricultural activities (17.5 percent) such as crop farming and gardening, livestock and poultry raising, fishing, and forestry and hunting. Moreover, a sizable portion of the Filipino households' source of income is remittances both from abroad (8.75 percent) and domestic sources (6 percent). These trends remained consistent from 2000 to 2015.

Looking at the source of earnings per income decile (Figure 2), salaries and wages from non-agriculture remain the highest source of income across the household segments, followed by remittances received by the households from both foreign and domestic sources.

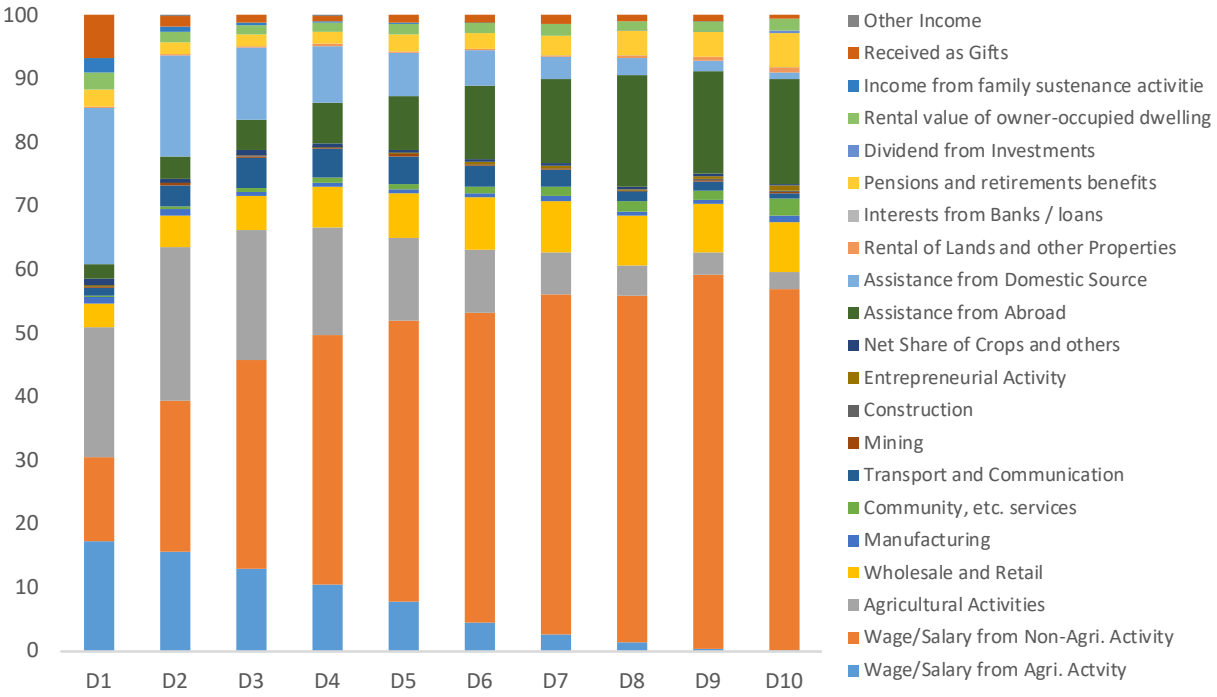
Households in the lower-income deciles draw most of their finances from agricultural activities and salaries from agriculture. However, the share of agriculture as an income source declines markedly as households move up across income groups. Meanwhile, receipts from entrepreneurial activities increase as one moves from a lower-income decile to higher decile households. It is also worth noting that only families occupying the upper deciles recorded income from financial activities such as interest earnings from banks, and loans and dividends from investments.

Figure 1
Share of Income Source of Filipino Households, 2000-2015



Source: Family Income and Expenditure Survey, Philippine Statistics Authority.

Figure 2
Share of Household Income Source by Income Decile, 2015



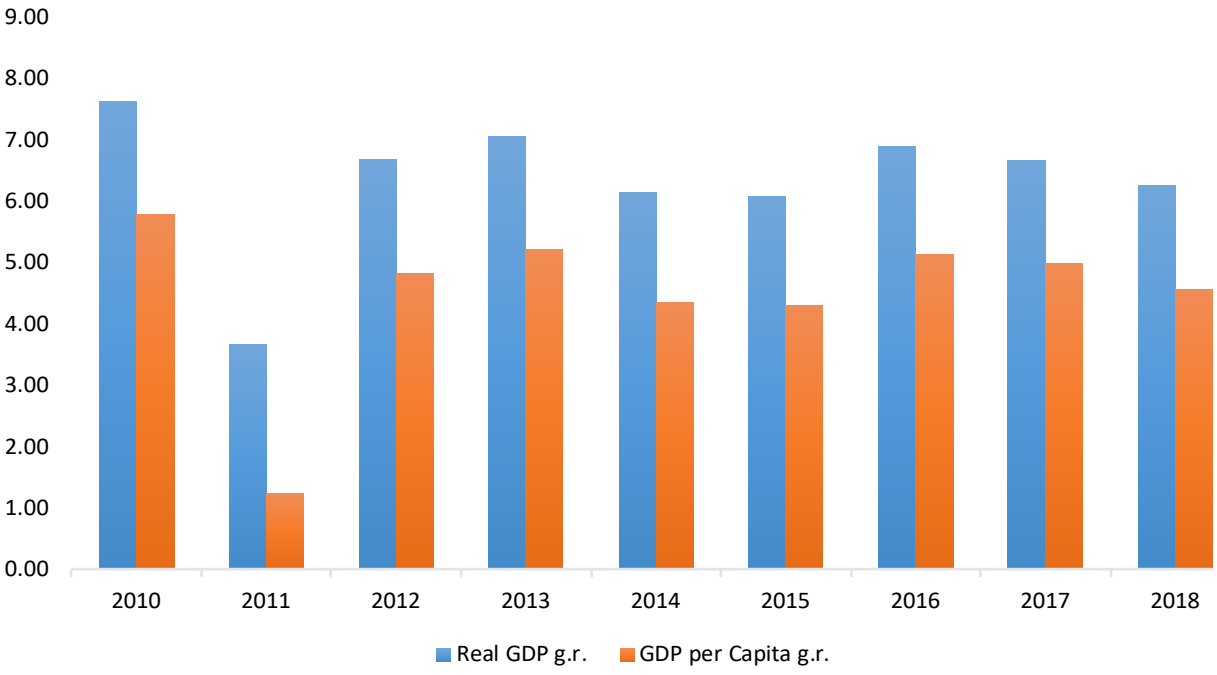
Source: Family Income and Expenditure Survey, Philippine Statistics Authority.

Consequent to the improvement of the overall economic output in the country is the rising income of Filipino households. However, the rate of economic expansion at the macro-level may not be as fast when viewed across regions and income groups. Figure 3 shows that the per capita GDP growth of the country, albeit within the positive territory, remained slower than the growth of real economic activity.

Regional per capita GDP from 2009-2018 (current prices) shows the glaring inequality across the regions over time (Figure 4). The income disparity is apparent even between advanced regions of NCR and CALABARZON (Region IVA). In 2018, the per capita output of CALABARZON amounted only to less than half (41%) of the per capita output of NCR. Meanwhile, the Autonomous Region in Muslim Mindanao (ARMM) posted the lowest per capita output across the years - ARMM's per capita output is equivalent to only 5.7 percent of NCR's output in 2018.

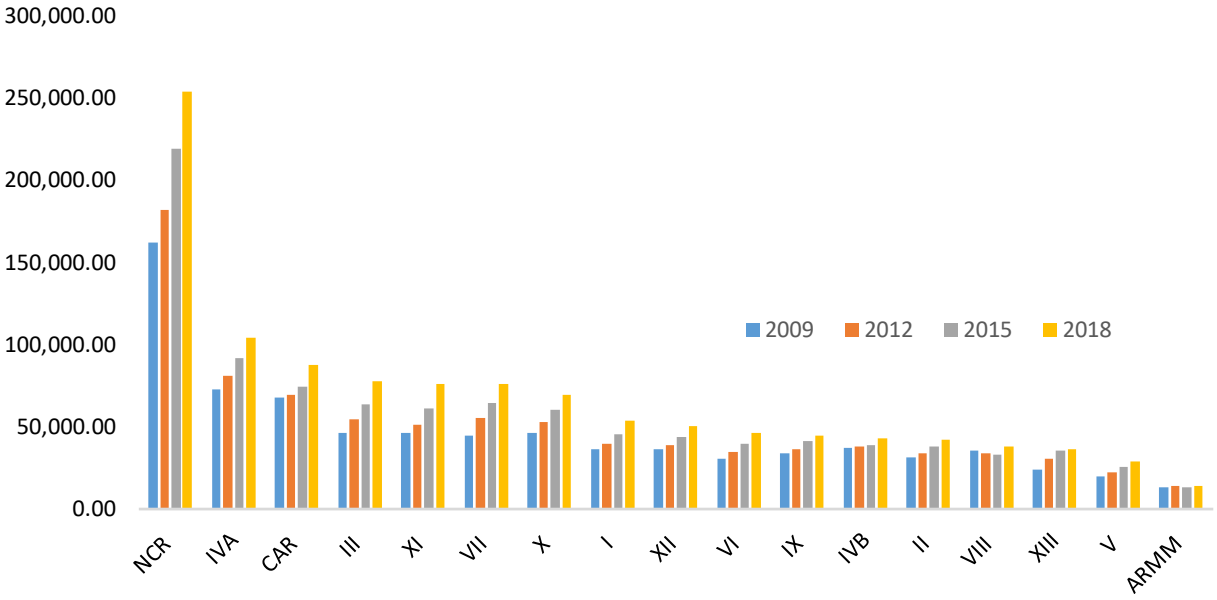
On the household level (Figure 5), the income of wealthy households represented by the first quintile tallied a faster rate of increase compared with its less affluent counterparts. This indicates the absence of income convergence across households and, in turn, a persistent income gap across Filipino households.

Figure 3
Real GDP Growth and GDP per Capita Growth in the Philippines, 2010-2018



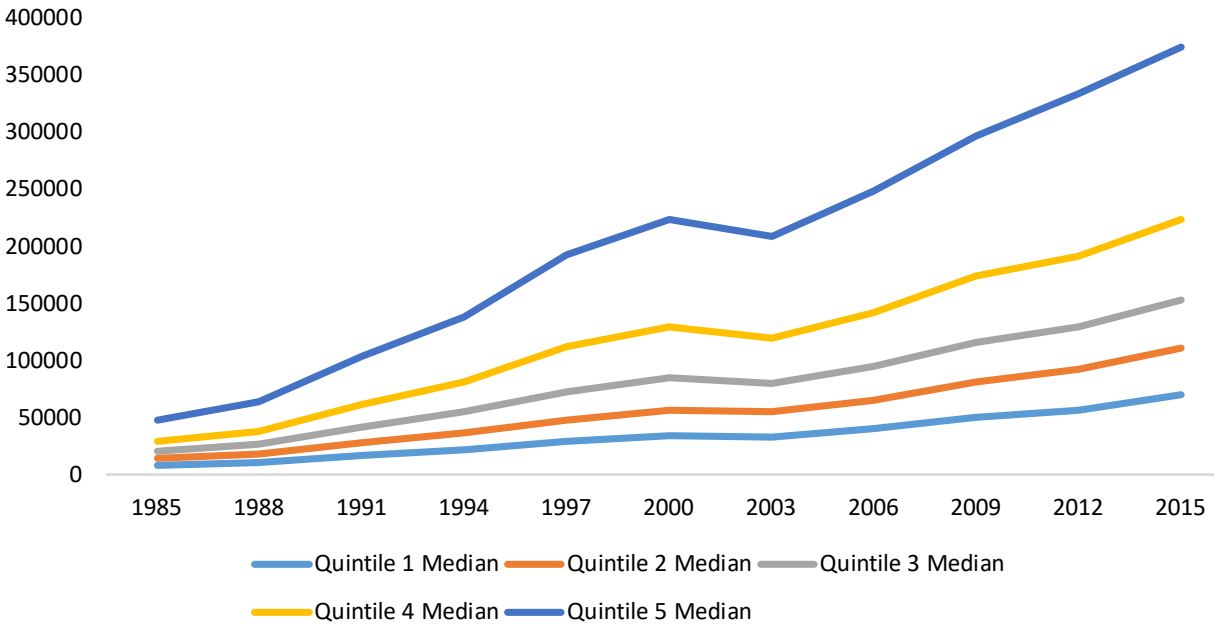
Source: National Income Accounts, Philippine Statistics Authority.

Figure 4
Regional Per Capita Income (2009-2018)



Source: National Income Accounts, Philippine Statistics Authority.

Figure 5
Total Income Growth Rates by Quintile, 1985-2015



Source: Family Income and Expenditure Survey, Philippine Statistics Authority.

3.2 Views on Income Inequality and GINI Trends in the Philippines

Several Filipino economists have already described the pervasive income disparity in the Philippines in the past. Estudillo (1997) conducted a comprehensive study on inequality outcomes in the country from the years 1961-1991, where she highlighted that over-all inequality in the Philippines during the study period remained firm and stable at elevated levels. Some studies typified inequality across space, such as the difference between urban and rural inequality (Estudillo, Otsuka, and Quisumbing, 2001). Meanwhile, Balisacan and Fuwa (2004) explored how spatial income inequality moved throughout the Philippines from 1985 to 2000 and examined the impact of macroeconomic variations on income inequality. They noted that macroeconomic outcomes might have minimum effects on sub-national levels of inequality.

The understanding of how inequality affects a country's development process is necessary as the literature presents an array of studies with opposing views on the role of inequality in economic growth and the welfare of the people.

Some studies maintained that higher inequality may not necessarily be bad for an economy, as higher inequality could potentially support growth (Ostry, Berg, and Tsangarides, 2014 and Farole, 2013), provided there are enough incentives for investors and entrepreneurs to set up new businesses and facilitate innovations, thus enhancing the income of the whole economy (Lazear and Rosen, 1981). This view is shared by Kaldor (1957), who noted that some degree of inequality might boost economic growth as long as those who have access to capital and savings will save and invest most of their income in the domestic economy. This, in turn, will support over-all savings and investments in the economy. Also, Bourguignon and Morrison (2002) suggested that inequality could be driven by the positive relationship between the geographical concentration of economic activity and economic growth.

On the other hand, there are also studies which suggested that high and persistent inequality is a bane for a country's economic growth and its people. This stems from the idea that inequality affects not only the poor but the rest of the economy. First, inequality is viewed to constrain the lower-income households of the resources needed to access quality health services and education, which may hinder human capital development in a nation (Perroti 1996), (Galor and Moav, 2004), (Aghion, Carol, and Garcia-Penalosa, 1999).

High income inequality is also linked to credit bubbles and financial crises. Kumhof, Ranciere, and Winant (2015) showed that rising inequality in the United States served as a precursor to high household leverage and crises. In particular, their research provides empirical evidence that the periods 1920–1929 and 1983–2008 both exhibited a significant increase in the income share of high-income households, a substantial increase in debt leverage of low- and middle-income households, and an eventual financial and real crisis.[10]

10. Kumhof, Micahel; R. Ranciere and P. Winant, (2015), "Inequality, Leverage, and Crises," *American Economic Review,* 2015, 105(3): 1217-1245.

Persistent income inequality could also lead policymakers to overlook the situation in the peripheral and lagging areas, as the nationwide indicators could shadow the real situation on the sub-national levels, i.e., regions and provinces. That is, when average inequality seems passable at a national level, this may cloud an underlying economic stagnation and ballooning poverty in the sub-national levels (Farole 2013).

Long-standing disparities are also sources of dissatisfaction towards governments, which could potentially threaten political and social cohesion. The higher demand for redistributive policies, as opposed to the productive policies, may dampen overall growth. This, however, depends on whether output inequality translates to income inequality (Aghion, Alesina and Trebbi, 2004). Should lagging regions be continuously left behind, as a result of their incapacity to make productive use of the resources and further aggravated by weak and non-inclusive institutions, then these lagging regions could fall into the "low growth trap" which could drag the over-all national growth potentials (Farole, Rodriguez-Pose and Storper, 2011).

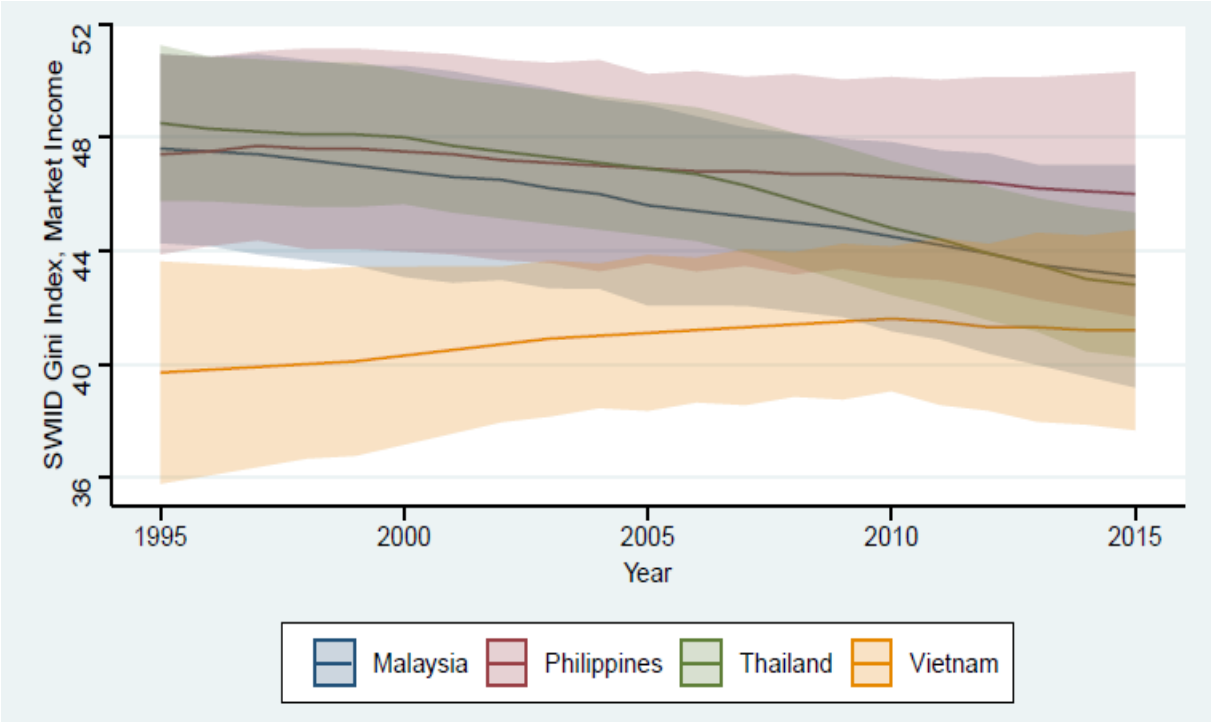
In the case of the Philippines, income inequality has gone down, albeit gradually over the years. This is reflected by the sluggish decline in the country's Gini coefficient from 48.5 in 1970 to 46 in 2015 (Table 1). The progress in terms of reducing inequality remains slow for the Philippines, vis-à-vis its Asian counterparts (Figure 6).

Table 1
GINI Coefficient Based on Market Income and Disposable Income, Philippines

	1970	*1980*	*1990*	*2000*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
GINI (Market Income)	43.7	42.4	42	42.5	41.6	41.5	41.4	41.3	41.2	41.1
GINI (Disposable Income)	48.5	47.2	46.8	47.5	46.6	46.5	46.4	46.2	46.1	46

Source: Standardized World Income Database v8.1 (Solt, 2019).

Figure 6
GINI of Select ASEAN Economies Based on Pre-Tax and Pre-Transfer Income, 1995-2015



Note: Solid lines indicate mean estimates; shaded regions indicate the associated 95% uncertainty intervals.
Source: Standardized World Income Inequality Database v8.1 (Solt, 2019).

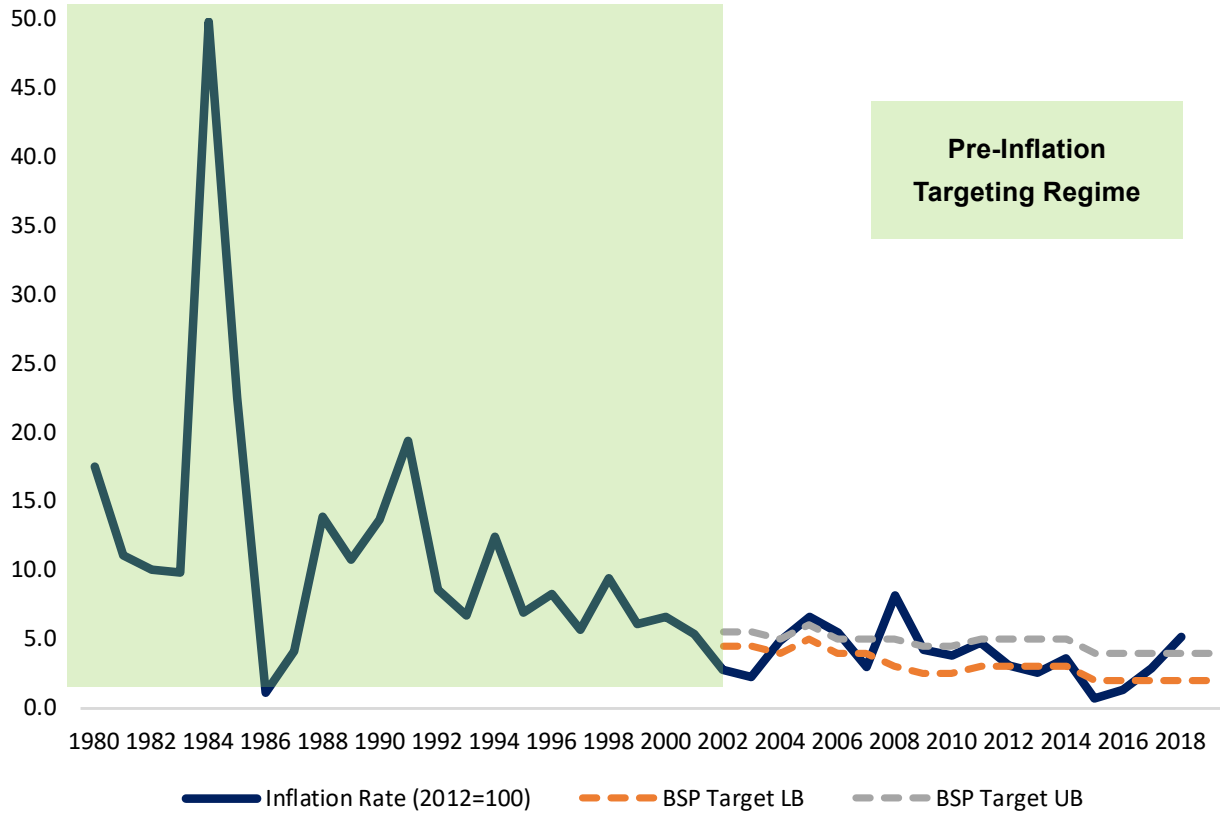
3.3 Monetary Policy and Inflation Targeting in the Philippines

Price stability was embedded early on as one of the primary goals of the Philippine monetary authority. The New Central Bank Act of 1993 in the Philippines stipulated that the newly instituted Bangko Sentral ng Pilipinas (BSP) must aim to achieve price stability. The BSP, accordingly, formally shifted to an Inflation Targeting (IT) monetary policy framework in 2002. Inflation Targeting (IT) is a framework that focuses on achieving price stability as the primary goal. Through IT, the BSP officially announces a headline inflation target, which it sets to achieve over a specified period. The inflation target is defined as the average year-on-year change in the consumer price index (CPI) over the calendar year, expressed as a point target with a tolerance interval, to provide flexibility in steering inflation. The achievement of the goal is measured by comparing the actual headline inflation with the publicly announced inflation target. The shift followed the earlier decision made by the Monetary Board (MB), the BSP's policymaking body, to change the country's monetary policy framework to IT on 24 January 2000.

The shift to IT was meant to address the risks brought by increased financial globalization and liberalization of the Philippine financial markets in the late 1990s. The change in the global financial landscape led to a weaker link between money, output, and inflation and rendered the Philippine economy more susceptible to large monetary and real shocks.[11]

The IT framework has been successful in the Philippines. Looking back, it is during the IT regime that the BSP recorded considerable success in bringing inflation rates lower and keeping inflation expectations well anchored. From an annual average of 12.1 percent from 1980 to 2000, the BSP succeeded in taming prices as headline inflation rate decelerated to a yearly average of 3.8 percent from 2002 to 2018. This also allowed the BSP to build its credibility through greater accountability and transparency.[12]

Figure 7
Inflation Trends in the Philippines, 1980-2019



Source: Philippine Statistics Authority and Bangko Sentral ng Pilipinas.

11. Guinigundo, D., (2008). "Transmission Mechanism of Monetary Policy in the Philippines," BIS Papers Chapters, in: Bank for International Settlements (Ed.), Transmission Mechanisms for Monetary Policy in Emerging Market Economies, Volume 35, pp. 413-425, Bank for International Settlements.
12. Guinigundo, D., (2017), "Implementing a Flexible IT in the Philippines," Philippine Central Banking: A Strategic Journey to Stability, Bangko Sentral ng Pilipinas, Manila.

4. Data and Methodology

4.1 Data and Variables

Data on individual income is obtained from the FIES survey.[13] The survey contains detailed information on income and expenditures of Filipino households and has been conducted by the Philippine Statistical Agency (PSA) since 1957. Over the years, the FIES changed the sampling design and collection methods, among others. For instance, starting in 1985, the frequency was adjusted triennially from the previous five years. In 2003, a modification in the use of a master sample for the surveys was introduced. This almost coincides with the BSP's shift towards an inflation-targeting framework. Hence, the empirical analysis covers triennial data for the sample period 2003 to 2015 with 200 thousand observations.

The paper employs total individual income as the primary dependent variable. This includes primary income, receipts from other sources received by all family members, and other receipts. Primary income includes salaries and wages, commissions, and other forms of compensation and net receipts from the operation of family-owned enterprises and the practice of profession. Meanwhile, receipts from other sources, include imputed rental values of owner-occupied dwelling units, interests, rentals, among others. Lastly, other receipts include profits from sales of stocks and bonds, among others.

Table 2
Variable Description

Variable	Definition
Total Income (tot_inc)	Triennial data on primary income, receipts from other sources, and other receipts. Expressed in natural logarithm.
Overnight Reverse Repurchase Rate (RRP)	The 3-year average of overnight lending rate to banks in natural logarithm.
Family Size (fsize)	Total number of individual members in a household
Educational Attainment (educ)	Total expenditure allotted for education
Inflation	3-year average expressed in natural logarithm
GDP	3-year average expressed in natural logarithm

Given that the BSP is an inflation-targeting central bank, the primary explanatory variable is the overnight reverse repurchase rate, which is the BSP's policy rate at which it lends to the banks. The variable is transformed to its 3-year average to match the frequency of the income data.

In line with existing literature, household and individual characteristics such as family size and educational attainment are included as control variables. Likewise, macroeconomic variables are included as additional controls like real GDP growth rate and inflation rate.

13. Note that one particular household in the survey could have multiple income-earning individuals. Thus, this paper uses income on an individual level for more granular analysis.

All variables, except family size and educational attainment, are expressed in the logarithms of their three-year average to match the frequency of the data on total income. Table 2 summarizes the variables and their definitions, and Table 3 provides descriptive statistics.

Table 3
Variable Summary Table

Variable	Mean	Std. Dev.	Min	Max
rrp	5.1	1.6	3.5	7.5
tot_inc	267880.1	419649.8	3258.0	60200000.0
educ	6503.0	19363.2	0.0	731000.0
fsize	21.3	25.0	1.0	305.0
gdp	119895.8	34448.2	72199.0	162196.0
inflation	3.1	1.6	0.7	5.5

4.2 Preliminary Analyses

4.2.1 Impact of RRP, Inflation, and GDP to Inequality

Before exploring the quantile regressions, the authors first examined the relationship between inequality and monetary policy by specifying a basic vector autoregressive (VAR) model as follows:

$$x_t = \begin{pmatrix} dlog(GDP\ SA)_t, dlog(CPI\ SA)_t, D(Policy\ Rate)_t, \\ dlog(Compensation\_Index)_t, dlog(PSEI)_t, GINI\_MKT_t \end{pmatrix}'$$

The macroeconomic variables included in the model are the seasonally adjusted real GDP, consumer price index, the reverse repurchase rate as key policy rate of the BSP, compensation index to account for labor income, and equity prices to account for asset prices. Meanwhile, an indicator variable representing the global financial crisis in 2008 was included as exogenous input to the model. Additional details on the VAR model are described in Appendices 1A to 1B.

The usual Cholesky decomposition was used in monetary policy identification. Subsequently, the impulse response functions of inequality with the various macroeconomic variables were obtained. Based on the VAR's impulse response functions, it is suggested that an expansionary monetary policy tends to reduce income inequality in the Philippines (Figure 8). This can be attributed to the income composition channel of monetary policy. Relatedly, a positive shock on inflation results in higher inequality in the ensuing periods providing evidence on the inflation tax channel. Meanwhile, a positive shock on the GDP was seen to reduce income inequality (Figure 9). The complete IRFs resulting from the specified VAR model are reported in Appendices 1C to 1E.

Figure 8
GINI Response to an Expansionary Monetary Shock

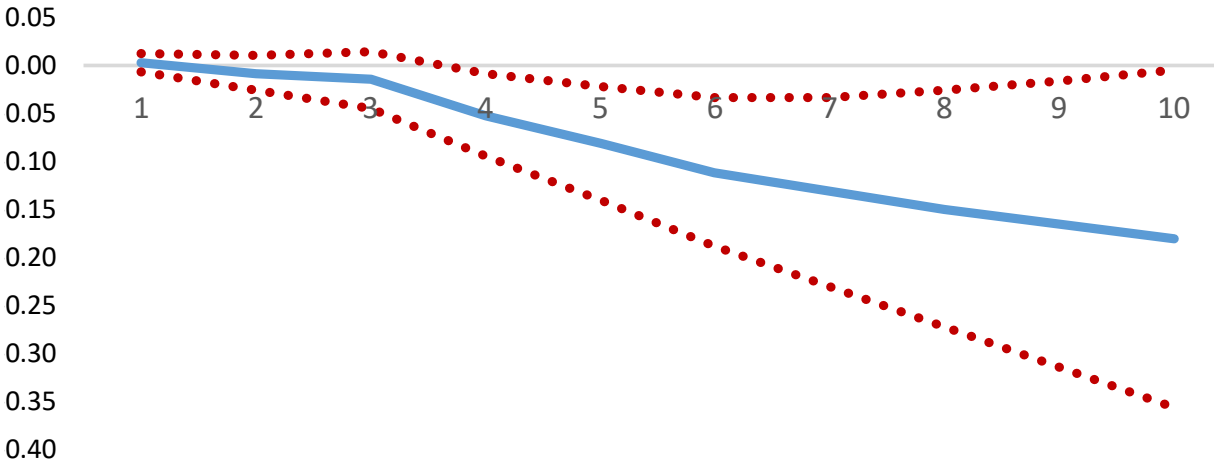
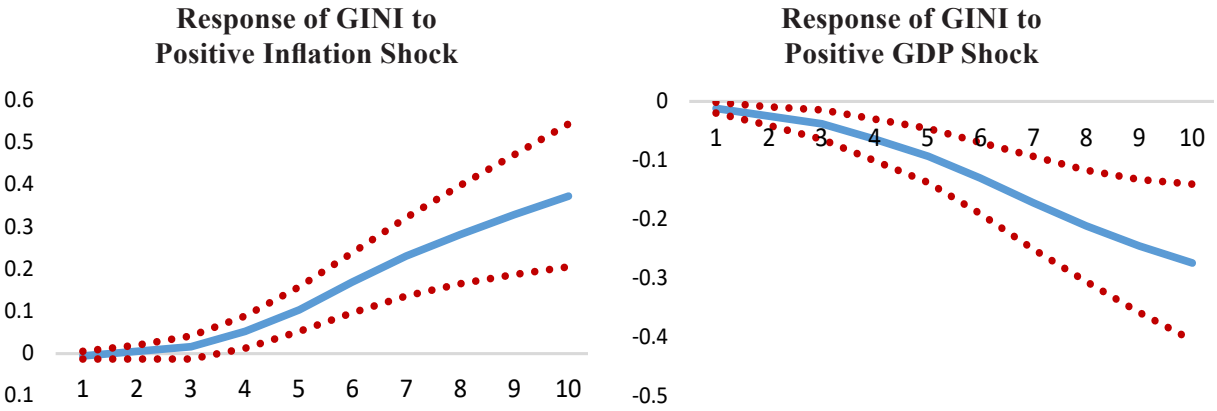


Figure 9
Impulse Response Function of GINI to Positive Shocks in Inflation and GDP



4.3 Empirical Methodology

The paper applies a quantile regression as an empirical strategy. Two reasons motivate this choice: 1) monetary policy could potentially generate distinct effects on different parts of the income distribution, and 2) the distribution of the income data is concentrated to the lower income levels and highly skewed to the left. Using conditional mean regression methods could potentially fail to capture parameter heterogeneity between monetary policy and various groups in the income distribution. Meanwhile, quantile regression can better capture the impact of the explanatory variable (RRP) on specific parts of the income distribution. The quantile regression model can be expressed as:

$$Q_{\tau}(Y_{i,t}|X_{i,t}) = C_{\tau} + \beta_{\tau}(MP)_{it} + \sum_j \gamma_{\tau} X_{i,t}^{j} + v_{i,t} \qquad (1)$$

Here, $Q_{\tau}(Y_{i,t}|X_{i,t})$ is the τth quantile regression function on income. Like Fang, et al. (2019), specific estimators are identified for each desired quantile (e.g. .01, .05, .10, .25, .50, .75, .90, .95, and .99). Meanwhile, MP is monetary policy, and X refers to the vector of control variables discussed above.

5. Results and Discussions

The quantile regression is applied to four iterations. The first iteration includes total income as the dependent variable and RRP rate as the only explanatory variable. Second, the iteration includes control variables such as characteristics of households such as family size and educational attainment. Third, we also include macroeconomic variables such as GDP and inflation as additional explanatory variables. The fourth model is then specified to include both the controls and the macroeconomic variables in the third iteration. The results are summarized in Table 4.

In the baseline model, an increase in RRP leads to a decrease in total income in all quantiles. The effect is higher in the more interest-sensitive higher-income quantiles. A one percent change in RRP leads to a 1.12 percent decrease in total income in the 99th quantile, which is higher compared to the corresponding change of 0.8 percent in the first quantile.

The results are pretty similar in model 2 when family characteristics like family size and educational attainment are included as controls. The negative impact of higher RRP remains more substantial for the upper quantiles. It is also observed that education positively affects income across all groups, but the benefit is more significant for the higher income groups. Meanwhile, the effect of family size on income is observed to be negative.

In model 3, the impact of the RRP becomes positive for almost all quantiles but remains negative in the 99th quantile. The negative impact, however, on the 99th quantile, is minimal at .005 percent. Meanwhile, inflation hurts all quantiles in the distribution. It can be observed that the magnitude is larger for lower-income quantiles. For instance, a one percent increase in inflation leads to a 0.3 percent decrease in income for those belonging to the first quantile and only a 0.2 percent decrease in income for those belonging to the 99th quantile. Lastly, GDP positively affects income in all quantiles with a more substantial impact on the lower quantiles.[14]

In model 4, when macroeconomic variables and household characteristics are all included, the negative impact of RRP becomes insignificant for the 95th and 99th quantiles. However, the effect of inflation remains significant in all quantiles, with the magnitude more considerable in the lower quantiles.

14. The variable family size was dropped as a control variable in the third model due to suspected error in the survey data collection.

Table 4
Quantile Regression Results

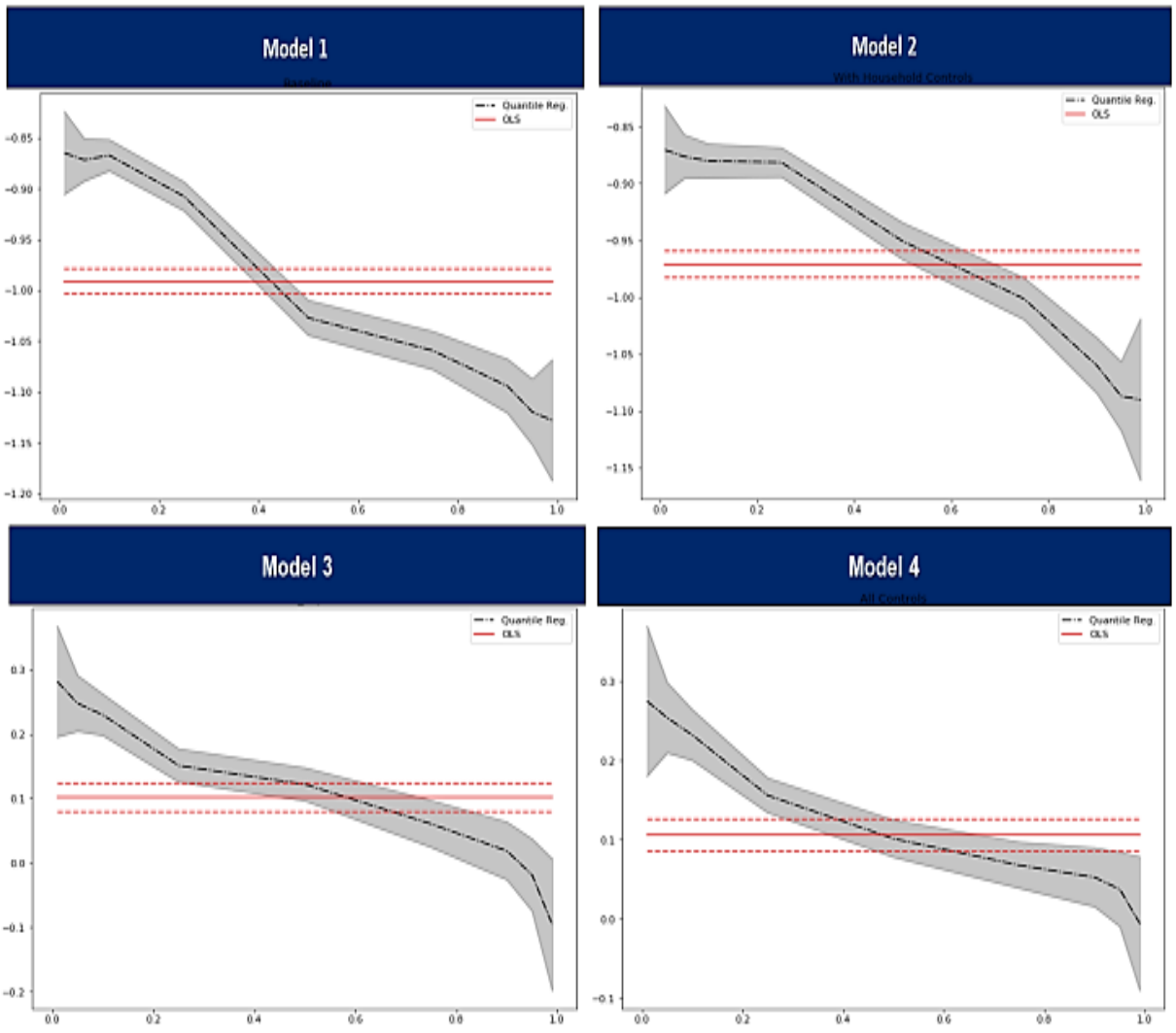
Quantiles	*Iteration 1* Base Quantile Regression	*Iteration 2* Quantile Regression with Controls			*Iteration 3* Quantile Regression with Macroeconomic Variables			*Iteration 4* Quantile Regression with Macroeconomic Variables and Control			
	Natural Log of RRP	*Natural Log of RRP*	*Education*	*Family Size*	*Natural Log of RRP*	*Natural Log of Inflation*	*Natural Log of GDP*	*Natural Log of RRP*	*Natural Log of Inflation*	*Natural Log of GDP*	*Education*
1st Quantile	-0.8648***	-0.87045***	1.02e-5***	0.010181***	0.281115***	-0.3431***	1.187844***	0.2747976***	-0.3368939***	1.173004***	1.08e-5***
	(0.0207984)	(0.0195684)	(4.66e-7)	(0.0001666)	(0.0438358)	(0.0124111)	(0.0462325)	(0.0481828)	(0.0126533)	(0.0474375)	(7.55e-7)
5th Quantile	-0.87168***	-0.87635***	1.45e-5***	0.0069***	0.247456***	-0.32588***	1.173264***	0.253925***	-0.3261195***	1.160397***	1.45e-5***
	(0.0106901)	(0.0098734)	(2.58e-7)	(0.0001054)	(0.0219136)	(0.00555)	(0.0224065)	(0.0226929)	(0.005698)	(0.0225858)	(3.49e-7)
10th Quantile	-0.86709***	-0.88023***	1.67e-5***	0.005382***	0.229678***	-0.32489***	1.167738***	0.2320821***	-0.3240006***	1.137926***	1.66e-5***
	(0.0078753)	(0.0070117)	(2.79e-7)	(8.71e-0.5)	(0.0162403)	(0.004173)	(0.0168667)	(0.0163854)	(0.0041773)	(0.0172424)	(2.65e-7)
25th Quantile	-0.90746***	-0.88147***	2.02e-5***	0.00293***	0.151096***	-0.31912***	1.097151***	0.1560187***	-0.3184914***	1.036713***	1.97e-5***
	(0.0073314)	(0.0062312)	(2.47e-7)	(7.16e-0.5)	(0.0128714)	(0.0030956)	(0.0139351)	(0.0112147)	(0.002924)	(0.0120549)	(2.48e-7)
50th Quantile	-1.027125***	-0.95067***	2.24e-5***	0.000535***	0.121924***	-0.29887***	1.038141***	0.101454***	-0.3035204***	0.9364139***	2.24e-5***
	(0.008337)	(0.0078819)	(1.99e-7)	(0.0000888)	(0.0126068)	(0.0032894)	(0.0145642)	(0.0120431)	(0.0031322)	(0.0136121)	(2.15e-7)
75th Quantile	-1.05928***	-1.00128***	2.28e-5***	-0.00036***	0.060532***	-0.2737***	0.9743938***	0.060062***	-0.2837663***	0.8929487***	2.32e-5***
	(0.00966)	(0.008811)	(1.99e-7)	(9.82e-0.5)	(0.0185527)	(0.0045002)	(0.019137)	(0.0149072)	(0.0037778)	(0.0157296)	(1.97e-7)
90th Quantile	-1.094295***	-1.0599***	2.15e-5***	-0.00064***	0.018624	-0.24501***	0.952282***	0.0527755***	-0.2630054***	0.9065911***	2.18e-5***
	(0.0135947)	(0.0122611)	(2.94e-7)	(0.000132)	(0.0225569)	(0.0055207)	(0.0238889)	(0.019075)	(0.0045108)	(0.0203591)	(2.40e-7)
95th Quantile	-1.119831***	-1.0868***	2.05e-5***	-0.00081***	-0.01875	-0.22922***	0.930234***	0.0375284	-0.2457786***	0.951621***	2.08e-5***
	(0.0166054)	(0.0159667)	(3.49e-7)	(0.0001602)	(0.0278606)	(0.006994)	(0.0313031)	(0.0240188)	(0.0240188)	(0.0249042)	(3.18e-7)
99th Quantile	-1.127999***	-1.08986***	1.79e-5***	-0.000167***	-0.09599**	-0.22368***	0.790123***	-0.0058042	-0.2319125***	0.9246201***	1.76e-5***
	(0.0303593)	(0.035806)	(6.73e-7)	(0.0003686)	(0.0484306)	(0.0129785)	(0.0588548)	(0.0430607)	(0.00122542)	(0.0203591)	(5.70e-7)

* Significance at a 90% Confidence Bound
** Significance at a 95% Confidence Bound
*** Significance at a 99% Confidence Bound. Numbers in parenthesis indicate robust standard errors.

5.1 General Observations

The results of the impact of the BSP policy rate on the total income in all four models are presented in graphical form in Figure 10. In the following panels, the X-axis corresponds to the different quantiles in the income distribution. The Y-axis represents the beta coefficients for each explanatory variable. The grey line corresponds to the confidence intervals for each coefficient.

Figure 10
Impact of RRP on Total Income



Source: Authors' Computation.

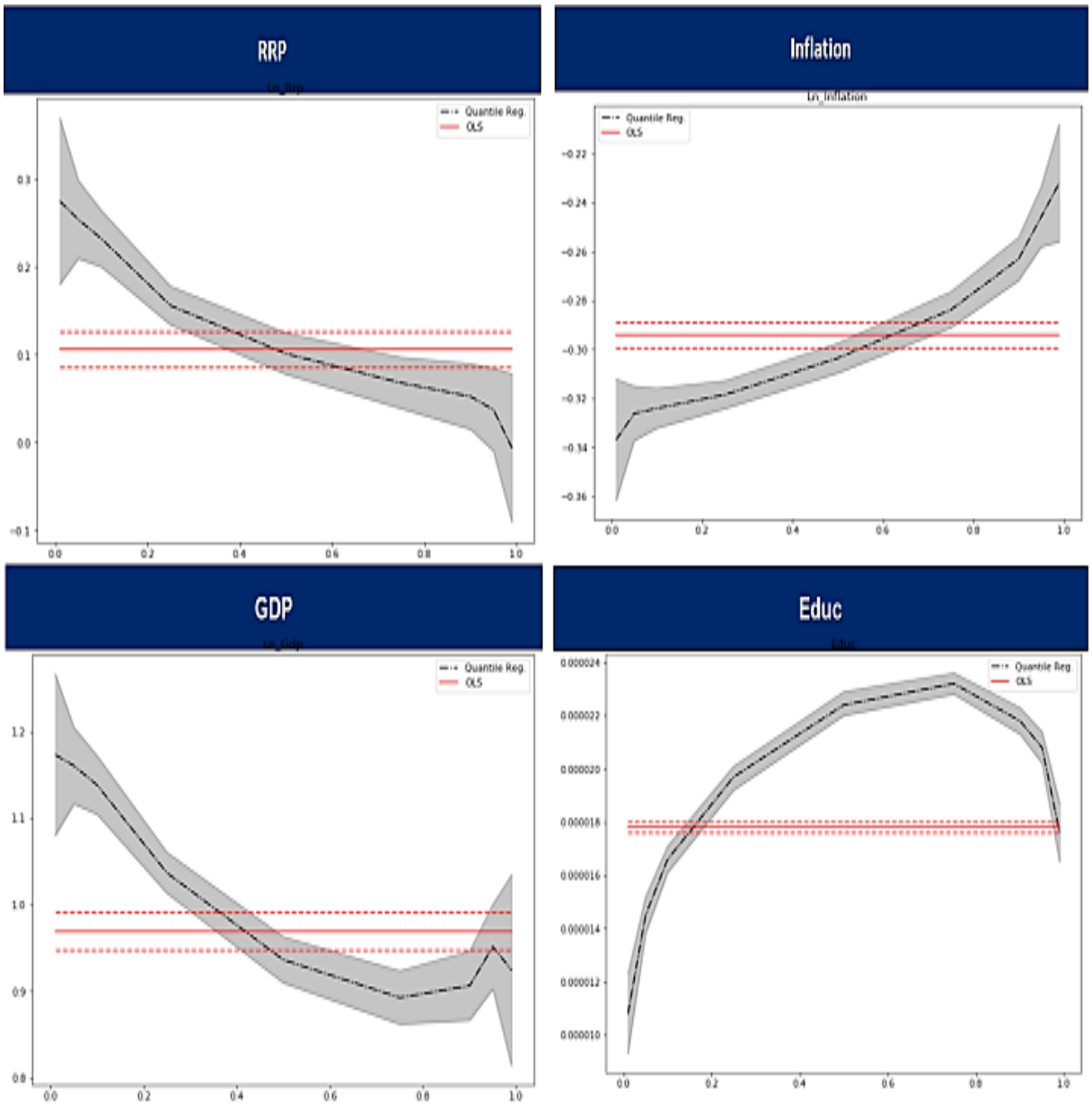
Several general observations can be made. First, in all models, the impact of monetary policy via the central bank's policy rate generate effects of varying magnitude across income levels. Second, the negative impact of an increase in RRP is more pronounced in higher-income quantiles. These results appear to be consistent with the suggestions of HANK models, which identify heterogeneity in income composition as a potential channel of monetary policy's asymmetric effects. Households obtain their incomes from various sources, each of which may respond differently to changes in monetary policy. At the low end of the income distribution, households tend to depend more on transfer income. Meanwhile, households that fall near the median will rely mostly on labor income. On the other hand, households located in the upper tail of the income distribution will rely more on business and capital income as well as income from financial assets such as bonds and equities.

An increase in the central bank's policy rate could potentially lead to a higher cost of borrowing, thus lowering investments and profits. Likewise, higher interest rates could lead to the adjustment of asset prices, such as bonds. This could explain the broader impact of RRP on total income in the higher quantiles. However, when macroeconomic variables are included, the negative effect on higher quantiles becomes smaller and insignificant. These particular results suggest that this distribution channel is relatively weak in the Philippine context. The said observation can be partly explained by the fact that income from investments such as equities and bonds, which are more sensitive to interest rate changes, are mostly concentrated to a very small number of individuals belonging to the higher quantile of the income distribution.

Third, inflation appears to have a more substantial negative impact on the lower-income quantiles (Figure 11). Increases in inflation disproportionately affect income in two ways. First, higher inflation erodes the purchasing power of lower-income individuals to a greater extent. Second, the increase in expected inflation also disproportionately erodes the purchasing power of individuals that rely more on cash to conduct their transactions. Lower-income households are expected to use more cash as a percentage of their total expenditures. Erosa and Ventura (2002) highlighted that expected inflation acts as a regressive consumption tax, increasing inequality.[15] The study results suggest that the distributional impact of monetary policy significantly operates through the inflation channel in the Philippines. Likewise, this appears to be the most critical distributional channel in the Philippines.

15. Erosa, Andres and Gustavo Ventura, (2002), "On Inflation as a Regressive Consumption Tax," *Journal of Monetary Economics,* Elsevier, Vol. 49(4), pp. 761-795, May.

Figure 11
Quantile Regression Results, Model 3



Source: Authors' Computation.

6. Conclusion

The study aims to present the necessary first steps in the analysis and assessment of the distributional impact of monetary policy in the Philippine setting. In detail, the study focused on examining the variations in the BSP's policy rate as the primary monetary policy instrument and how it affects the total income of households across income groups.

The study first used a VAR model to check the general direction of how macroeconomic variables such as output growth, inflation, and the variation in the BSP's policy rate affect inequality as measured by the GINI coefficient. Based on the VAR model's impulse response functions, expansionary monetary policy is seen to reduce inequality in the case of the Philippines. It is also worth noting that a positive shock to output reduces inequality, while a positive shock to inflation drives inequality higher.

Subsequent to the VAR analyses, the paper then employed quantile regression to characterize how variation in the BSP's main monetary policy instrument affects income across different income groups in the Philippines. The paper specified four quantile regression models to ensure the robustness of results.

The regressions yielded a significant impact of the BSP's policy rate to income at varying magnitude across income levels. In particular, the more affluent households bear a more substantial negative effect on income. These results are consistent with the findings of the HANK models, which identify heterogeneity in income composition as a potential channel of monetary policy's asymmetric effects. Households obtain their incomes from different sources, each of which may react differently to changes in monetary policy.

More importantly, the quantile regression highlights the negative association between inflation and total income across all household groups. In particular, the poorest households are hit the hardest following an inflationary episode. This is consistent with the preliminary assessment made in the paper, which noted the inequality-worsening effect of a positive shock to inflation.

The paper's results suggest that the inflation channel appears to be the most important distributional channel of monetary policy in the Philippines. This finding has a significant policy implication – the BSP, as well as similar emerging central banks, can also tackle issues such as inequality by remaining faithful to their traditional objective of safeguarding price stability.

In an emerging and developing economy like the Philippines, keeping prices within target benefits the poor most, specifically the lowest income rungs of the population. The BSP track inflation rates for the poorest segment of Philippine society, cognizant of the difference in their basket of goods and economic behavior. This segment relies heavily on the ability of monetary policy to rein in inflation, mainly because they feel a heavier brunt if the central bank misses its inflation target.

Monetary policy contributes best to desirable socio-economic objectives (e.g., lower cost of living, higher growth, among others) by focusing on promoting low and stable inflation as it helps ensure that the real economy expands along the maximum sustainable growth path associated with price stability.

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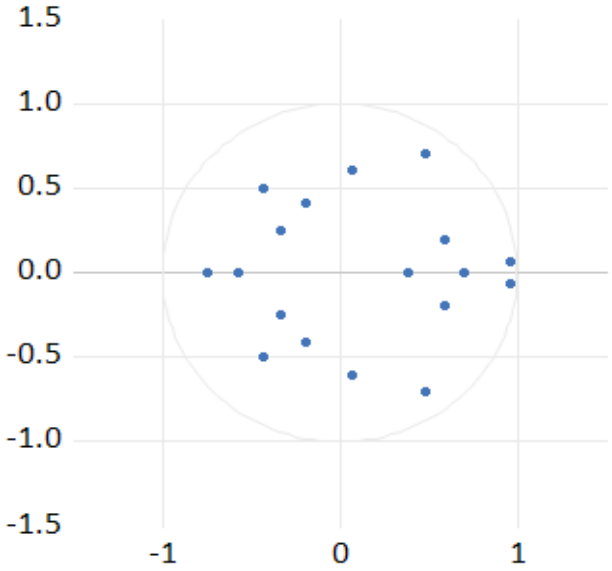
Appendix

Appendix 1A – VAR Stability Test
Inverse Roots of AR Characteristics Polynomial



No root lies outside the unit circle; VAR satisfies the stability condition

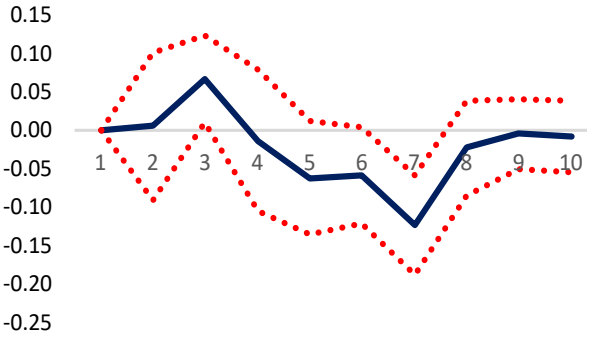
Appendix 1B – VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	438.68	NA	0.00	-18.07	-17.87	-18.00
1	593.32	270.63	0.00	-23.47	-22.30	-23.03
2	654.66	94.56	0.00	-24.99	-22.84*	-24.18
3	694.72	53.42*	5.91e-18*	-25.61*	-22.49	-24.43*
4	715.00	22.82	0.00	-25.42	-21.32	-23.87

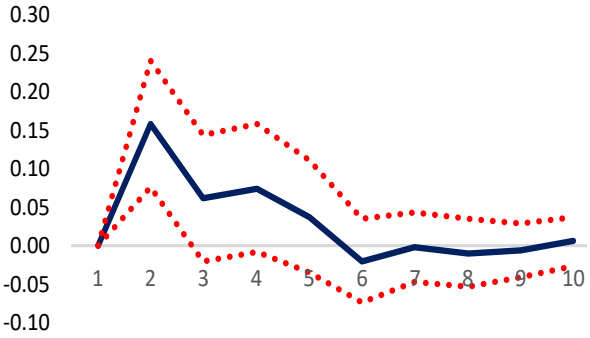
* : indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix 1C –Response to Expansionary Monetary Policy

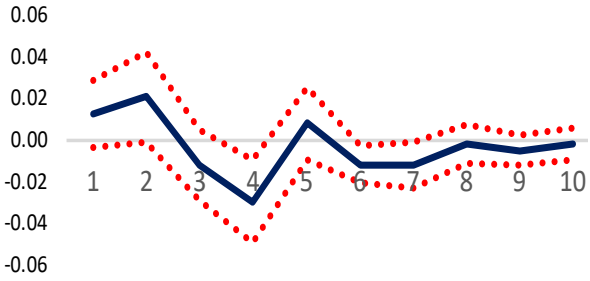
Response of GDP growth to Expansionary MP



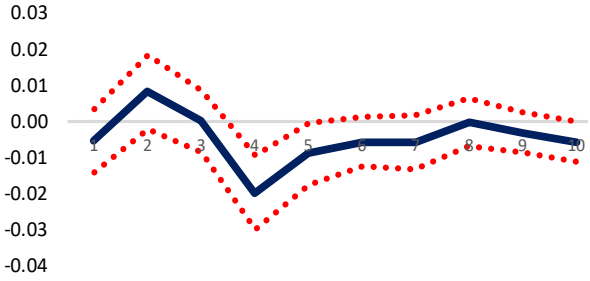
Response of Inflation to Expansionary MP



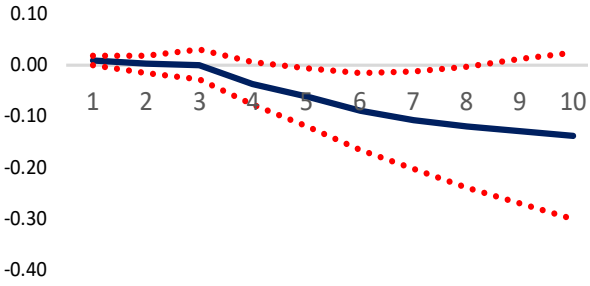
Response of Compensation to Expansionary MP



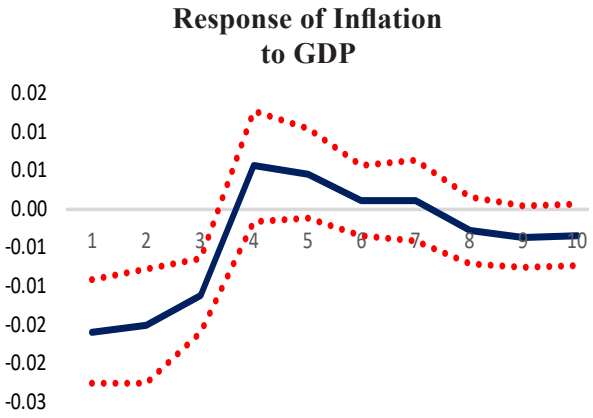
Response of Equity Prices to Expansionary MP

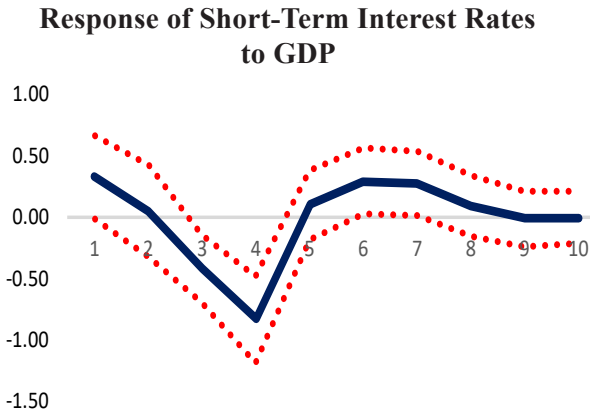


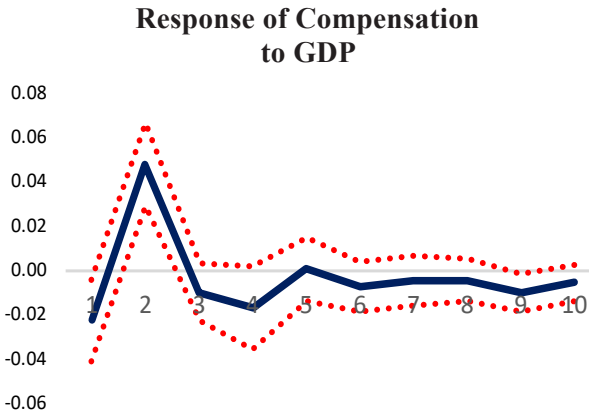
Response of GINI to Expansionary MP

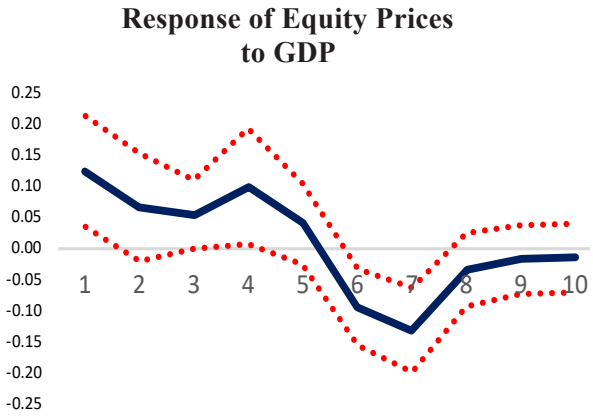


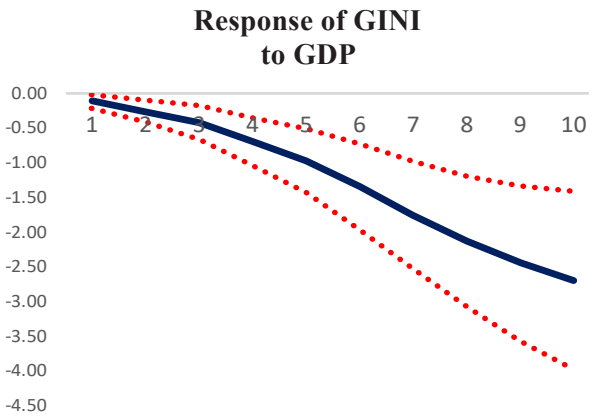
Appendix 1D –Response to 1 S.D. Innovation to GDP Growth





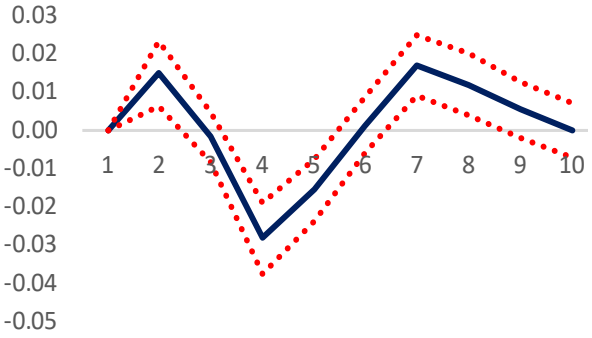




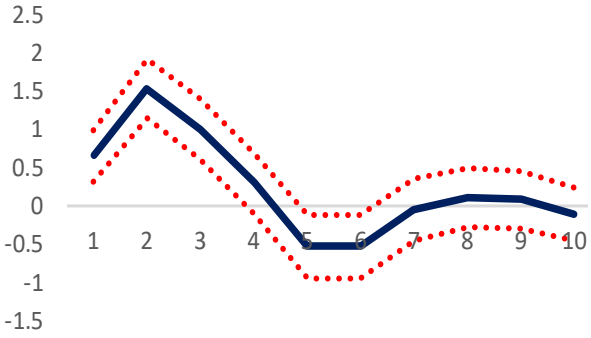


Appendix 1E –Response to 1 S.D. Innovation to Inflation

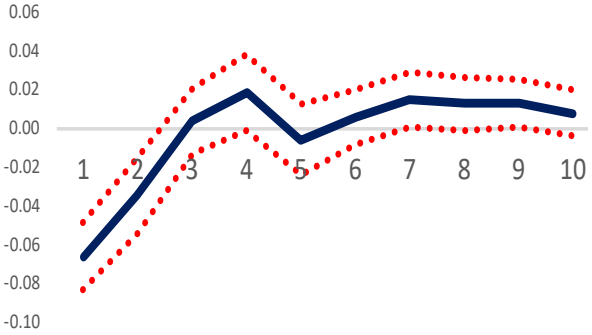
Response of GDP to Inflation



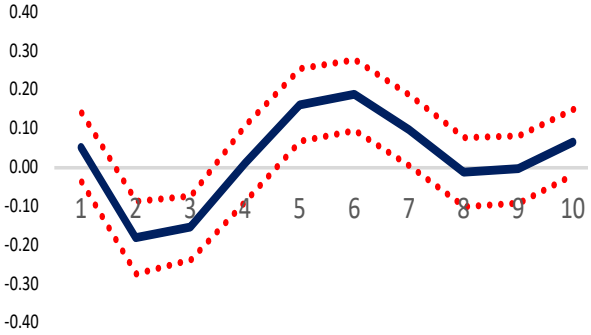
Response of Short-Term Interest Rate to Inflation



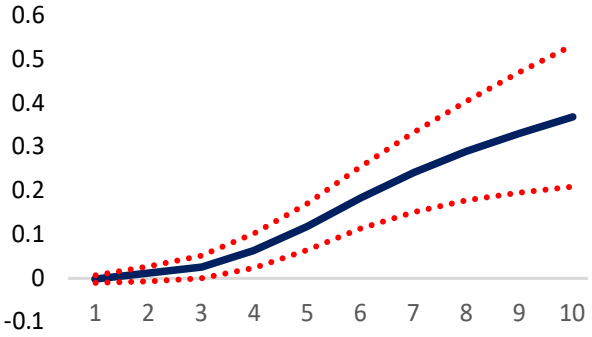
Response of Compensation to Inflation



Response of Equity Prices to Inflation



Response of GINI to Inflation



CHAPTER 6

DISTRIBUTIONAL IMPACT OF MONETARY POLICY IN SRI LANKA[1]

By

K K C Sineth Kannangara[2] and Anil Perera[3]

1. Introduction

The impact of monetary policy on income inequality has recently come to the attention of the academia and policy makers. At the same time, growing inequality, particularly in advanced economies, has attracted the attention of central bankers (Yellen, 2014; Bernanke, 2015; Draghi, 2016). As summarized by Furceriab, Loungania and Zdzienicka (2018), extensive literature has suggested many causes of inequality such as the technological progress, demographics, globalization and the structure of the labor market and more recently, monetary policy has also been added to this list as a possible cause. As argued by Romer and Romer (1998), one pertinent question that can be raised is whether monetary policy can be used as a tool to influence inequality, which in turn affects poverty levels of an economy[4].

The global financial crisis and the subsequent policy responses and developments, particularly quantitative easing remain as one of the key reasons behind increased attention on the monetary policy – inequality nexus. For example, it is argued that a prolonged reduction in policy interest rates can generate an income loss for savers holding interest-bearing assets, or that expansionary measures supporting financial asset prices are beneficial especially for the savers holding financial assets. In fact, some studies point to the negative impact of the accommodative monetary policy stance in many advanced economies on income and wealth distribution (Acemoglu and Johnson, 2012; Stiglitz, 2015) and evidence suggests that exogenous monetary policy easing lowers inequality (for example, see Ostry, Loungani and Berg, 2019). On the other hand, some studies suggest a positive impact of expansionary monetary policy on inequality through its impact on employment (for example, Draghi, 2016). In contrast, a view that has become increasingly popular since the financial crisis

1. We are thankful to Dr. Maria Teresa Punzi, Project Leader of the SEACEN Research Project on "The Distributional Impact of Monetary Policy in SEACEN Member Economies", Dr. Ole Rummel of the SEACEN Centre, participants of the SEACEN Research Seminar held on 31 October - 1 November 2019 for their valuable comments. We are also grateful to the Senior Deputy Governor Dr. P N Weerasinghe and the Senior Management of the Central Bank of Sri Lanka; Director of Domestic Operations Department Mr. C A Abeysinghe and the Director of Economic Research Department Dr. C Amarasekara of the Central Bank of Sri Lanka and the staff of the Modelling and Forecasting Division of the Economic Research Department of the Central Bank of Sri Lanka for their support. The views and opinions expressed in this paper are those of ours and do not necessarily reflect the official position of the Central Bank of Sri Lanka.

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4. In contrast, it is also argued that central banks do not care about the link between monetary policy and inequality. For example, Voinea and Monnin (2017) note that central bankers had started to forget about any possible links of monetary policy on inequality.

is that expansionary monetary policy can exacerbate inequality. To this end, studying the distributional consequences of monetary policy is important, particularly for emerging market economies, given their underdeveloped financial systems and issues related to monetary transmissions and the effective outcomes of monetary policy.

In this context, this paper quantitatively assesses the distributional effects of monetary policy in the case of Sri Lanka. Generally, Sri Lanka is considered as one of the few emerging countries with high human capital, consistent with some advanced countries (Arun et al., 2013) and the country has managed to reduce income poverty from 26.1 percent in 1990/91 to 4.1 percent by 2016. Nevertheless, it appears that income inequality has not changed dramatically for more than four decades. As such, the richest 20 percent receives more than half the total household income, while the poorest 20 percent only receives 5 percent of household income. At the same time, income inequality remains high at 0.45 as measured by the household income. It is observed that prior research suggests different causes for inequality (and poverty) in Sri Lanka. For example, empirical evidence suggests that gender and ethnicity matter for income inequality in Sri Lanka (Arun et al., 2013; Jayasinghe, 2019). While certain studies such as Perera et al. (2014) suggest that unilateral trade liberalization reduces poverty and income inequality, some studies, for example, Narayan et al. (2004) suggest that loss of human capital in the lagging regions remains a source of inequality.

To that end, this paper contributes to the literature by assessing how conventional monetary policy affects income inequality in Sri Lanka by way of identifying the causal effect of monetary policy shocks on inequality. The study also investigates the factors determining the magnitude of the impact and whether the impact is symmetric across positive and negative monetary policy shocks (i.e., tightening and easing) as well as across the business cycles. To our knowledge, these issues, particularly the relationship between monetary policy and inequality has not been examined in the context of Sri Lanka.

Based on time series data for the period 1970 – 2018 and employing standard time series estimation methods, this study observes some supporting evidence for the monetary policy and inequality nexus. Nevertheless, the findings suggest that innovations in monetary policy as proxied by a change in the policy interest rates do not lead to a persistent increase/ decrease in inequality. These results are robust for different specifications and they do not indicate a substantive and persistent impact of monetary policy on inequality.

The rest of the paper is organized as follows. Section 2 presents a brief discussion on relevant literature, while Section 3 discusses the institutional setup. Section 4 discusses the data, measures of monetary policy shocks and income inequality, and the methodology. Section 5 presents the results on income inequality and Section 6 concludes with a discussion on policy implications.

2. Brief Literature Review

A number of theoretical and empirical research have attempted to identify the effects of monetary policy on income inequality. In this section, some prior literature is briefly reviewed with a view to position the current study in the Sri Lankan context, while defining the scope of the paper.

In an early contribution, Romer and Romer (1998) observe that monetary policy influences inequality while poverty works in the opposite directions in the short-run and the long-run. Accordingly, they suggest that expansionary monetary policy increases poverty in the short-run, which is very much in line with some recent evidences as suggested in Ostry et al. (2019). Romer and Romer (1998) also suggest that low inflation driven by monetary tightening and stable aggregate demand improves the well-being of the poor in the long-run. Doepke and Schneider (2006) observe that an unexpected decrease in policy rates will benefit borrowers and hurt savers, while Heathcote et al. (2010) show that a decrease in monetary policy rates would lead to a decline in inequality. In a study carried out by the Deutsche Bundesbank (2016), it is suggested that an expansionary monetary policy tends to increase income inequality.[5] However, the distributional effects of a monetary policy are not constant over time. In a recent contribution, Furceri et al. (2018) observe that contractionary monetary policy shocks increase income inequality on average, and the effect is asymmetric (varies over time) depending on the type of shock and the state of the business cycle. These studies confirm that there is a clear divergence with regard to the evidence for the monetary policy-inequality nexus.

As discussed in the Introduction, in spite of the fact that Sri Lanka has been able to achieve notable progress in reducing poverty, the country is still faced with significant income inequality. Several research studies have attempted to attribute this to several dimensions such as gender and ethnicity, etc. However, the impact of monetary policy on inequality has not yet been examined in the Sri Lankan context.

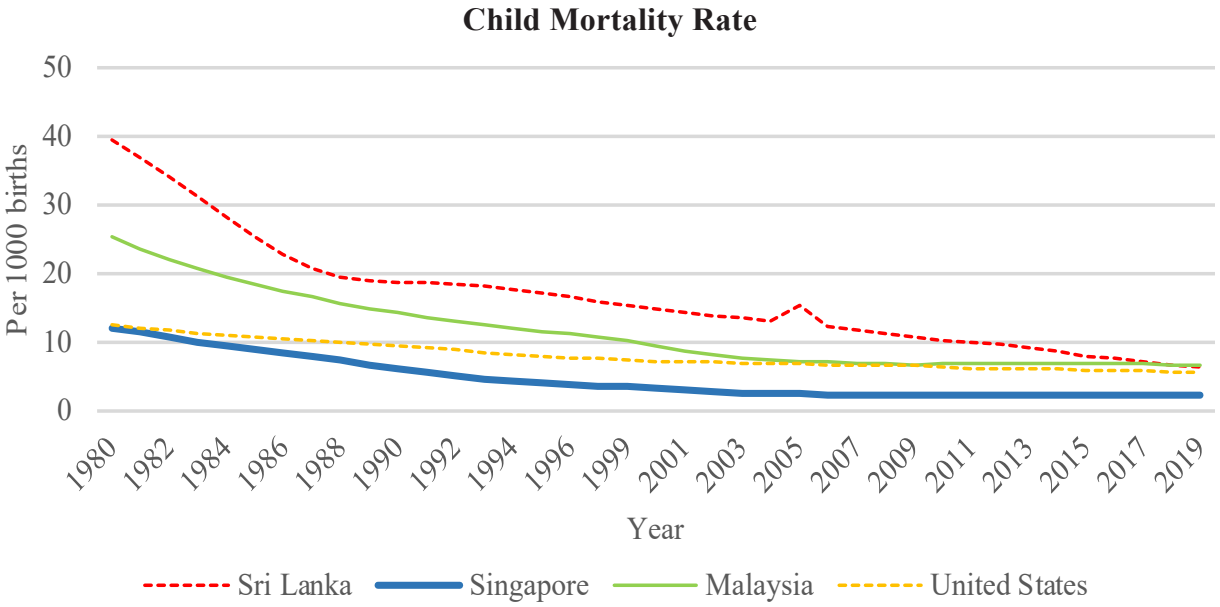
3. Institutional Setup

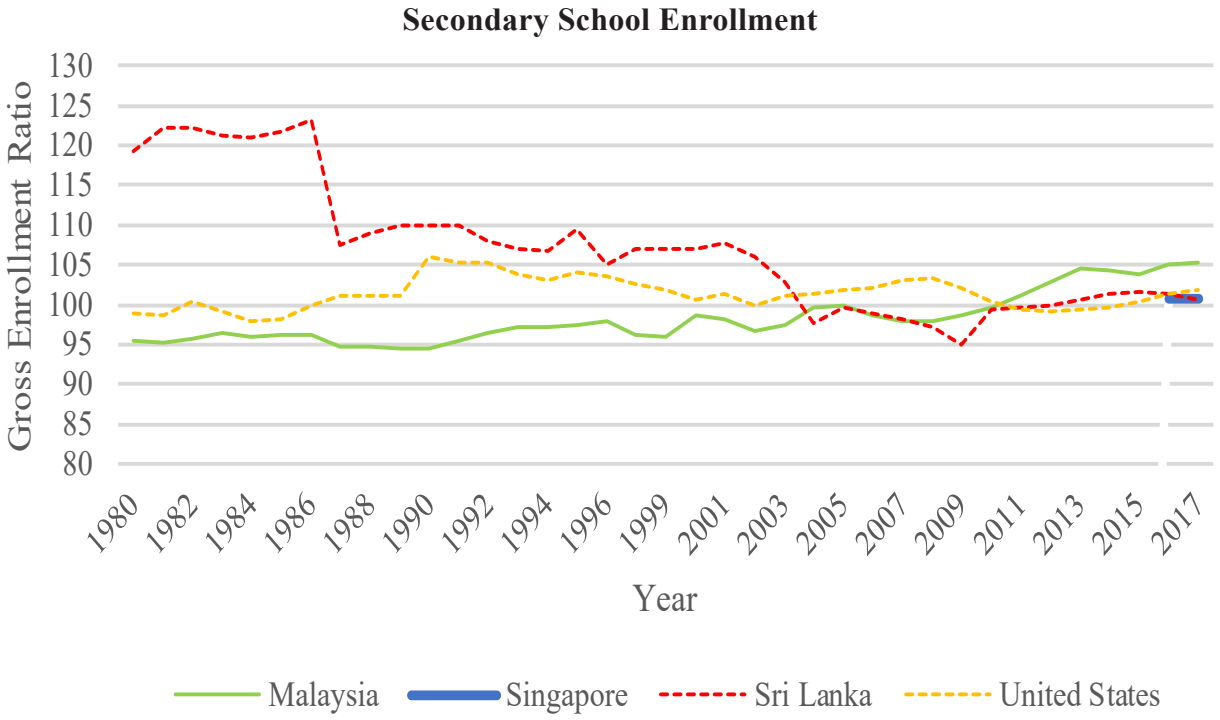
3.1 Socio-economic Background of Sri Lanka

Sri Lanka is an upper middle-income country with a per capita income level of around USD 4,102 in 2018. Although the economy is characterized as a vulnerable small open economy affected by domestic and global macro-economic developments, the country pursues remarkable socio-economic improvements, on par with other upper-middle income and developed economies (Figure 3.1). Nevertheless, the economic performance of the country remains lagging behind compared to the performances of peer economies such as Korea, Thailand and Malaysia. Since gaining independence in 1948, various economic policies were adopted by successive governments in Sri Lanka with a view to boost economic growth and reduce poverty, although the outcomes were not sufficient to provide the expected stimulus for growth thrust (Athukorala and Jayasooriya, 1994). This can be attributed to several factors including internal strife, inconsistent policies and structural issues. The economic liberalization in the late 1970s paved the way for certain transformations of the economy. However, although the economy started a new era ushered in with positive spill-over effects of the open economy policy package (Figure 3.2), it could not sustain the growth thrust for a longer period due to adverse impacts of the internal strife (Abeyratne, 2004). However, the Sri Lankan economy transformed into a services-oriented modern economy over the time, reaching a ratio of 57.7 percent of GDP in 2018, followed by the industry (26.1 percent) and agriculture (7.0 percent) sectors.

5. Deutsche Bundesbank Monthly Report September 2016, Available at: https://www.bundesbank.de/en/publications/reports/monthly-reports/monthly-report-september-2016-667170

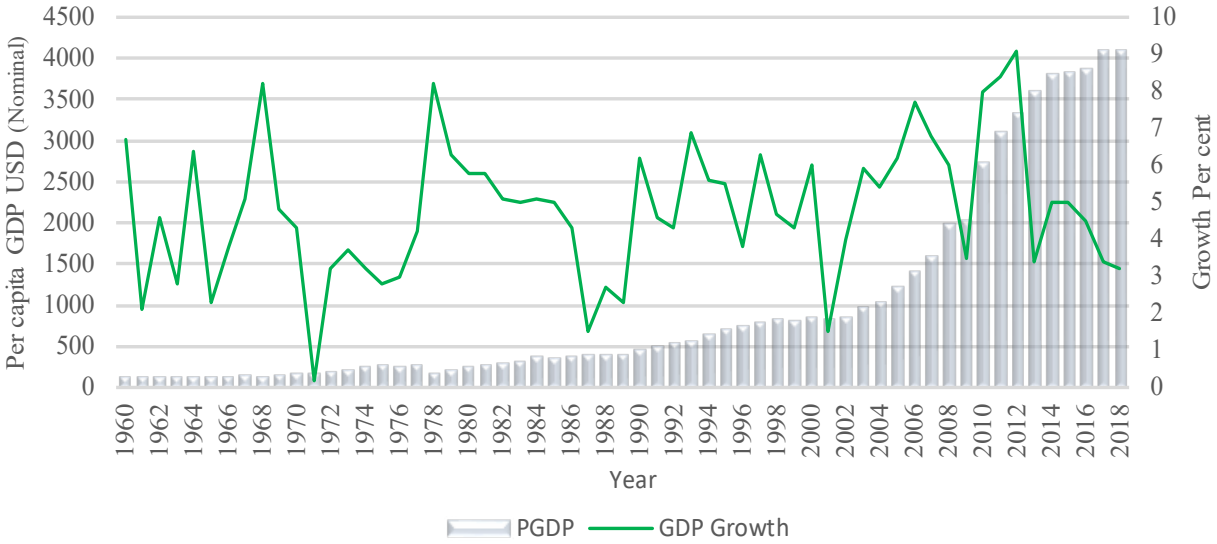
Figure 3.1
Evolution of Selected Socio-economic Parameters





Source: World Bank.

Figure 3.2
Growth Dynamics of the Sri Lankan Economy



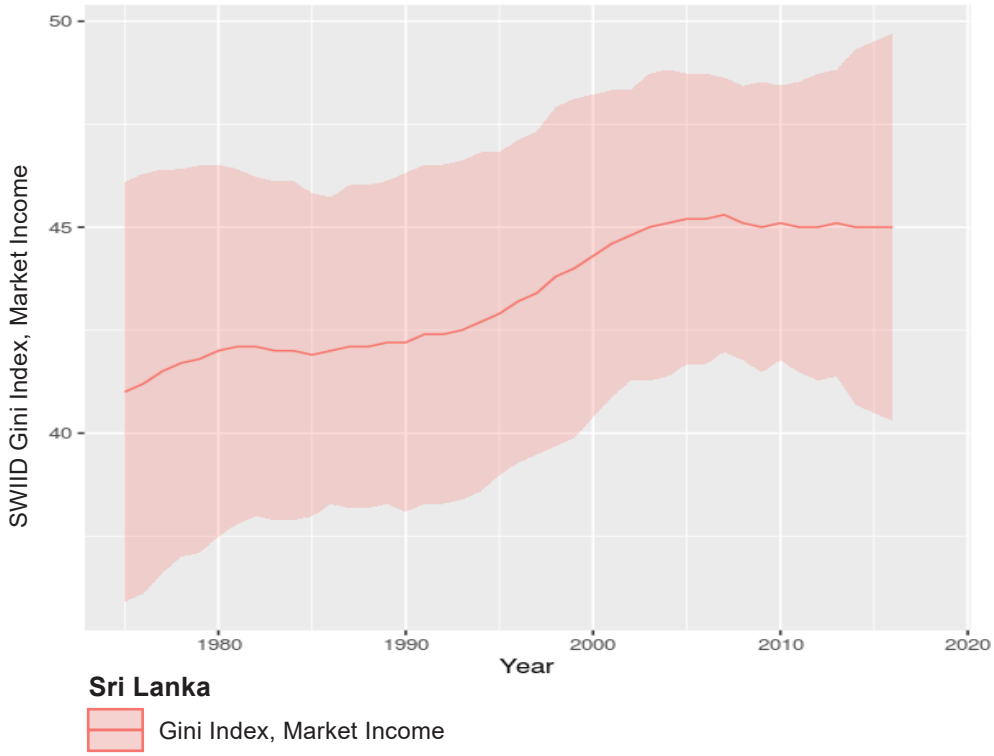
Source: Central Bank of Sri Lanka.

3.2 Trends in Inequality

Inequality in income distribution continues to be a major concern for the policy makers in Sri Lanka. The Household Income and Expenditure Survey (HIES) conducted by the Department of Census and Statistics, which is conducted once in three years, is the key survey exploring the trends and dynamics of inequality in Sri Lanka. Although, extreme poverty is not an apparent condition for the economy, inequality in terms of income distribution has increased over the time (Figure 3.3). However, the economy shows some positive signs in income distribution, while the number of people living below the poverty line (Poverty Headcount Index, HCI) has decreased significantly over time (Figure 3.4). Although inequality has come down over the national level, regional disparities continue to persist.

Notably, the government has taken various measures, for example, introducing programs such as "*Janasaviya*" and "*Samurdhi*" to eradicate extreme poverty, malnutrition, etc. However, there are still some sectors that require the attention of the policy makers, especially the estate sector. Although a decrease in HCI has been observed, the segment remains just above the poverty line and is highly vulnerable to economic or social shocks. This is because the majority in this segment represents agricultural workers including estate workers and disabled people, and they could easily fall back below the poverty line. Further, the HIES results for 2016 show that the richest 10 percent of the households has about 35.4 percent of total income in Sri Lanka, while it accounts for 38.6 percent when the rural sector is considered. The poorest 10 percent share only 1.6 percent of the total pie and increases to 2.1 percent when the estate sector is considered.

Figure 3.3
Movements in GINI Index



Note: Solid lines indicate mean estimates; shaded regions indicate the associated 95% uncertainty intervals.
Source: Standardized World Income Inequality Database v8.1 (Solt, 2019).

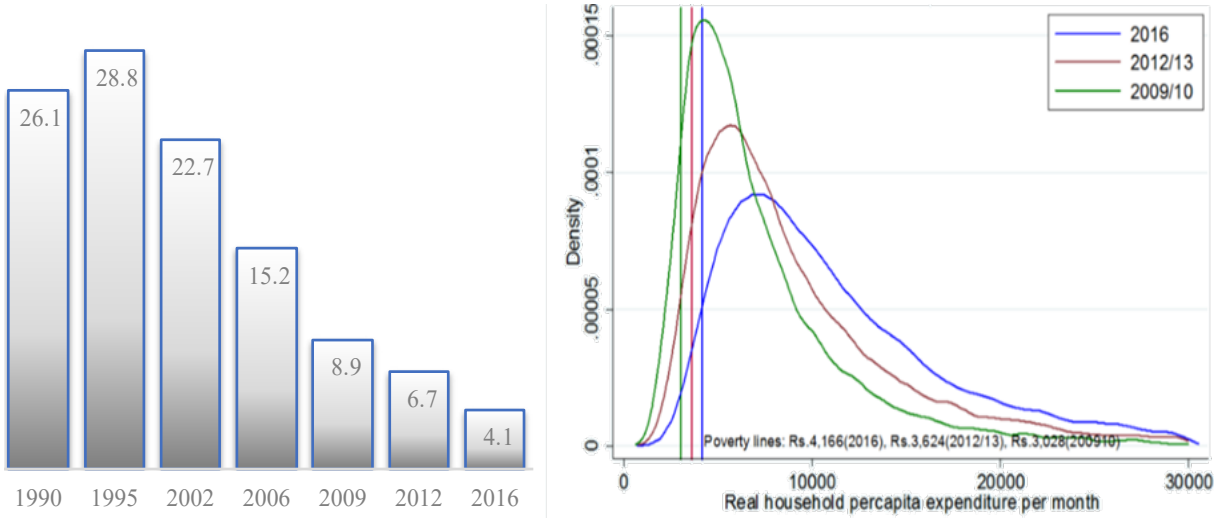
Table 3.1
Contribution to Total Poverty by Sector

Sector	Poverty Head Count Index (%) - 2016
Sri Lanka	4.1
Urban	1.9
Rural	4.3
Estate	8.8

Source: Household Income and Expenditure Survey, Department of Census and Statistics, Sri Lanka.

Sri Lanka possesses many avenues for mitigating poverty and ensuring income distribution, such as increasing female labor participation, employment creation, and decentralization of economic centres covering other provinces of the country, which are currently concentrated in few areas mainly around the centre, Colombo. Further, increasing the formal sector coverage to include informal sector workers and regional integration are among other areas which need the attention of policy makers to reduce poverty in the country, and to escape from the middle-income trap.

Figure 3.4
Poverty Headcount Index and Distribution of Income and Poverty Line



Source: Household Income and Expenditure Survey, Department of Census and Statistics, Sri Lanka.

3.3 Monetary Policy Framework of Sri Lanka

The monetary targeting framework was introduced in Sri Lanka in the 1980's and price stability was achieved by influencing the monetary aggregates, particularly broad money supply. However, recent developments in the economy such as the dis-connection between money supply and inflation and high volatility and instability observed in the money multiplier and the velocity of money, suggest that monetary targeting appears to have been weakened. At present, Sri Lanka relies on an enhanced monetary policy framework, which consists features of both monetary targeting and inflation targeting, where the medium-term target is to maintain inflation at the mid-single digit levels, by way of influencing short-term interest rates. As such, the Central Bank of Sri Lanka has explicitly announced the process of adopting the Flexible Inflation Targeting Framework by 2020. However, the growth in broad money supply is also taken into consideration as an indicative intermediate variable, whereas the Average Weighted Call Money Rate (AWCMR) is considered as the operating target of the monetary policy framework.

3.4 Channels of Monetary Policy Shocks and Inequality

Coibion et al. (2012) looks at five possible channels by which monetary policy shocks could affect inequality. Firstly, the income composition channel explains how household income is affected by a monetary policy shock. Generally, most households receive labor income while others receive income from financial sources or by owning firms. If accommodative monetary policy causes the profits of firm owners to increase, compared to wages of households, households receive disproportionately lower income, thus raising inequality. Secondly, the financial segmentation channel shows that active market participants benefit after an expansionary monetary policy shock, as an increase in money supply will affect the redistribution of wealth for market participants and accordingly, inequality could rise.

According to the portfolio channel that explains the link between expansionary monetary policy and inequality, responding to an expansion in money supply and lower interest rates, low-income households tend to hold more currency and lower amount of assets compared to high-income households. An inflationary environment during an expansion of money supply, could increase consumption inequality of low-income households by way of transferring income from low-income households to high-income households.

On the other hand, the savings redistribution channel explains how expansionary monetary policy actions lead to a lowering of inequality. Accommodative monetary policy could hurt savers while benefiting borrowers, thus reducing consumption inequality, assuming that savers are generally wealthier than borrowers.

The earnings heterogeneity channel is the last channel examining the link between monetary policy and inequality. Most households earn from the labor market, with earnings from the labor market being the primary source of income. Different wage rigidities and different household characteristics such as the number of children and age could be observed among different income groups and thus earnings of both low- and high-income households could react differently to the changes in money supply. Accordingly, as explained by Carpenter et. al. (2004), monetary policy shocks could lead to disproportionate changes in unemployment within low-income groups. Basically, if monetary policy reduces unemployment among low income groups, it will in turn reduce inequality among them.

4. Data and Methodology

In this section, we present a detailed discussion on the data used in this study, starting with a discussion on the procedure of selecting appropriate measures for inequality.

4.1 Key Variables

4.1.1 Inequality Measures

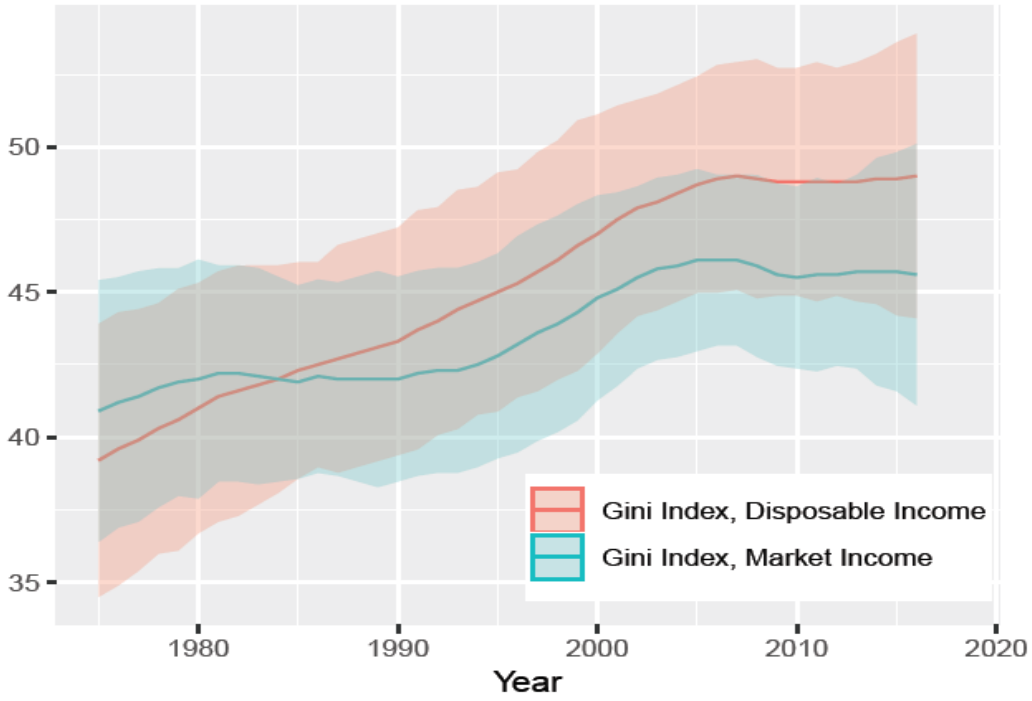
Data on income inequality for Sri Lanka can be obtained from the Household Income and Expenditure Survey (HIES) conducted by the National Statistical Agency, Department of Census and Statistics of Sri Lanka (DCS). However, inequality data for Sri Lanka measured by the GINI[6] is only available from 1981 with a five-year interval. This limits the scope of our study. Hence, alternatively, as guided by Furceri et al. (2018), we retrieved inequality data from the Standardized World Income Inequality Database (SWIID) published by Harvard Dataverse[7]. The SWIID database includes income inequality data measured as disposable and market income inequality for the period starting from 1960 to the present date for about 196 countries. However, in the case of Sri Lanka, required data is only available from 1970 to 2015. Given the adequate length of the data series, we used SWIID based data to measure

6. Gini coefficients are theoretically bounded between 0 (each reference unit receives an equal share of income) and 100 (a single reference unit receives all income).

7. The Standardized World Income Inequality Database (SWIID), http://fsolt.org/swiid/. The SWIID includes measures of disposable (post-tax, post-transfers) and market (pre-tax, pre-transfers) income inequality (Gini indices). It incorporates data from several sources (United Nations University's World Income Inequality Database, the OECD Income Distribution Database, World Bank, Eurostat, the Luxembourg Income Study) and standardizes it.

inequality. Figure 4.1 illustrates the behavior of inequality data used in the present analysis, which indicates that income inequality measured both in terms of market and disposable income have increased in Sri Lanka over the period 1970 to 2015.[8]

Figure 4.1
Inequality Based on Market Income and Disposable Incomes



Note: Solid lines indicate mean estimates; shaded regions indicate the associated 95% uncertainty intervals.
Source: Standardized World Income Inequality Database v8.1 (Solt, 2019).

4.1.2 Monetary Policy Shock

In this study, monetary policy shock is considered as exogenous as there is no direct impact from monetary policy shocks to inequality, and vice versa. This is because the changes in monetary policy rates are not driven by inequality (inequality is not a target of central banks) and economic conditions can influence (at least in the short-term) both inequality and monetary policy actions (Furceri et al., 2018). Therefore, as guided by previous research studies, particularly in the emerging market context, for example, McCallum (1994); Haughton and Iglesias (2012) and Perera (2013), the 3-month Treasury bill rate (T_Bill rate) is used as the proxy for the monetary policy rate.[9] We then generated the forecast error (FE) of the monetary policy rate as the difference between the actual policy rate (T_Bill rate) and forecasted policy rate (T_Bill_fore) derived as shown in Equation (1). The same approach

8. Measures of inequality based on Gini coefficients of market and net incomes (income net of transfers and taxes).

9. The Average Weighted Call Money Rate (AWCMR) is the current operating target of the monetary policy framework of the Central Bank of Sri Lanka. However, as a longer AWCMR series is not available and given the significant volatility in AWCMR, we used the 3-month Treasury bill rate as the proxy for the policy rate in this exercise.

was used for calculating the forecast errors of GDP growth (FE_g) and inflation (FE_i) [10]. The forecast error derived as above were used to derive the variable MP, which serves as the proxy for monetary policy shock and is used for deriving the dummy variable to identify different monetary policy shocks.

$$FE_T = T\_Bill\_rate - T\_Bill\_fore \quad (1)$$

We broadly follow Furceri et al. (2018) to estimate the regression model based on Equation (2) in order to derive the exogenous monetary policy shock. Accordingly, the residual ϵ_t stands for the exogenous monetary policy shock, MP in the economy.

$$FE_T = \alpha + \beta\, FE_i + \gamma\, FE_g + \epsilon_t \quad (2)$$

4.2 Estimation Method

The impact of the monetary policy shock is tested deploying Vector Auto Regression (VAR) models. Our data sample used for empirical estimates spans for the period 1990 – 2015, which includes the annual average data obtained from the data library of the Central Bank of Sri Lanka (CBSL). As the VAR models allow the capturing of dynamic responses of variables, the VAR models is seen as appropriate for this study.

4.2.1 Baseline Model

The baseline VAR model to capture the impact of monetary policy shock on inequality of this study is given by the following equation:

$$Y_t = c + \sum_{i=1}^{n} A_i\, Y_{t-1} + \varepsilon_t \quad (3)$$

$$Y_t = \begin{bmatrix} T\_Bill \\ X_t \\ GINI\_Disp \end{bmatrix};$$

$GINI\_Disp$, which represents a measure of inequality is disposable inequality, whereas T_ Bill is used as the proxy for the monetary policy rate and X_t includes a set of control variables such as GDP growth, unemployment, and inflation[11].

10. Forecasts were done using the Auto Regression Integrated Moving Average (ARIMA) method.
11. In some models, we have used the exchange rate (USD/LKR) and oil price as control variables in addition to these variables.

4.2.2 Inequality in Contractionary or Expansionary Monetary Policy Shocks

In order to check whether contractionary or expansionary monetary policy shocks act differently on inequality, as an extension to the baseline model, based on the variable MP, we derive a dummy variable that takes the value of one for contractionary monetary policy shocks and zero for expansionary monetary policy shocks. For the purpose of explaining the impact of monetary policy cycle, we re-estimate Equation (3) with new variables as shown in Equation (6).

$$Y_t = c + \sum_{i=1}^{n} A_i Y_{t-1} + \varepsilon_t \qquad (6)$$

$$Y_t = \begin{bmatrix} Dummy * T\_Bill \\ (1 - Dummy) * T\_Bill \\ X_t \\ GINI\_Disp \end{bmatrix};$$

4.2.3 Inequality in Different States of the Business Cycle

We further extend our analysis to check whether the effect of monetary policy shocks on inequality is different depending on the state of the business cycle, following the same method used by Furceri et al. (2018). Accordingly, we estimate Equation (7), including the Smooth Transition Function, G_t, where G_t is derived using an indicator (z) to represent the state of the economy, i.e., passing a recessionary or an expansionary period at the time of the shock. While calculating z, the deviation of GDP growth rate (annual) from the trend is derived using the Hodrick-Prescott (HP) filtered GDP series. With reference to Auerbach and Gorodnichenko (2012), we also use a high smoothening parameter of λ = 10,000, in order to achieve a smooth curvature of the transition function and filtered GDP series as shown in Figure 4.3.

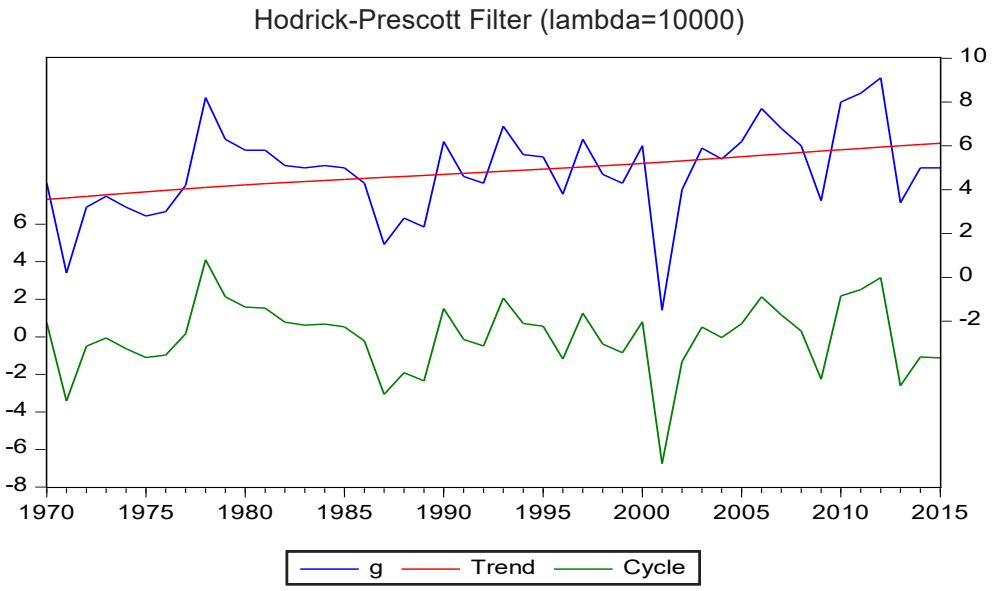
$$Y_t = c + \sum_{i=1}^{n} A_i Y_{t-1} + \varepsilon_t \qquad (7)$$

$$Y_t = \begin{bmatrix} G_t * T\_Bill \\ (1 - G_t) * T\_Bill \\ X_t \\ GINI\_Disp \end{bmatrix}$$

$$\text{where}, G_t = \frac{exp^{(-\gamma z_t)}}{1 + exp^{(-\gamma z_t)}} \; and \; \gamma = 1.5$$ [12]

12. With reference to Furceri et al. (2018) we use γ=1.5. Results were checked for robustness with γ=1.2. and the same results were observed. These results are given in Annex 1.

Figure 4.3
HP Filtered GDP



Source: Authors' Estimates.

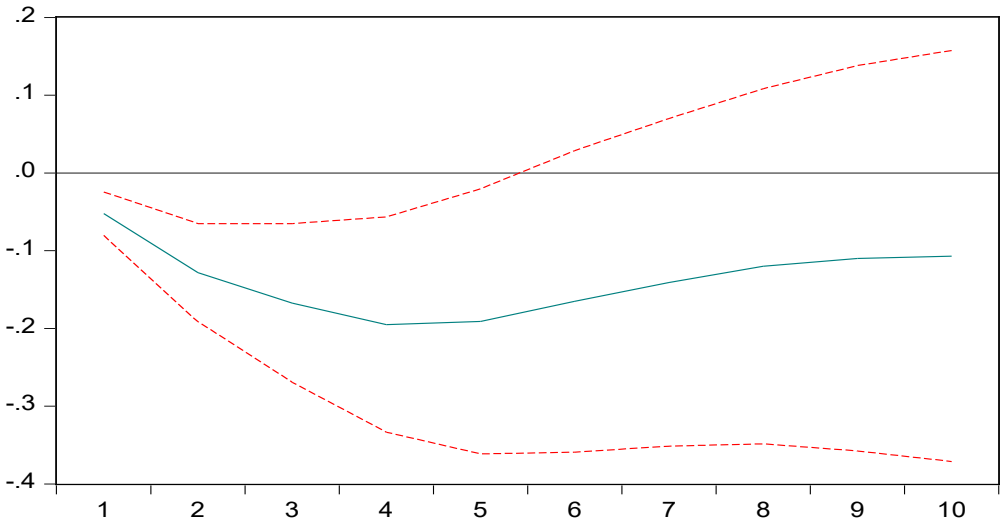
5. Results and Discussion

In this section, we present the results of the VAR model employing inequality measures and monetary policy shocks along with other key variables in the system.

5.1 Baseline Model

The estimation results of Equation (3) based on the Gini coefficient for disposable income as the measure of inequality are presented in Figure 5.1.

Figure 5.1
Results of the Baseline Model:
Impact of T_Bill Rate to Disposable Income Inequality



Source: Authors' Estimates.

As per the Impulse Response Functions reported in Figure 5.1, it appears that monetary policy tightening leads to a significant reduction in inequality, particularly in the short-run. Although the negative impact of a monetary shock on inequality does not appear statistically significant and is not persistent across the time horizon, these results broadly suggest that contractionary monetary policy tends to reduce income inequality. This observation is broadly in line with prior literature, for example, Ampudia (2018) and Davtyan (2017), which suggest that contractionary monetary policy decreases income inequality. Ampudia (2018) observes that an indirect income channel, which has an overwhelming importance, especially for households holding few or no liquid assets, could induce a downward bias in inequality. In the case of Sri Lanka, it could be observed that a significant portion of household savings are allocated for interest bearing assets given the lack of alternative or non-interest-bearing assets. Hence, during the periods of monetary tightening, income on their interest-based assets rises thereby improving their consumption and welfare at the aggregate level. This is very applicable in the case of senior citizens who mainly rely on interest income generated out of financial assets placed at financial institutions. Hence, the decline in inequality in response to monetary tightening in Sri Lanka can be tracked down to the working of an indirect interest rate channel as observed by Ampudia (2018). Nevertheless, these observations do not appear consistent with Furceri et al. (2018), which observe that monetary policy tightening leads to a long-lasting increase in income inequality.

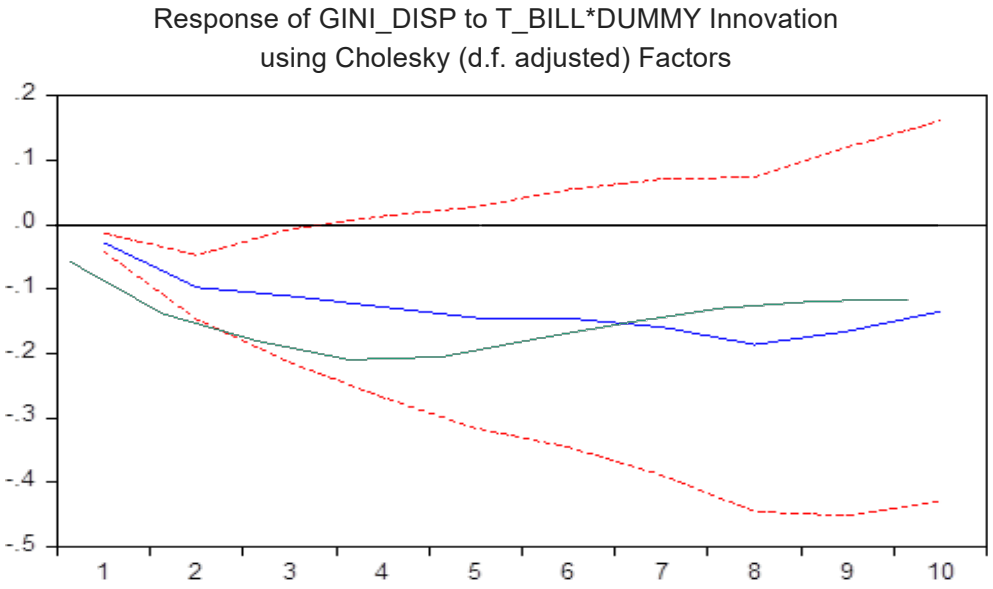
5.2 Extended Models

As an extension to the analysis and in order to examine the robustness, we make several alterations to the baseline VAR model. First, we consider the impact of monetary policy cycles on inequality. This is important because there are divergent views on the impact of monetary policy cycles on the distributional effects of monetary policy. For example, some prior literature suggests that positive monetary policy shock (contractionary monetary policy) has a larger and significant impact on economic activity and hence a negative impact on inequality. This is because monetary contraction leads to high interest rates, resulting in small firms facing difficulties in obtaining external finances, identified as the so-called credit channel of monetary transmission. Hence, considering the importance of the credit channel and the impact through economic activity, it would be important to gauge the impact of monetary policy on inequality across different monetary policy cycles.

Figures 5.2 and 5.3 present the results of the extended VAR models incorporating the dummy variable which takes the value of one for positive monetary policy shocks (monetary contraction) and zero otherwise.[13]

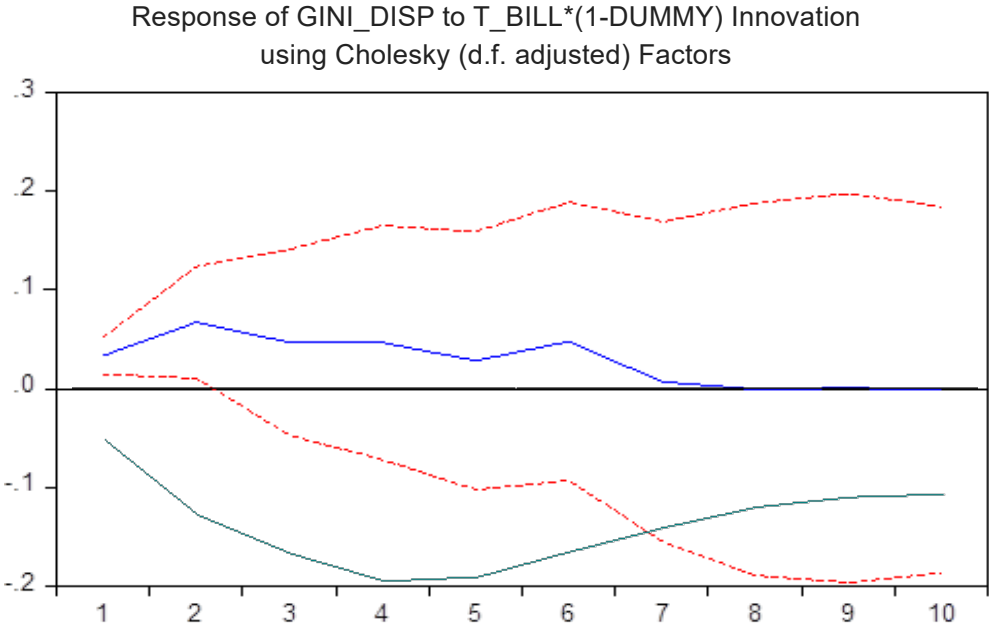
13. When presenting the results, which only indicate some significance, we have superimposed the baseline response obtained from the baseline model for comparison purposes.

Figure 5.2
Impact of Contractionary Monetary Policy Shock on Disposable Income Inequality



Note: Estimation is based on Equation (6). Solid blue line shows the response to an unanticipated contractionary monetary policy shock. Solid green line denotes the baseline response presented in Figure 5.1.
Source: Authors' Estimates.

Figure 5.3
Impact of Expansionary Monetary Policy Shock on Disposable Income Inequality

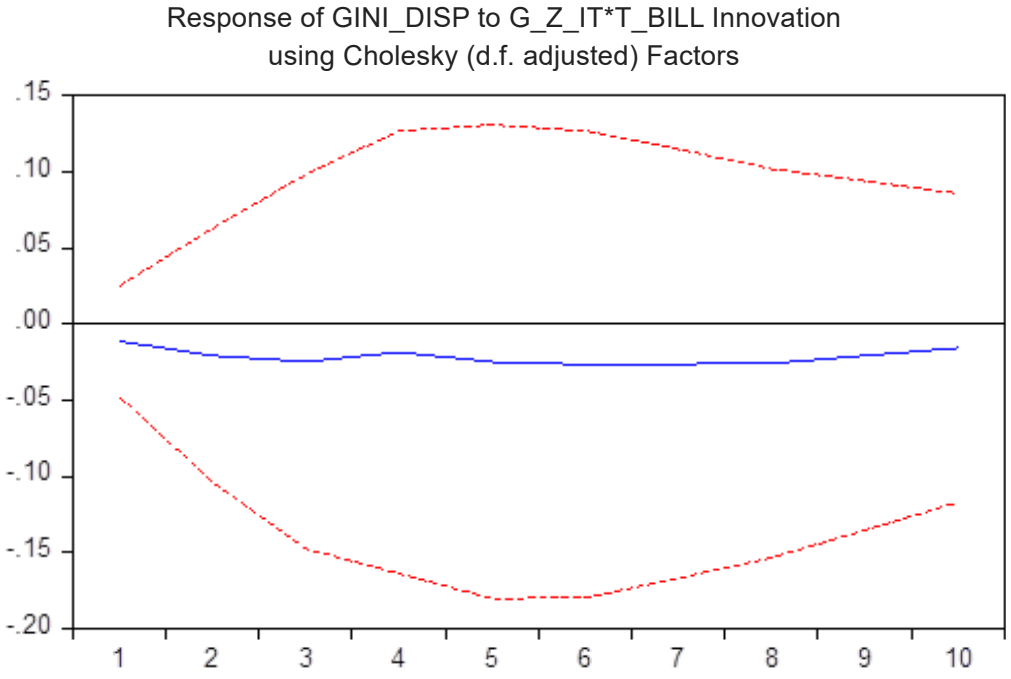


Note: Estimation is based on Equation (6). Solid blue line shows the response to unanticipated contractionary monetary policy shock. Solid green line denotes the baseline response presented in Figure 5.1.
Source: Authors' Estimates.

The results presented in Figure 5.2 and 5.3 suggest that the sign of monetary policy shock, i.e., nature of the monetary policy cycle does matter somewhat for inequality. As such, some evidences are observed suggesting that positive monetary policy shocks (contractionary monetary policy) lead to a decrease in inequality in the short-run, but it increases in the long-run, albeit less persistent than the baseline. This can be seen in the evidence for the existence of credit market imperfections and changes in investments by the small firms due to high external financing costs. These results broadly contrast the results of Furceri et al. (2018) at least in the short-run, but are in line with some prior literature, for example, Davtyan (2017), which suggests that contractionary monetary policy decreases income inequality, and monetary policy might be considered as another effective policy instrument which can be used to reduce inequality.

It is argued that the effects of monetary policy tightening are larger during periods of economic expansions, while monetary policy easing only has effects during periods of recessions, suggesting asymmetric effects of monetary policy on inequality (Matthes and Barnichon, 2015). Guided by this premise, we further examine monetary policy shocks and their impact on inequality for different business cycle conditions. Figures 5.4 and 5.5 present the results of the impact of monetary policy shocks across recessionary and expansionary periods of the economy.[14] As Figure 5.5 presents some significant results, we have superimposed the baseline response for comparison purposes.

Figure 5.4
Impact of Monetary Policy Shock to Market Inequality in Recessions

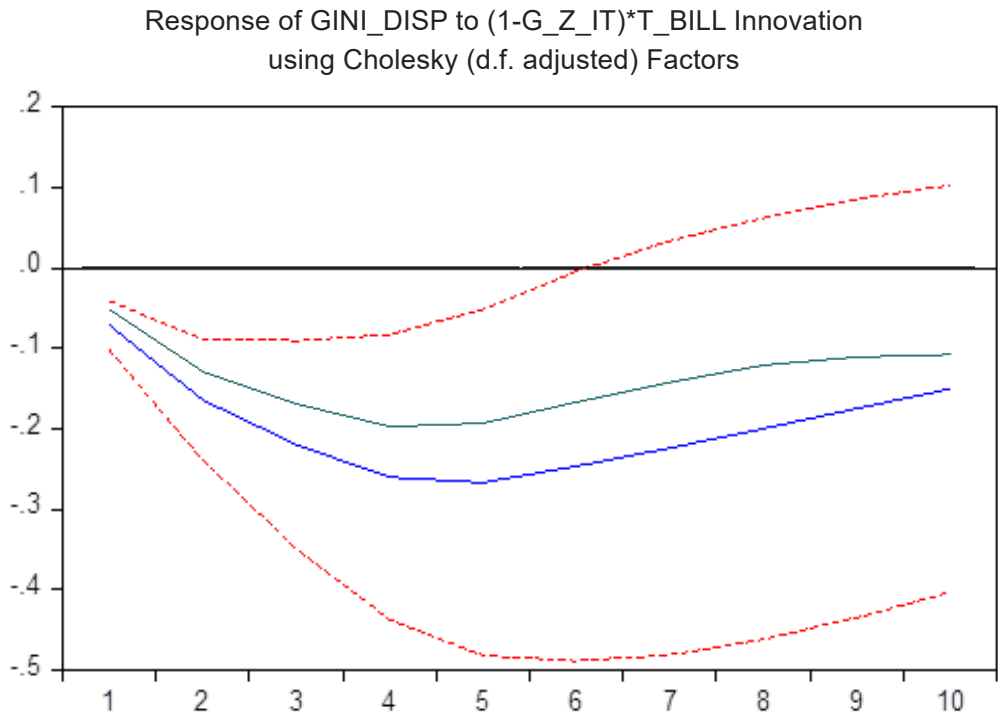


Note: Estimation is based on Equation (6). Solid blue line shows the response to an unanticipated contractionary monetary policy shock.

Source: Authors' Estimates.

14. In this study, we use $\gamma = 1.5$ for the smooth transition function between different states of the economy and the results reported in Annex 1 are robust for $\gamma = 1.2$ as in Furceri et al. (2018).

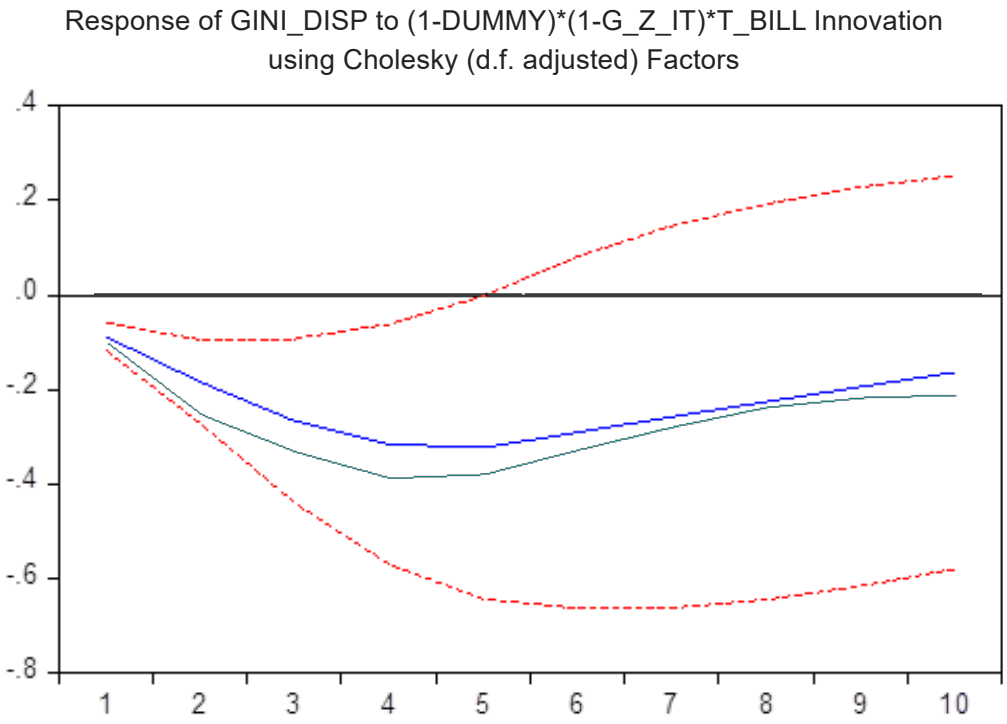
Figure 5.5
Impact of Monetary Policy Shock to Market Inequality in Expansions



Note: Estimation is based on Equation (6). Solid blue line shows the response to an unanticipated contractionary monetary policy shock. Solid green line denotes the baseline response presented in Figure 5.1.
Source: Authors' Estimates.

The results presented in Figure 5.4 and 5.5 suggest that monetary policy shocks tend to have significant effects on inequality during expansions than recessions. They also show that the impact of a positive monetary policy shock during an expansion leads to a further reduction in inequality compared to the baseline. As argued by Furceri et al. (2018), this approach tends to mask the important differences in the response of inequality to positive and negative monetary policy shocks across the business cycles. To uncover such heterogeneity, we generated further estimates for positive and negative monetary policy shocks across the business cycles, and the results are reported with proved significance in Figure 5.6.

Figure 5.6
Impact of Negative Monetary Policy Shock to Market Inequality in Expansions



Note: Estimation is based on Equation (6). Solid blue line shows the response to an unanticipated contractionary monetary policy shock. Solid green line denotes the baseline response presented in Figure 5.1.

Source: Authors' Estimates.

Based on Figure 5.6, some evidence for a decline in inequality can be observed amidst the impact of a tight monetary policy cycle and a booming business cycle although the impact is not persistent across the time horizons. At the same time, we observe that other monetary policy cycles and business cycles do not produce consistent and significant results to suggest that there is notable heterogeneity in the response of inequality to different monetary policy and business cycles. This suggests the difficulty of using monetary policy as a tool (by way of pursuing monetary relaxation or tightening measures) to address the inequality issue in an economy.

6. Conclusions and Policy Implications

This paper evaluates the distributional effects of monetary policy for Sri Lanka. While monetary policy shocks in this study were identified using the causal estimation of the effect of monetary policy shocks on inequality, alternative measures of inequality were employed to represent the dynamics of income distribution. The econometric study of the paper was carried out based on the standard VAR representation applied on the annual time series data in the Sri Lankan context.

Based on the empirical evidence and different model specifications, we observe some evidence for the nexus between monetary policy and inequality in Sri Lanka, which provide some implications for the consideration of the policy makers including monetary authorities. While we observe that contractionary monetary policy shocks reduce income inequality to some extent, innovations in policy interest rates do not lead to a persistent increase/decrease in inequality. At the same time, we observe that different specifications do not indicate substantive impact of monetary policy on inequality. Hence, we conclude that although there are some evidences for the distributional effects of monetary policy in the Sri Lankan context, permanent and strong effects of monetary policy on inequality cannot be determined. Moreover, the distribution of income does not seem to impact the transmission mechanism of monetary policy.

It should be noted that these observations are subject to some caveats. This study uses inequity data derived from an external database due to the lack of accurate internal inequality data. The study is also based on the standard time series modelling approach without considering time varying parameters. As such, in order to further ensure the robustness of the results, different model specifications and different proxies for inequality would need to be considered, while considering the structural breaks and time varying properties of data. Moreover, it would be vital to investigate the distributional effects of monetary policy across different business sectors, and such efforts are left for future research in the Sri Lankan context.

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Annex 1

Robustness check with Gamma = 1.2
Figure A1 - 1
Impact of Monetary Policy Shock to Market Inequality in Recessions

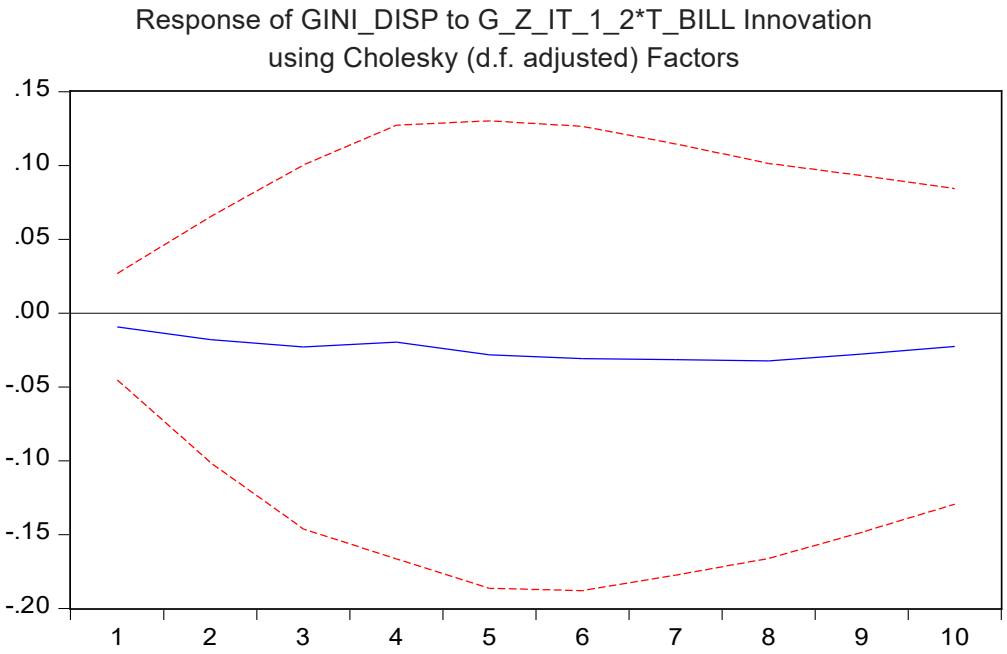


Figure A1- 2
Impact of Monetary Policy Shock to Market Inequality in Expansions

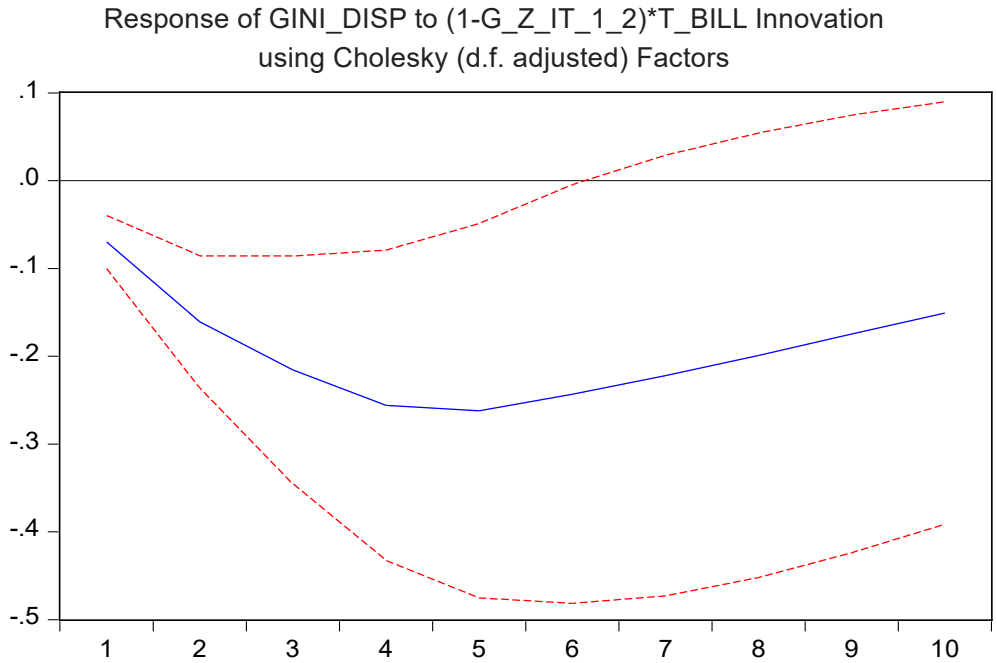
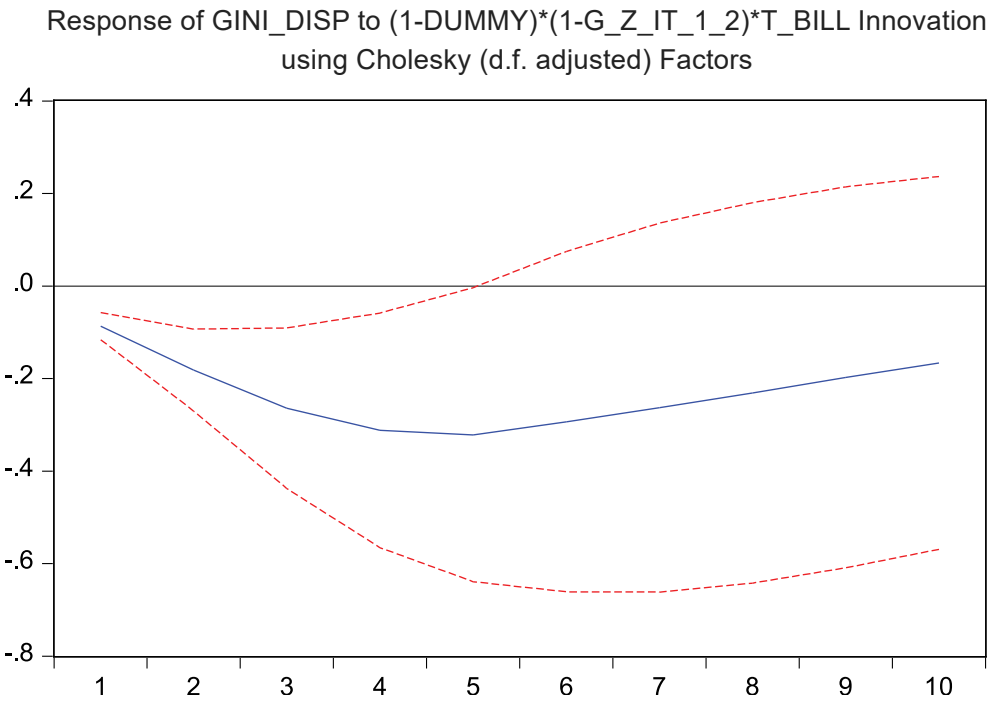


Figure A1 – 3
Impact of Negative Monetary Policy Shock to Market Inequality in Expansions



CHAPTER 7

THE IMPACT OF MONETARY POLICY ON INCOME AND WEALTH DISTRIBUTION: A CASE OF THAILAND

By

Passakorn Tapasanan and Piraya Ronaparp[1]

1. Introduction

Not long after experiencing the financial crisis, Thailand adopted a flexible inflation targeting regime from May 2000, a change from the long implemented exchange rate targeting framework, which followed a brief period of monetary targeting regime[2]. Since then, Thailand has been able to achieve price stability, where core inflation moves favorably within the target range[3] most of the time (Chart 1). Of late, however, when Thailand changed the target of core inflation to headline inflation, it has fallen uncomfortably short of the lower bound of the target range. Despite this shortfall, Thailand has still been able to maintain price stability along with its coherent objectives of supportive economic growth and a sound financial system.

Chart 1
Inflation and Inflation Target Range

1. The Bank of Thailand, Email: PassakoT@bot.or.th or PirayaR@bot.or.th. All views expressed are solely those of authors and cannot be taken to represent those of the Bank of Thailand or the SEACEN Centre.
2. Bank of Thailand was founded in 1942. It first adopted the pegged exchange rate regime (Second World War - June 1997), and briefly adopted the monetary targeting regime (July 1997 - May 2000) after floating the exchange rate. https://www.bot.or.th/English/MonetaryPolicy/MonetPolicyKnowledge/Pages/Framework.aspx
3. Since the adoption of flexible inflation targeting regimes, Thailand has had multiple target ranges throughout its history. Core inflation target at 0-3.5% (May 2000 – Dec 2008), Core inflation target at 0.5-3.0% (2009 - 2014), and Headline inflation target at 2.5% with a tolerance band of 1.5% (2015 to present). https://www.bot.or.th/English/MonetaryPolicy/MonetPolicyKnowledge/Pages/Target.aspx

From a macro perspective, effective conduct of monetary policy in Thailand, through price stability and economic growth, is widely acknowledged. Yet few evidences point to its effectiveness from a micro perspective, particularly on household income and wealth. There is still a need for researchers to investigate this area. However, an in-depth exploration at the individual household level, rich micro-data source is required. Since 2007, Thailand has been conducting revised household surveys[4], which comprise detailed household level data, including a variety of perspectives on income source and wealth.

To fully exploit available household level micro-data, our analysis follows the framework used in certain researches, but adapts the approaches to make it appropriate for the context of Thailand. The analysis begins with finding the relationship and **the impact of monetary policy, particularly the policy rate, on aggregate economic variables; namely GDP, CPI, house price, stock price, yield, and effective rates**. **Once known, the impact will then be distributed into the household surveys, mainly classified into three different channels.** The first channel considers the earnings composition of household from wage and business profits. The second channel is the saving remuneration channel, focusing on net financial position of households, both net savers and borrowers. The third channel is the asset price channel, through capital gains that each household earns from financial assets. After the impact on all available households is distributed, it is compiled into quintiles. This would distinguish the difference across groups, and allows us to determine which channel is the most effective.

From a macro perspective, the results obtained from our SVAR model are consistent with conventional macroeconomic theories which state that expansionary monetary policy produces a positive impact on output and prices, whilst negatively affects bond yields and effective rates. In terms of the distributional impact of monetary policy, it is found that wealthy households are more sensitive to monetary policy shocks through asset price and earnings composition channel, based on the assumption that the SVAR model yields symmetric results for contractionary and expansionary monetary policy. This supports the notion that the implementation of expansionary monetary policy may increase income and wealth inequality. Our study also makes a remark about aged citizens who are likely to lose from a lowering of the policy rate as net savers, unlike others who receive benefits as net borrowers.

The remainder of the paper is organized as follows. Section 2 provides the literature review regarding the distributional impact of monetary policy on income and wealth in other countries, along with research on the impact of monetary policy on the Thai economy. Section 3 describes the framework, data, and approaches taken to study the distributional impact of monetary policy in Thailand. Section 4 shows the results of the impact of monetary policy on the aggregate economy using SVAR analysis. Section 5 shows results of the study through the lens of income, wealth and age distribution. Section 6 provides further discussions on consumption, housing, and household debt to provide a better understanding of the behavior of Thai households. Finally, Section 7 concludes.

4. "Household Socio-Economic Survey". http://www.nso.go.th/sites/2014en/Pages/survey/Social/Household/The-2017-Household-Socio-Economic-Survey.aspx

2. Related Literature

Research analyzing the distributional impact of monetary policy on households, namely on income and wealth inequality, has received growing attention. There is a great deal of research that focuses on the distributional impact from conventional monetary policy, for instance, Romer and Romer (1999) or Bunn et al. (2018). After the global financial crisis, unconventional monetary policies were used and prompted researchers to investigate its distributional impact as well, notably Casiraghi et al. (2017). With regard to the examination of the impact of conventional and unconventional monetary policy on income and wealth inequality, results are still ambiguous and sometimes negligible in several countries (Colciago et al., 2019).

In Thailand, however, the number of studies that investigates the relationship between monetary policy and income and wealth inequality is fairly limited. Only the impact of monetary policy on aggregate economy is well known. Disyatat and Vongsinsirikul (2003) studied the monetary transmission mechanism in Thailand from 1993 to 2001. They found that monetary policy is effective mainly through the interest rate channel, in which investment is sensitive and banks act as a conduit for the pass-through to the real sector. Concurrently, they also found evidence of the pass-through from the credit channel, the exchange rate channel and the asset prices channel to a lesser extent. All these findings serve as the foundation for monetary policy analysis in this chapter.

3. Methodology and Data

The methodology used in this analysis is based mainly on Casiraghi et al. (2017), which can be roughly divided into two parts; the impact of monetary policy on the aggregate economy and the mapping of the distributional impact on aggregate economy to household profiles (Chart 2). However, different from Casiraghi et al. (2017) who estimates multiple sets of single equations for the Bank of Italy quarterly model of the Italian economy (BIQM), our analysis is based on the estimation of a Structural Vector Autoregressions (SVARs) analysis for the aggregate economy.

Chart 2
Flow Chart Represents the Structure of Methodology

Estimation of the impact of monetary policy on aggregate economy.

Estimates effects of contractionary policy on a large set of economic variables.

Using sets of SVARs model with multiple sets of restrictions on macroeconomic variables, interest rates, and asset prices.

Mapping of the distributional impact on aggregate economy to household profiles.

Analysis using effects from expansionary monetary policy, assuming symmetrical impact with contractionary policy.

Using Thailand's household socio-economic survey (SES), we update each household's economic and financial position at the most disaggregated level, through earnings composition channel, savings remuneration channel, and asset prices channel.

Compare differences across income, wealth, and age quantile groups.

3.1 Impact of Monetary Policy on Aggregate Economy

To capture the effect of monetary policy on aggregate economy, we have selected a number of variables to be estimated as listed in Table 1. By estimating macroeconomic variables, interest rates, and asset prices, all the main transmission channels of monetary policy will be covered.

Table 1
List of Variables

Macro Variables	Interest Rates	Asset Prices
GDP	Policy rate	House prices
CPI	Deposit rate	Bond prices
Labor earnings	Bond rate	Stock prices
Business profits	Lending rate	

GDP denotes chained-link gross domestic product taken from the National Economic and Social Development Board. CPI denotes headline consumer price index taken from the Bureau of Trade and Economic Indices. For Labor earnings or wages, we use average nominal non-agriculture earnings from the International Labour Organization. For business profits, the corporate profits are used as a proxy, and are taken from the Stock Exchange of Thailand. For interest rate variables, the Bank of Thailand provides database for 1-day Repurchase Rate (RP1D), New Loan Rate (NLR)[5] combines with the Minimum Retail Rate (MRR), and 3-month deposit rate (D3M) to represent policy rate, lending rates, and deposit rates respectively. For bond rates, we use the average 2-year government bond yield (B2Y) from the Thai Bond Market Association. For asset prices, we use the Stock Exchange of Thailand Index (SET) to represent stock prices, and use the house price index (HOUSEP) from the Government Housing Bank and commercial banks database composited by the Bank of Thailand. All variables are quarterly data. The range of time series for each variable is varied, with the longest dating back to 1993Q1. The estimation period used will be up to 2017Q4. The summary of statistics can be found in Table 2.

Table 2
Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP (mn)	106	1780.4	485.6	1067.2	2702.0
CPI (Index)	98	83.1	14.4	55.2	102.9
Wage (Baht)	74	10872.8	2550.7	7464.9	14724.8
Corpprof (mn)	76	209.0	58.7	1	329.0
RP1D	102	3.8	4.1	0.7	21.0
B2Y	76	2.7	1.0	1.3	5.3
MRR	76	7.8	0.8	6.2	9.0
D3M	76	1.9	0.9	0.8	4.0
SET (Index)	106	940.0	456.8	245.8	1805.8
HOUSEP (Index)	106	140.6	33.6	90.8	209.8
Bond Price (Index)	50	106.3	2.7	100.3	113.3

5. New Loan Rate is the weighted average of interest rates on new loan contracts extended by 14 Thai commercial banks each month. The loan contracts exclude consumer loans, credit card loans, repurchase agreements, bank guarantees, as well as loans extended to financial intermediaries, the public sector and non-residents. The dataset covers loans with value of 20 million baht or higher for all loan types, purposes and maturities, and includes both secured and unsecured loans. Moreover, interest rates used in the calculation refer to the mid-rate between the lowest and the highest rates in each loan contract.

3.2 Mapping of the Distributed Impact to Household Profiles

The results from the SVAR model are then mapped onto household-level data, assuming a symmetric impact between contractionary and expansionary monetary policy. We make every effort to update all related items. However, due to the lack of some information, several assumptions are made through the mapping process. Three transmission channels will be considered in this study: earnings composition, savings remuneration and asset price channels. According to Casiraghi et al. (2017), these channels can be summarized respectively by the equations below.

$$YN_{i,t} = YL_{i,t} + \pi_{i,t} + AY_{i,t} \quad (1)$$

$$YF_{i,t} = r_{d,t}D_{i,t-1} + r_{b,t}B_{i,t-1} - r_{l,t}L_{i,t-1} + AFY_{i,t-1} \quad (2)$$

$$GW_{i,t} = P_{h,t}H_{i,t} + P_{b,t}B_{i,t} + P_{a,t}A_{i,t} + D_{i,t} \quad (3)$$

$$W_{i,t} = GW_{i,t} - L_{i,t} \quad (4)$$

From the earnings composition in (1), the main sources of income are considered. Households mostly receive wages as their main income, while those who are self-employed rely on business profits. Thus, non-financial income ($YN_{i,t}$) is composed of labor earnings or wages ($YL_{i,t}$), business profits ($\pi_{i,t}$), and other income such as transfers ($AY_{i,t}$). From savings remuneration in (2), interest income and payments are considered. This financial income ($YF_{i.t}$) is composed of interest received from deposit rate ($r_{d,t}$) times amount of deposits ($D_{i,t-1}$), interest received from bond yield ($r_{b,t}$) times amount of bond holding ($B_{i,t-1}$), and other financial income ($AFY_{i.t}$), but deducted by interest paid from lending rate ($r_{l,t}$) times amount of loans ($L_{i,t-1}$). Finally, for asset prices in (3), it considers the value of asset holdings from the wealth perspective. The amount of gross wealth ($GW_{i,t}$) is composed of house price ($P_{h,t}$) times number of house holding ($H_{i,t}$), bond price ($P_{b,t}$) times amount of bond holding, stock price ($P_{a,t}$) times amount of stock holding ($A_{i,t}$), and amount of deposit. However, these holdings of assets might not come from income alone, but can also come from borrowings. Thus, to consider net wealth ($W_{i,t}$), gross wealth has to be deducted by the amount of loans as in (4).

3.2.1 Earnings Composition Channel

Based on equation (1), only three components of household non-financial income, labor earnings, business profits and transfers, are allowed to respond to a change in the policy rate. Labor earnings are regarded as the main source of income for the majority of Thai households, according to the household socio-economic survey. As a number of studies show that labor earnings are not only determined by macroeconomic variables, but also by the characteristics of workers, we construct an auxiliary equation to estimate the effects of monetary policy in order to control for such factors. A further explanation of the construction and estimation of the auxiliary equation will be given in Section 5. Apart from labor earnings, it appears that the sum of business profits is large amongst high-income households whilst low-income ones rely heavily on transfers. However, the impacts on transfers are ignored as we firmly believe that it would depend on fiscal policy rather than monetary policy.

3.2.2 Savings Remunerations Channel

Interest receipts and payments pertaining to the informal financial sector are excluded from the analysis because we do not know whether or not non-bank lenders adjust their lending rates in accordance with the policy rate. Due to the absence of information about the interest rates at the household level, it is presumed that banks offer the same deposit and lending rates to households, and all rates are adjustable with regard to the policy rate.

3.2.3 Asset Price Channel

By the supposition that a change in policy rate affects only house and stock prices, the outstanding values of other assets such as savings and bonds remain constant throughout the analysis. However, since we are unable to disaggregate bond and equity, the ratio of bond to equity, which equals to 40:60, is applied to all households. The figure is obtained from the Flow of Funds Accounts published by the National Economic and Social Development Council (NESDC) in 2017 where data on bond and equity owned by households are reported at the national level. Apart from that, it is also assumed that there is no shift in the composition of household assets after the policy rate changes, e.g. if the policy rate falls, stock prices will increase, but households will not sell stocks to buy a new house.

Micro data from the Household Socio-economic Survey (SES) administered by the National Statistical Office (NSO) are taken to estimate the distributional impact of monetary policy. The full dataset containing all information on household income, expenditure and wealth is released once every alternate year. This study uses the most recent observations which were released in 2017. Aside from the aforementioned, the SES also provides details of family compositions that allows us to scrutinize various aspects of the effects of monetary policy.

Table 3 presents some descriptive statistics of Thai households in the year of 2017. On average, the family size in Thailand is relatively small compared with other countries, for instance, the Philippines. Two out of three members aged between 15 and 60 years old are supposed to generate revenue for individual households. It is also noticeable that the average age of the household head who mainly gives financial support to the whole family is around 54, meaning that he or she will leave the job market shortly since Thai citizens generally retire at the age of 60.

Table 3
Descriptive Statistics of Thai Households Survey 2017

	Mean	Min.	Max.	S.D.
Characteristics				
- No. of household members[1]	2.8	1	13	1.5
- Age < 15 yrs.	0.5	0	7	0.8
- Age > 60 yrs.	0.6	0	5	0.8
- Age of household head[2] (yrs.)	53.7	13	99	15.2
Income and Expenditure (usd*)				
- Income per month[3]	898.2	-4,994.8	99,758.7	1,416.4
- Expenditure per month	714.6	25.7	72,649.2	659.6
Wealth (thousand usd)				
- Assets[4]	57.0	0.0	14,232.1	111.7
- Outstanding debt	6.0	0.0	1,000.0	18.0
- Net wealth	51.0	-832.0	14,232.1	109.0

Remarks:

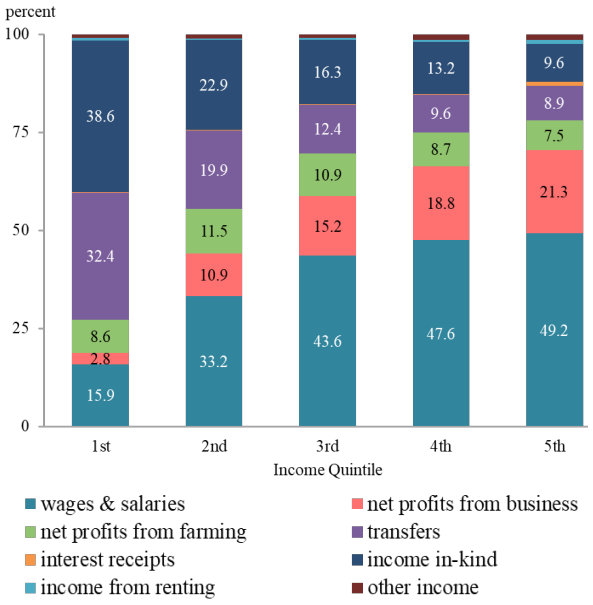
1. Excluding servants.
2. Age of the household head is top-coated at 99.
3. Income includes net profits from business and farming which are allowed to be negative.
4. Assets are comprised of dwelling, land and building for business, vehicles and financial assets

*. 1 U.S. Dollar is approximately equal to 30 baht.

Regarding household income and expenditure, it is found that the minimum of earnings is negative whilst the lowest expense is greater than zero. This indicates that some households make a loss from running a business or farming during the year but have to spend some money to maintain their livelihood. Likewise, the wealth statistics show that some households do not have any assets but take out loans. By taking these two numerical facts into consideration, it can be conjectured that a number of Thai households need to borrow money to finance consumption.

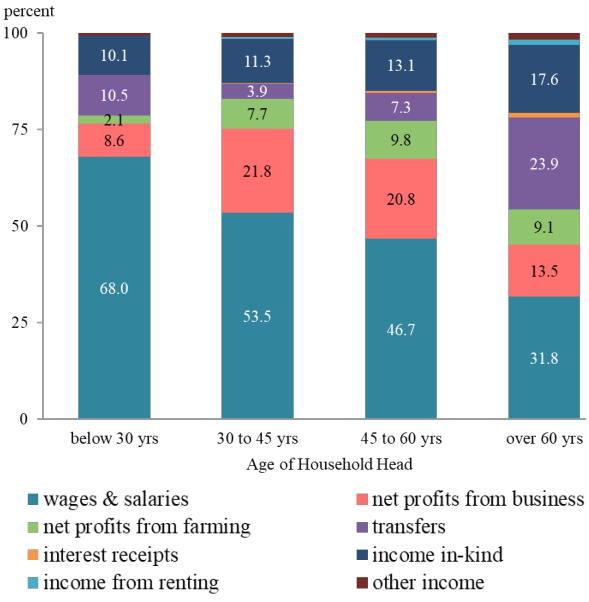
The composition of household income by income group is exhibited in Chart 3. A key difference between the richest and poorest group is that impoverished families rely on transfers and income in-kind whereas well-off families earn money by working. Moreover, the proportion of wage and salary plus net profits from business and farming gets higher as households become richer. Chart 4 depicts the income compositions classified by age group. The age of the household head is chosen as a proxy for each family. A share of wage and salary in total income is smallest for the group of people over 60 years old. This is very logical since most of them are, perhaps, retired.

Chart 3
Composition of Income by Income Group (2017)



Source: The National Statistics Office, Authors' calculations

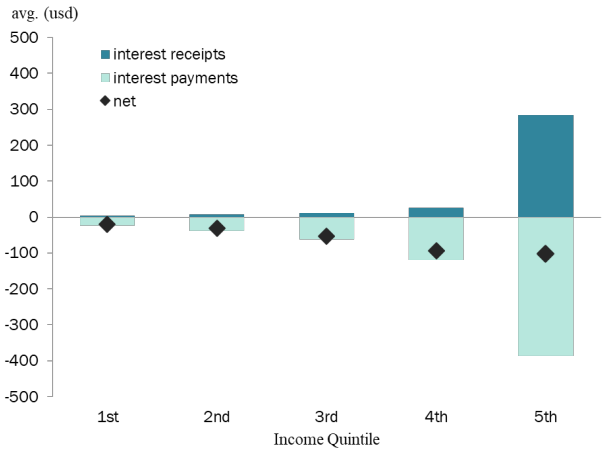
Chart 4
Composition of Income by Age Group (2017)



Source: The National Statistics Office, Authors' calculations

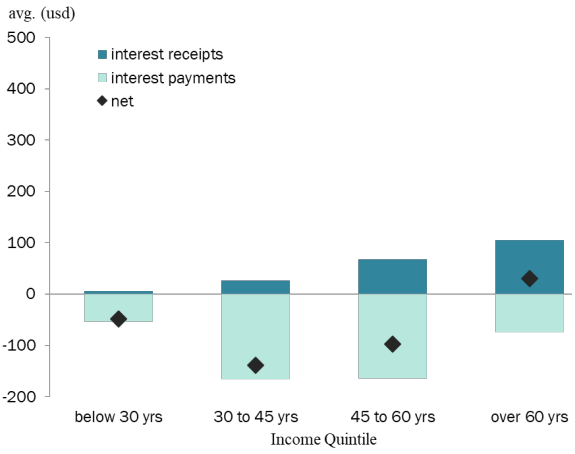
Regarding interest receipts, it is observed from both charts that their share in the total income is miniscule. However, it is worth noting that such data is reported on a net basis, and therefore may mask the fact that households are both borrowers and lenders at the same time. In this case, based on 2017 data, Thai households were found to be net borrowers, for every income group (Chart 5). Such a finding could be a cause for concern, particularly as it is revealed that aging households are still shouldering significant interest burdens (Chart 6).

Chart 5
Interest Receipts and Payments by Income Group (2017)



Source: The National Statistics Office, Authors' calculations

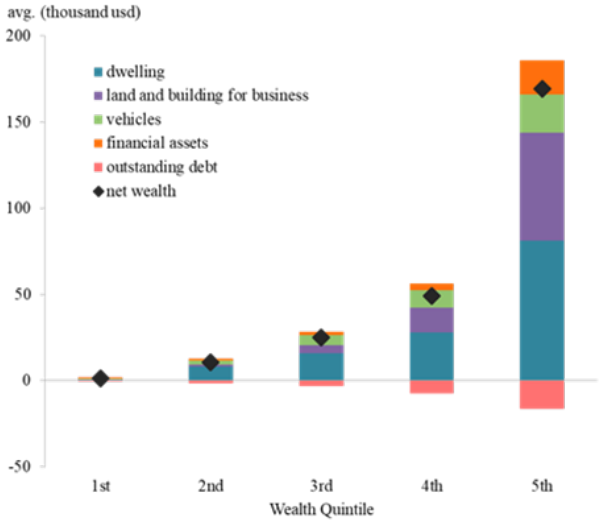
Chart 6
Interest Receipts and Payments by Age Group (2017)



Source: The National Statistics Office, Authors' calculations

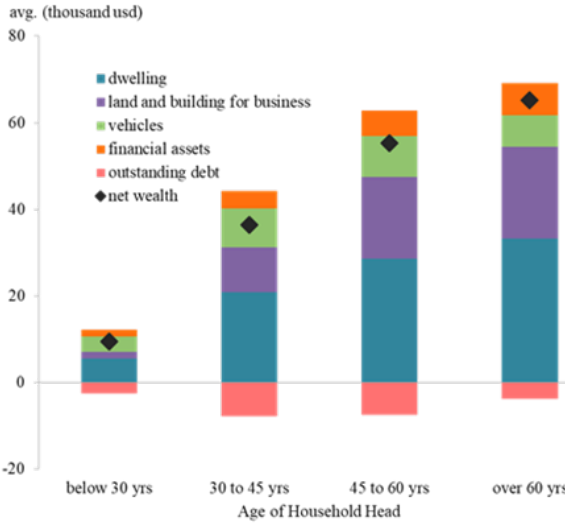
Thai households generally accumulate wealth by acquiring assets such as houses and land. Deducting gross wealth by the outstanding value of liabilities yields net wealth displayed in Chart 7. The majority of assets owned by households are dwellings, followed by land and buildings for business use. Financial assets, on the other hand, are mostly held by the wealthiest group. Outstanding debt increases together with gross wealth but at a slower pace. Chart 8 illustrates net wealth categorized by age group. Net wealth rises as people grow older, although 30-to-60-year-old heads owe much higher debt than the younger ones.

Chart 7
Net Wealth by Wealth Group (2017)



Source: The National Statistics Office, Authors' calculations

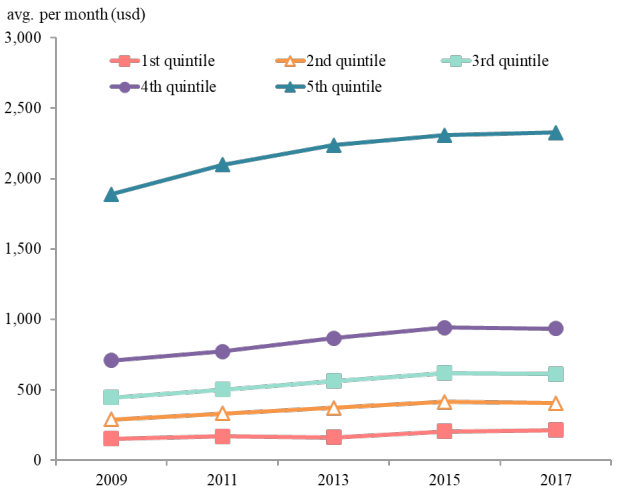
Chart 8
Net Wealth by Age Group (2017)



Source: The National Statistics Office, Authors' calculations

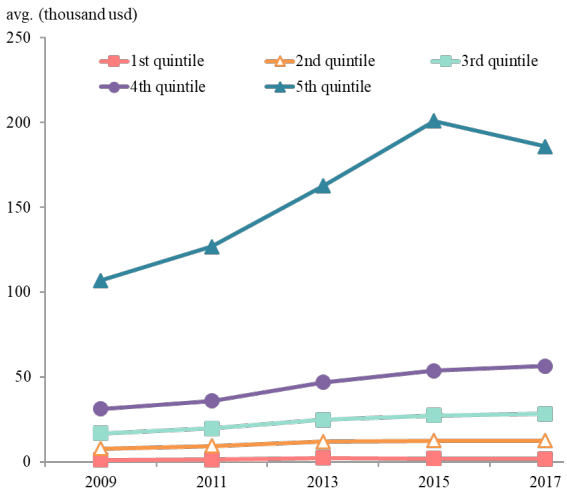
At the national level, Chart 9 and 10 exhibit the gap between the rich and the poor which has widened over the past decade. This signifies that, in Thailand, the attempts to redistribute income and wealth over the past decade have not been successful, and the impacts of monetary policy may either ameliorate or exacerbate this concern.

Chart 9
Thailand's Household Income Distribution (2009 - 2017)



Source: The National Statistics Office, Authors' calculations

Chart 10
Thailand's Household Wealth Distribution (2009 - 2017)



Source: The National Statistics Office, Authors' calculations

4. Analysis of Monetary Policy Impact on Aggregate Economy

Using SVARs as the main approach, we are able to estimate the impact of monetary policy on aggregate economy as it captures the dynamic effects of a policy shock on variables of interest. However, there are some drawbacks and limitations using a single SVAR as we have a fair number of variables of interest. It becomes too complicated for the system and impractical to check consistency and significance when all of them are estimated at the same time. To solve this problem, we use multiple sets of smaller SVARs instead with restrictions as represented in Chart 11.

Chart 11
SVAR Restrictions by Model

Macroeconomic Model

$$\begin{bmatrix} \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp1d} \\ \varepsilon_{loan} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} \nu_{gdp} \\ \nu_{cpi} \\ \nu_{rp1d} \\ \nu_{loan} \end{bmatrix}$$

Bond Yield Model

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{ffr} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp} \\ \varepsilon_{fx} \\ \varepsilon_{by} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & a_{46} & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & 0 & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{ffr} \\ \nu_{gdp} \\ \nu_{cpi} \\ \nu_{rp} \\ \nu_{fx} \\ \nu_{by} \end{bmatrix}$$

Effective Rates Model

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{ffr} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp} \\ \varepsilon_{fx} \\ \varepsilon_{r} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & a_{46} & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ 0 & 0 & a_{73} & a_{74} & a_{75} & 0 & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{ffr} \\ \nu_{gdp} \\ \nu_{cpi} \\ \nu_{rp} \\ \nu_{fx} \\ \nu_{r} \end{bmatrix}$$

Stock Price Model

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{ffr} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp} \\ \varepsilon_{fx} \\ \varepsilon_{set} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & a_{46} & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{ffr} \\ \nu_{gdp} \\ \nu_{cpi} \\ \nu_{rp} \\ \nu_{fx} \\ \nu_{set} \end{bmatrix}$$

House Price Model

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{ffr} \\ \varepsilon_{ipr} \\ \varepsilon_{cpi} \\ \varepsilon_{nlr} \\ \varepsilon_{fx} \\ \varepsilon_{hp} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & a_{46} & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ 0 & 0 & 0 & a & a & 0 & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{ffr} \\ \nu_{ipr} \\ \nu_{cpi} \\ \nu_{nlr} \\ \nu_{fx} \\ \nu_{hp} \end{bmatrix}$$

For the macroeconomic model, we impose 'recursive' restrictions according to Disyatat and Vongsinsirikul (2003). The ordering listed above is consistent with the assumption about the speed in which variables respond to shocks where output is the last to react, followed by prices and financial market variables. For instance, GDP does not react contemporaneously by the shocks from RP1D, while RP1D can react contemporaneously from innovations in GDP and CPI.

To address the 'prize puzzle' problem[6], as is the case in Disyatat and Vongsinsirikul (2003), we include the bank loans variable (LOAN), which are credits to the non-financial sector from the Bank for International Settlements, into the model as well. However, an adjustment is made by replacing exogenous variables to inflation expectation (INFEXP) taken from Consensus Forecasts, instead of using exchange rate. This is in line with the regime change from exchange rate targeting, thus the use of exchange rate as an exogenous variable in Disyatat and Vongsinsirikul (2003), to flexible inflation targeting regime in the present day.

For remaining models, we impose 'non-recursive' restrictions based mainly from Elbourne (2007), with some adjustments made to fit with our analysis. Here, commodity prices, fed funds rates (FFR), and exchange rate are added to the system. This is because the remaining variables of interest for interest rates and asset prices channel are sometimes linked to and caused by factors other than macroeconomic fundamentals. Furthermore, Thailand's characteristic as a small and open economy makes it susceptible to the external environment. Thus, a recursive structure used in prior models would not be appropriate for estimation, and we need to take into account a wider range of factors in the system. Inflation expectation (INFEXP) is also included as an exogenous variable to represent the inflation targeting regime. Note that in our analysis, money demand is dropped from the system as its importance diminishes over time and its inclusion failed the LR tests. We use Dubai oil price (DUBAI) to represent commodity prices, and USDTHB (FX) for the exchange rate. The ordering of each model is listed as Chart 11, where the variables of interest are ordered last.

For the stock price model, we restrict the system based on Zare et al. (2013). The SET index that represents stock prices is sensitive to shocks that occur in the economy and is swift to respond. Therefore, it is contemporaneously affected by shocks from every other variable in the system. For the bond yield model, similar restrictions are imposed. But only the exchange rate does not contemporaneously affect the bond yield, as the relationship between them is vague in Thailand. For the effective rates model, three variables are used in the same restrictions, namely NLR, MRR, and D3M. We run the model for each of these variables separately. The restrictions omit the contemporaneous effects from the external environment, namely DUBAI, FFR, and FX, as these variables mainly rely on bank decisions. Finally, for the house price model, a few adjustments are needed as the housing market behaves uniquely compared to other variables. We replace GDP with gross fixed capital formation (IPR) as it correlates more with house price[7], and NLR is used as a proxy for policy rates. The model using NLR works because house prices are more sensitive to lending rates as it drives the demand for mortgages, and NLR tracks the movement of central bank's policy actions quite closely.

---

6. In Disyatat and Vongsinsirikul (2003), price puzzles arise when a contractionary policy shock leads to a rise in inflation. An explanation is that policy makers might be able to observe variables that contain information about the future inflation, but they are left out of the model. Then a rise in policy rates might be associated with higher prices because they reflect policy responses to information indicating future inflation. To address this issue in the case of Thailand, bank credit is included in the system as the supply of bank loans is crucial for business investment in Thailand. Inclusion of bank loans helps because GDP and prices respond positively to innovations in bank lending.

7. We have tried replacing GDP with private consumption, as is used in a number of literatures, but the model failed the LR tests and house price did not appear significant in response to shocks of policy rate or lending rates.

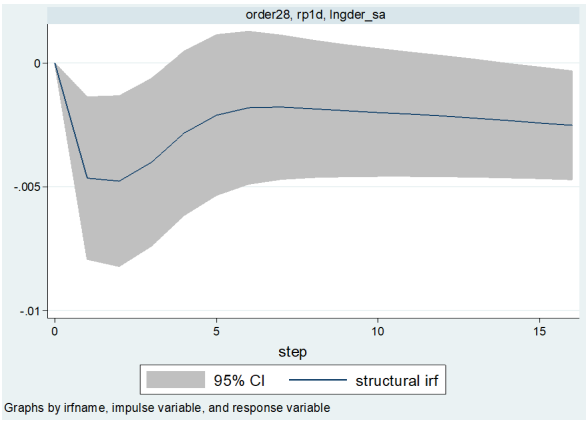
Preparing for SVARs, we ran the unit root test and cointegration test. We found that GDP, CPI, DUBAI, FX, SET, HOUSEP, and LOAN contain unit roots but are cointegrated. Therefore, we use the log transformation on these variables, while leaving the remaining interest rate variables unchanged.

In order to derive the impact of monetary policy on the aggregate economy from SVARs, the impulse response analysis is the key to quantify it. We mainly focus the impulse from RP1D to the response of the variables of interest based on corresponding models explained in the previous section. Starting with the macroeconomic model, the impulse-responses of RP1D to GDP and CPI are shown in Chart 12. The positive shocks from RP1D to GDP and CPI are significant for 8 quarters before reverting to mean. It also has a negative impact on them, which is consistent with theories where contractionary monetary policy leads to a reduction in output and prices through the good and services market and money market. For other macroeconomic variables, we have also tried to add wages and corporate profits into the recursive structure and experimented with different ordering, but to no avail as they are both insignificant. However, the impact on wages will be explained in later sections. For the bond yield and effective rates model, the impulse-responses of RP1D to B2Y, D3M, NLR, and MRR are shown in Chart 13. The positive shocks from RP1D to effective rates and yields are positively significant as expected. The rise in policy rate should drive other corresponding interest rates to rise as well. However, unlike macroeconomic variables, it is significant for only around 3 quarters as they are susceptible to other factors and quick to respond. Finally, for the asset prices model, the impulse-responses of RP1D to SET and HOUSEP are shown in Chart 14[8]. However, different behavior of stock price and house price can be observed. Stock price responds negatively for 2 quarters directly from the shock of the policy rate. On the other hand, house price initially does not respond to RP1D as it is insignificant. But as mentioned above, the replacement with NLR shock as a proxy causes HOUSEP to be significant for 2 quarters. Despite the difference in behavior, they are in line with the theory as rising interest rates drive down the value of the asset prices.

8. We have also tried estimating the impact from the shock of policy rates on bond prices. But the data for bond prices are limited and it is difficult to find a reliable benchmark. The results are also insignificant.

Chart 12
Impulse Response Function of RP1D to GDP and CPI

Gross Domestic Product
Impulse: RP1D, Response: GDP



Consumer Price Index
Impulse: RP1D, Response: CPI

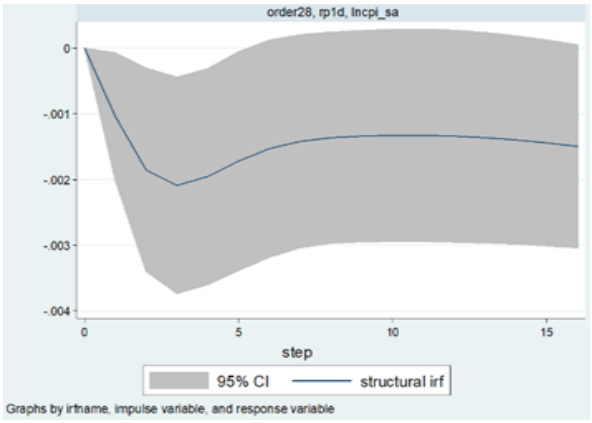
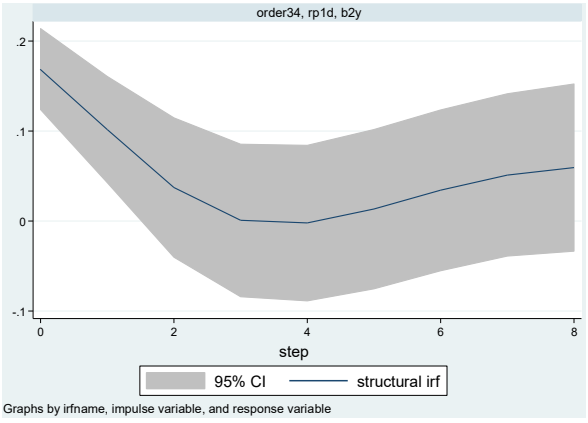
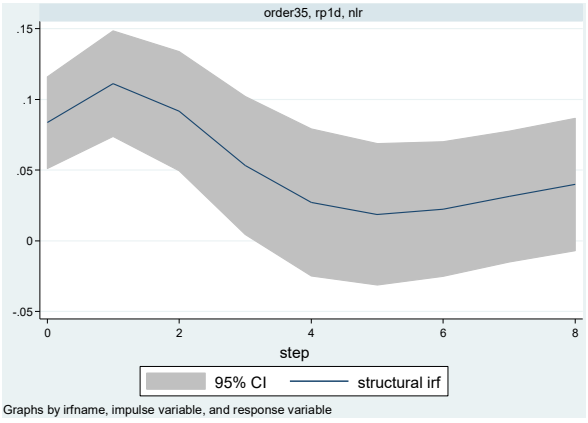


Chart 13
Impulse Response Function of RP1D to B2Y, D3M, NLR, and MRR

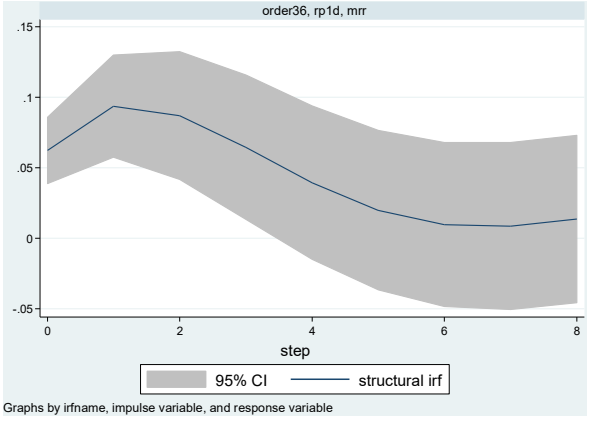
Bond Yield 2Y
Impulse: RP1D, Response: B2Y



New Loan Rate
Impulse: RP1D, Response: NLR



Minimum Retail Rate
Impulse: RP1D, Response: MRR



Deposit Rate
Impulse: RP1D, Response: D3M

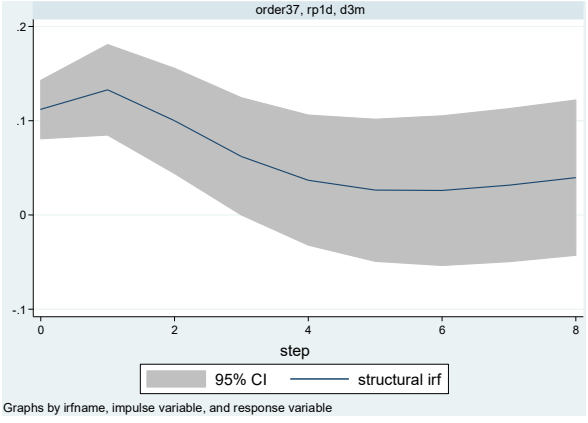
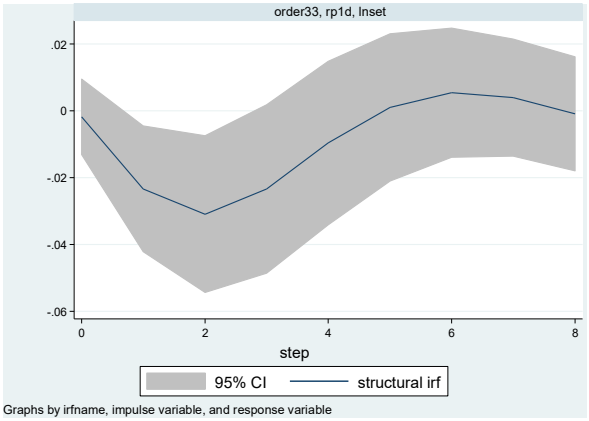
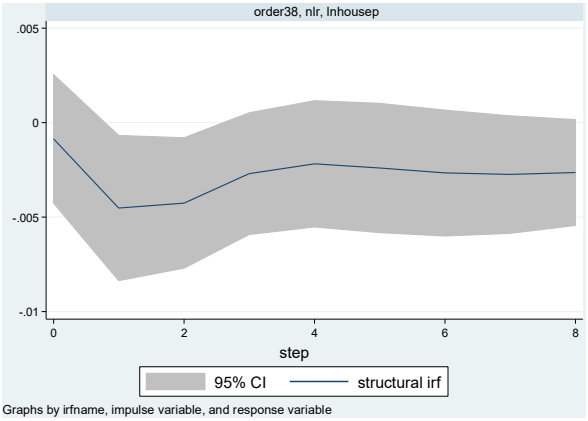


Chart 14
Impulse Response Function of RP1D to SET and HOUSEP

SET Index
Impulse: RP1D, Response: SET



House Price
Impulse: RP1D, Response: HOUSEP



Once we confirm the significance of the variables of interest and check for consistency across the model, we attempt to transform the impulse response estimates into an impact of annual change. For every variable of interest, we set the actual average of 2017 as a starting point. Then we calculate the new value from the response we estimated using coefficients as a growth rate or change, depending on variables, up to 4 quarters[9] going forward cumulatively[10]. After we acquire new values for 4 periods, specifically 4 quarters in 2018, we then find the average and calculate the annual growth or change from 2017. However, positive innovations from RP1D in each model are different; in other words, values in RP1D from 1 S.D. shock in RP1D in each model differs. We need to transform the annual growth or change proportionally the basis of the change from 0.25 percent increase in policy rate[11]. The overall results can be found in Table 4. A full description of the SVARs results are in the Appendix.

9. For HOUSEP, we calculate using coefficients only up to 2 quarters, as it is insignificant after that.
10. For example, to calculate annual change for SET, we first find the average of 2017 from actual data. We then calculate the new SET value in period 0 using coefficient as growth rate in that period. For SET value in period 1, we use new SET value in period 0 as a base and use coefficient in period 1 as a growth rate. We keep doing this up to period 4.
11. For annual growth of HOUSEP from NLR shock, we derived the annual change of NLR from a rise of 0.25% in RP1D first before using it to calculate HOUSEP growth.

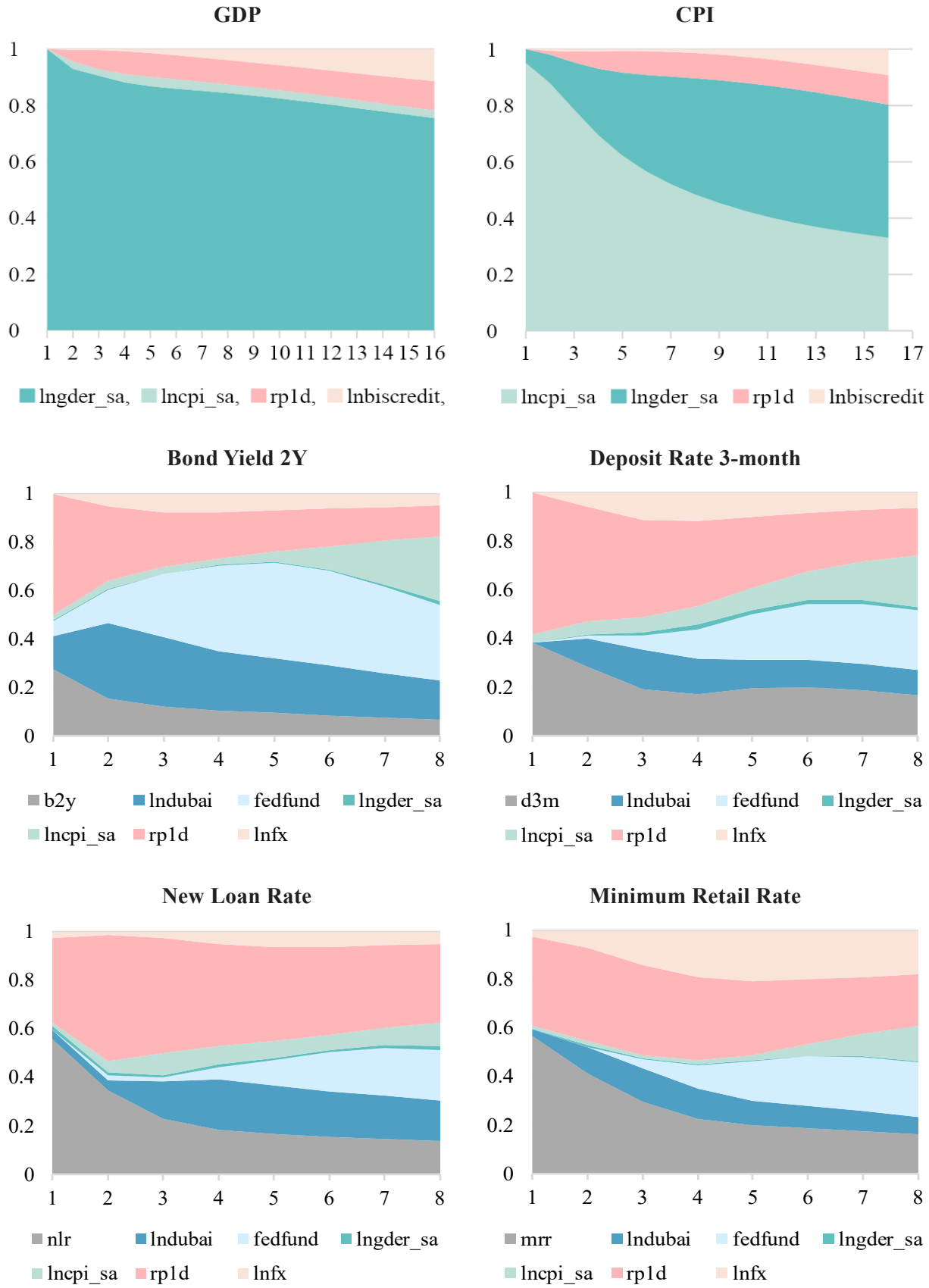
Table 4
Results from the Transformation of IRF into Annual Growth or Change

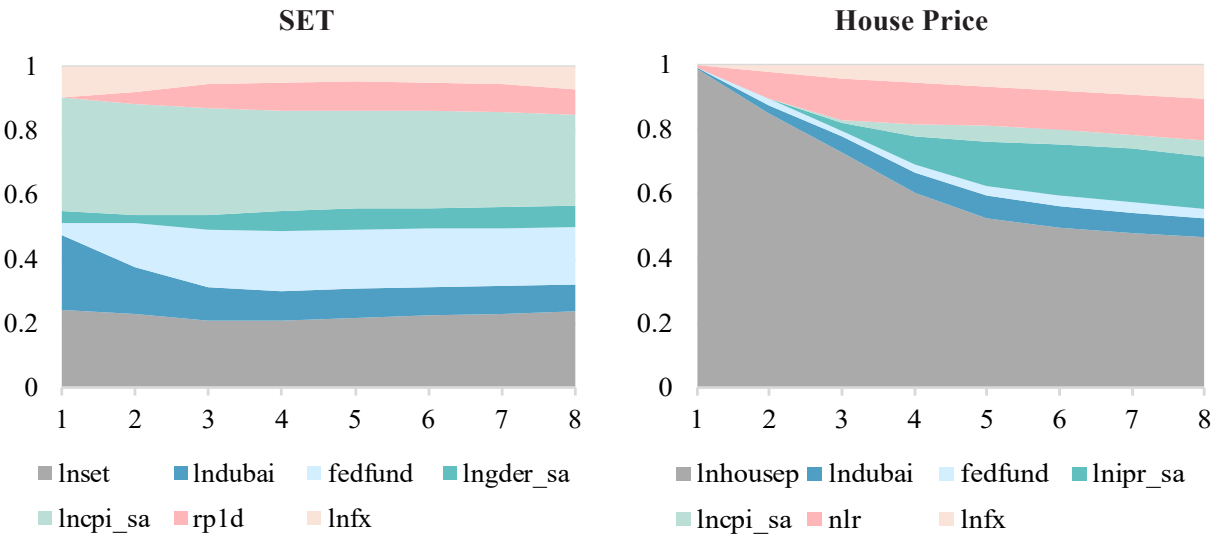
Variables	lnGDP	lnCPI	B2Y	D3M	MRR	NLR	lnSET	lnHOUSEP
Average 2017	2546.83 bn	100.85	1.53%	1.03%	7.94%	4.00%	1612.83	192.53
Annual change from 1 S.D. Shock	-1.62%	-0.69%	0.31%	0.44%	0.35%	0.37%	-5.53%	-0.96%
Value of 1 S.D. RP1D	0.2%	0.2%	0.14%	0.13%	0.14%	0.15%	0.14%	0.13% (1 S.D. NLR)
Annual change from 0.25% increase in RP1D	-2.02%	-0.87%	0.55%	0.85%	0.62%	0.61%	-9.87%	-4.51%

Chart 15 summarizes the share of fluctuations through the variance decompositions for each variable of interest caused by the shock from RP1D. For macroeconomic variables GDP and CPI, RP1D accounts for around 8 percent of the fluctuation in output and price after 1 year, while own shocks account for almost the rest. We see diminishing effects of policy rates on macro economy overtime when compared to the results from Disyatat and Vongsinsirikul (2003) for which policy rate accounted for 35 percent in output, despite the difference in the type of policy rate used[12]. For yield and effective rates, however, the fluctuations came considerably from RP1D of around 30-40 percent. It is as expected since policy actions from the central bank are an important factor to determine banks' and financial markets' activities. For stock price, RP1D accounts for around 8 percent, which is less than interest rates as it is susceptible to various factors. Finally, for house price, the lending rate, which also acts as a proxy for policy rates, accounts for around 10 percent of the fluctuations.

12. Disyatat and Vongsinsirikul (2003) used 14-day Repurchase Rate as policy rate at the time. But since January 2007, the Bank of Thailand has used 1-day repurchase rate (RP1D) as the policy rate.

Chart 15
Variance Decomposition Analysis from the Shock of RP1D





Amid global economic slowdown, financial market volatility, and subdued inflation, the Bank of Thailand has been holding its policy rate constant at 1.5 percent from 2015 to 2018. This somehow creates a low-for-long environment in the economy, where the behavior of economic agents might be distorted and are no longer a direct function of the level or change in the policy rate. In the case of Thailand, for instance, this low-for-long environment has incentivized households to search for higher yields in other assets, particularly real estates. Therefore, it is possible that such speculative demand has been contributing to a rise in real estate prices, despite the policy rate remaining unchanged.

In attempting to address this problem, we have also performed robustness checks on the results we found with counterfactual analysis, adapting the approach from Kapetanios et al. (2012). Instead of interpreting results directly from SVARs, we forecast and compare the annual difference from two scenarios; 'Baseline scenario' where RP1D are held constant from 2015 to 2017 and 'Hiking scenario' where RP1D increases by 25bps every quarter from 2015 to 2017. To do this we set the starting point at 2017Q4 and forecast the variables of interest using RP1D in the Baseline scenario for 4 periods up to 2018Q4. We then replace RP1D with the Hiking scenario and forecast for the same 4 periods, while maintaining estimates and holding other variables in the system constant. Finally, we calculate the difference in average value from both scenarios. The results can be seen in Table 5. Despite the difference in magnitude, they do not differ much from impulse response analysis in terms of overall impact.

Table 5
Forecast Difference in Average Value from Baseline and Hiking Scenario

Variables	lnGDP	lnCPI	B2Y	D3M	MRR	NLR	lnSET	lnHOUSEP
Forecast difference	-0.58%	-0.31%	0.52%	1.09%	0.23%	0.72%	-2.25%	-0.74%

5. Analysis of the Distributed Monetary Policy Impact on Household Profiles

This study focuses merely on the employed. A change in the policy rate is assumed to exert no effect on the decision to enter or leave the workforce. The presence of heterogeneity in labor earnings has been widely discussed in literature. In the case of Thailand, for example, Warunsiri and McNown (2010) construct models to estimate the returns to education by taking unobserved heterogeneity into account. Such heterogeneity is often referred to the ability or motivation to work varied by the characteristics of workers. It is, therefore, useful to incorporate data from the Labour Force Survey (LFS), which is conducted by the NSO as well, into our estimation to control for individual-specific effects.

The NSO, in fact, collects data on wages and workers' characteristics on a monthly basis. The data are, however, regarded as repeated cross-sections because the same respondents are not required to complete the survey every month, but even so, it is still able to create pseudo-panel data defined by geographical area, gender, marital status and the level of education. Five years of the survey, from 2013 to 2017, are used to obtain 1,224 clusters in total. After that, the following equation is estimated using fixed effect regression.

$$ln(w)_{i,t} = \beta_0 + \beta_1 * age_{i,t} + \beta_2 * ln(gdpr)_t + \beta_3 * ln(cpi)_t + \beta_4 * LIS_t + \varepsilon_{i,t} \quad (5)$$

where i indexes individual groups of workers, and j indexes year. w denotes monthly labour income in nominal terms which includes wage / salary, overtime pay and bonus. age denotes the average age of workers as a proxy of working experience. $gdpr$ and cpi denote real GDP and Consumer Price Index. LIS denotes the percentage of labor income share to GDP[13]

Real GDP and headline inflation are employed as linkages between the policy rate and wage. The labor income share to GDP is added to the equation above for two reasons. One is to measure the gap between wage and productivity. If labor income share to GDP rises, it implies wage paid to workers is greater than labor productivity per se, so the employer will cut down employment, and wage will eventually go down (Conway et al., 2015). The relationship between labor income share and wage is thus expected to be negative. The other one is that a decrease in labor income share to GDP implies an increase in capital share to GDP, given only two factors, labor and capital, are used in production. As automation has received growing attention, an increase in GDP may not induce employment but investment in machinery and equipment in lieu. Including such a variable is, therefore, supposed to capture this phenomenon and help reduce bias towards the coefficient of real GDP.

Table 6 presents the estimates of the wage equation (eq. 5). Test-statistics are computed using clustered standard errors that are robust to heteroscedasticity and correlations across groups of workers. All coefficients are statistically significant at any conventional significance level. We find that a 1 percent increase in real GDP and CPI leads labor earnings to increase by 0.3 percent and 0.7 percent, respectively. Since a 25-basis-point decrease in the policy rate causes real GDP and CPI rise equally by 0.6 percent year-over-year, labor earnings are expected to rise by 1.2 percent year-over-year for all households.

13. See ILO (2019) for the methodology in detail

Table 6
Estimates of the Wage Equation

Dep. var. = ln (wage)	Coefficient
age	0.016*** (0.002)
ln (gdpr)	0.292*** (0.043)
LIS	-0.024*** (0.002)
ln (cpi)	0.707*** (0.196)
constant	4.015*** (0.957)
Adjusted R^2	0.19
F-statistics	163.23

Numbers in parentheses are clustered standard errors.
*** indicates significance at 1% level.

The effects of expansionary monetary policy via the three transmission channels are illustrated in Chart 16 to 36. The results are calculated both in cash terms and as percentage of income or gross wealth. Changes in labor earnings and net interest receipts affect household income whilst changes in asset price affect household gross wealth.

Chart 16
Effects on Income by Income Group in Cash Terms

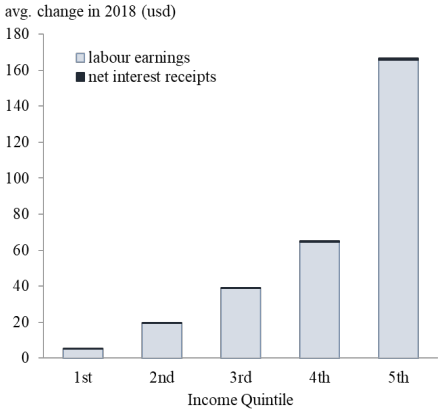


Chart 17
Effects on Income by Wealth Group in Cash Terms

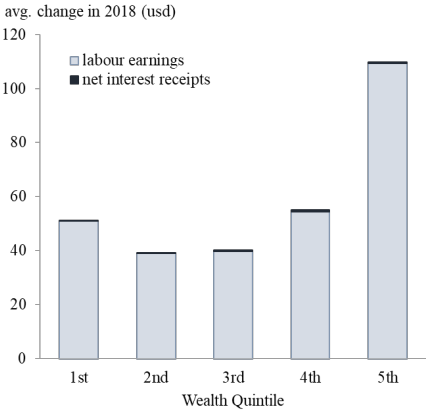


Chart 18
Effects on Income by Age Group in Cash Terms

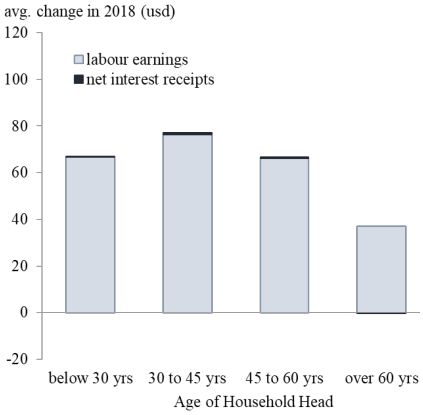


Chart 19
Effects on Income by Income Group as Percentage of Income

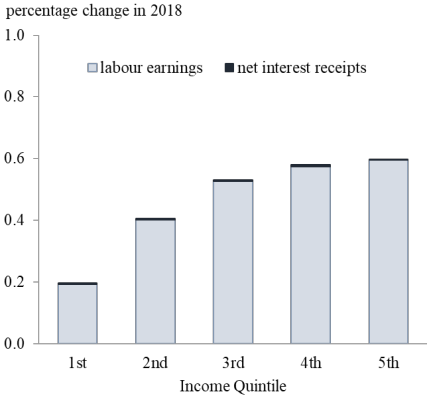


Chart 20
Effects on Income by Wealth Group as Percentage of Income

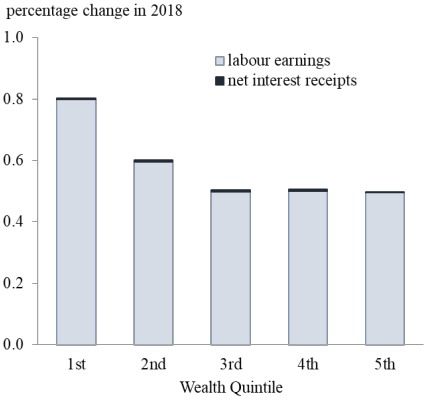


Chart 21
Effects on Income by Age Group as Percentage of Income

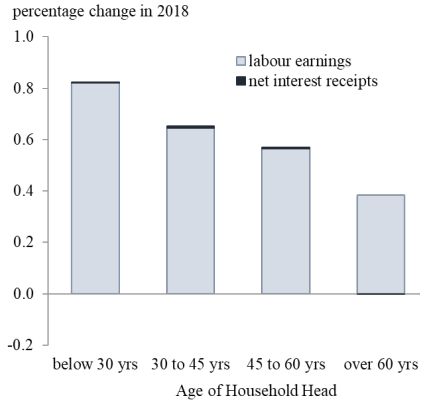


Chart 22
Effects on Wealth by Income Group in Cash Terms

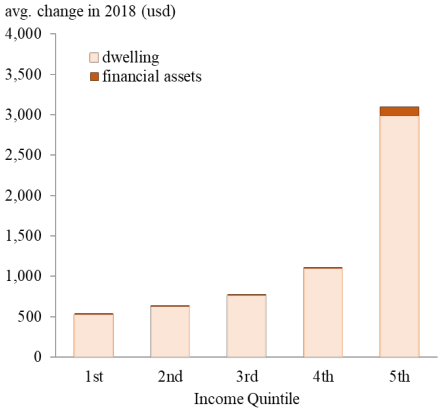


Chart 23
Effects on Wealth by Wealth Group in Cash Terms

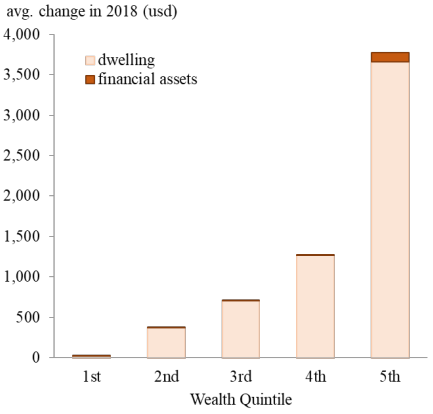


Chart 24
Effects on Wealth by Age Group in Cash Terms

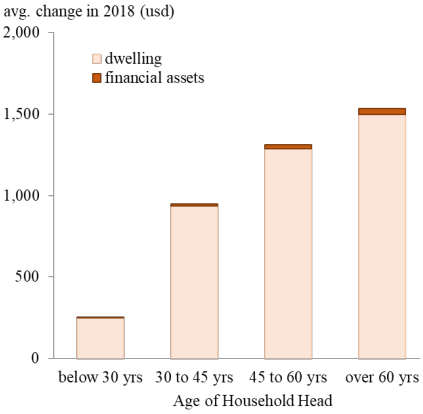


Chart 25
Effects on Wealth by Income Group as Percentage of Wealth

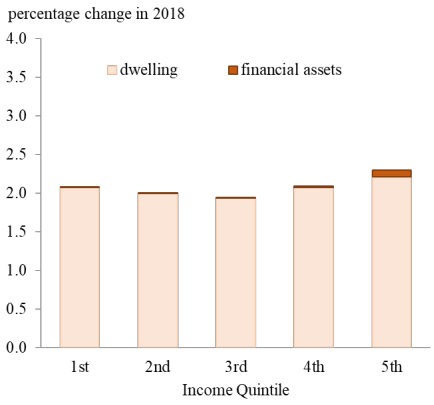


Chart 26
Effects on Wealth by Wealth Group as Percentage of Wealth

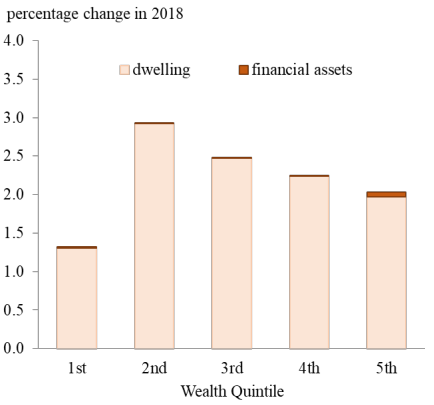


Chart 27
Effects on Wealth by Age Group as Percentage of Wealth

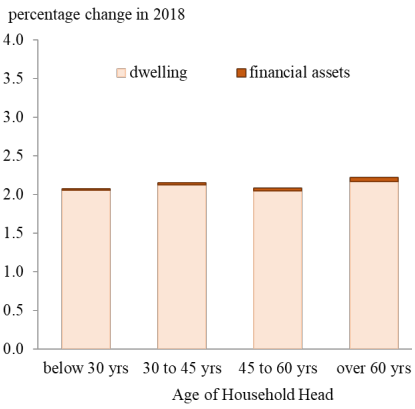


Chart 28
Effects on Income and Wealth by Income Group in Cash Terms

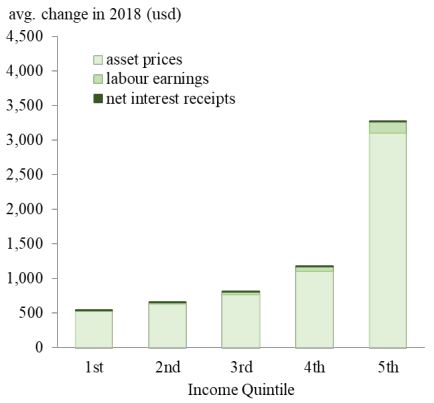


Chart 29
Effects on Income and Wealth by Wealth Group in Cash Terms

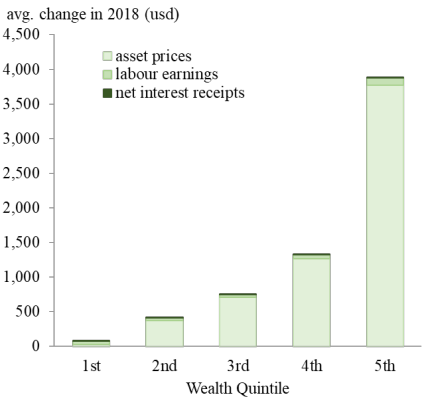


Chart 30
Effects on Income and Wealth by Age Group in Cash Terms

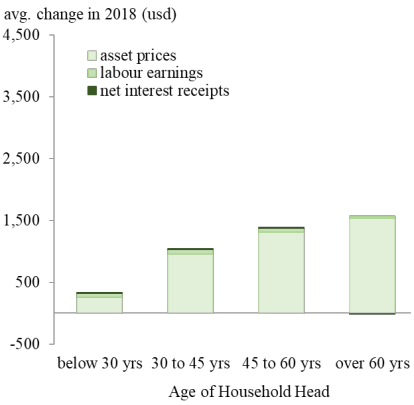


Chart 31
Effects on Income and Wealth by Income Group as Percentage Change of Income

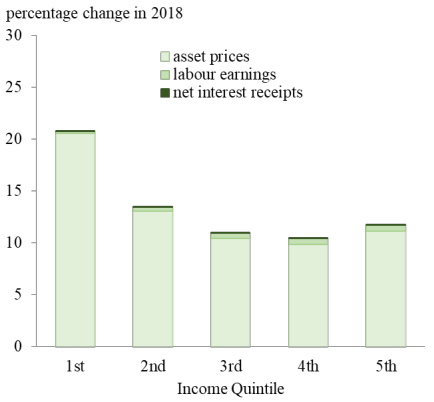


Chart 32
Effects on Income and Wealth by Wealth Group as Percentage Change of Income

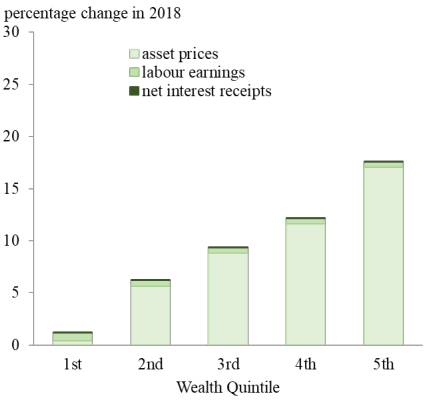


Chart 33
Effects on Income and Wealth by Age Group as Percentage Change of Income

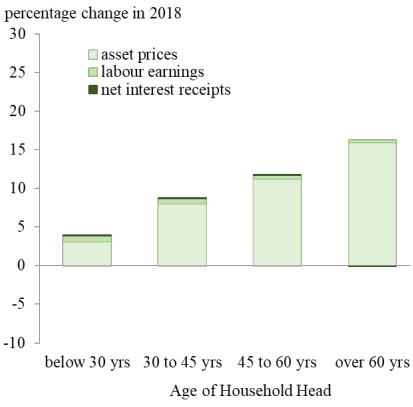


Chart 34
Effects on Income and Wealth by Income Group as Percentage Change of Wealth

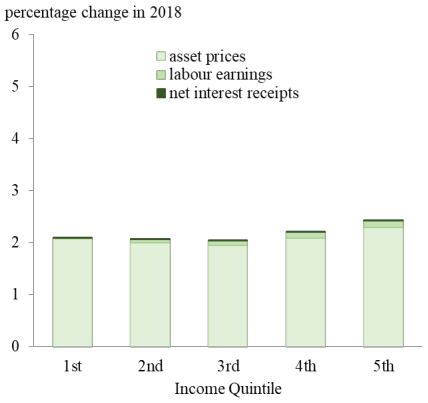


Chart 35
Effects on Income and Wealth by Wealth Group as Percentage Change of Wealth

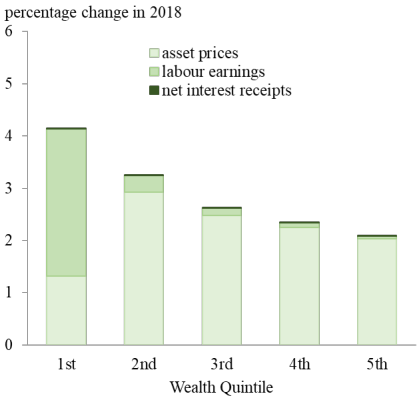


Chart 36
Effects on Income and Wealth by Age Group as Percentage Change of Wealth

Source: Authors' calculations.

The magnitude of the effects on households depends on three components: the interest rate sensitivity estimated by the SVAR model, the composition of income and wealth and the initial values of labor earnings, net interest receipts and assets reported in the SES.

Overall, in cash terms, Chart 28 to 30 show that **the implementation of monetary policy produces the largest effect on households through the asset price channel, followed by earnings composition and the savings remuneration channel.** Nonetheless, in terms of the percentage change of wealth, it is observed that households at the bottom quintile of the wealth distribution are mostly affected through the earnings composition channel, as shown in Chart 35, due to the lowest value of labor earnings they have at the beginning of the analysis, i.e. the lowest denominator.

The effects on household wealth are mainly caused by an increase in housing value. This is not only because of the interest rate sensitivity, but also a significant difference between the values of two assets owned by households. On the other hand, the effects on household income mainly occur from a rise in wages and salaries of which the share in the total income are considerably larger than that of net interest receipts. However, it is worth noting that expansionary monetary policy may produce a disproportionately negative effect on the elderly, who are net savers, via the saving remuneration channel, although Thai households, in general, are able to reap some benefits as net borrowers.

6. Discussion

Our empirical findings shed light on a low-for-long rate environment in Thailand. First, according to conventional macroeconomic frameworks, for instance, the Representative Agent New Keynesian (RANK), it is stated that the policy rate cut leads households to take out more consumer loans, hence causing aggregate consumption to increase. This is supported by Chuchurd (2006) and Suwanik and Peerawattanachart (2018) which demonstrate that the consumption of goods and services by poor households in Thailand can be increased by debt due to liquidity constraint. Nonetheless, since most of Thai households in our micro data are regarded as net borrowers, and at the country level, the ratio of household debt to GDP has remained high for several years, a further decrease in the policy rate might not be able to increase the country's aggregate consumption. Second, although we find that the expansionary monetary policy has a positive effect on house prices, the magnitude of the effect may be exaggerated because of the artificial demand for housing that typically occurs when the policy rate has been low for a long horizon. These two arguments, therefore, suggest the use of conventional monetary policy tools such as the interest rate together with the imposing of macroprudential regulations and the undertaking of structural reforms to boost the sustainable economic growth.

Furthermore, there are some limitations to bear in mind when interpreting our results. First, we perform a partial equilibrium analysis to examine the effects of expansionary monetary policy in this study. Second, due to the lack of household panel survey data, the analysis only gives short-run impacts on households.

7. Conclusion and Policy Recommendation

Our analysis is based on estimating the distributional impact of monetary policy on individual households through the lens of income, wealth, and age distribution. By estimating multiple sets of SVARs, we do find the significance of Bank of Thailand's policy rate on the aggregate economy, and financial markets. Thus, we are able to map these results onto Thailand's Household Socio-Economic Survey. At the household level, it is found that **wealthy households are more sensitive to monetary policy, compared with the poor ones, mostly through the asset price channel whilst the effects through savings remuneration are minimal.** However, as we firmly believe that a change in transfers, which are supposed to tremendously affect income of poor households, depends heavily on fiscal policy, thus the use of a policy mix is recommended in order to reduce income and wealth inequality in Thailand. More importantly, such inequality should be a wake-up call for the government to focus on structural policies, particularly by expediting the much-needed investment in a social safety net and health infrastructure.

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Appendix

This section intends to display in more details the results from the SVARs estimation in Section 4. Focusing on the impact of monetary policy shocks on macroeconomic variables, yield, effective rates, and asset prices, we again show the restrictions for each model in Chart 1A. For the macroeconomic model, the variables are log of GDP (lnGDER), log of CPI (lnCPI), policy rate[14] (RP1D), and log of loans (LOAN). For the remaining models, the variables are log of Dubai crude oil price (lnDUBAI), Fed Fund Rate (FEDFUND), log of GDP (lnGDER), log of CPI (lnCPI), policy rate (RP1D), USDTHB (FX), 2-year bond yield (B2Y), New Loan Rate (NLR), Minimum Retail Rate (MRR), 3-month Deposit rate (D3M), log of SET Index (lnSET), log of gross fixed capital formation (lnIPR), and log of house price (lnHOUSEP). All models include inflation expectations (INFEXP) as exogenous variable. After setting up the models, Impulse-response analysis is used, focusing on policy rate shocks (RP1D) on variables of interest.

Chart 1A: SVAR Restrictions by Model

Macroeconomic Model

$$\begin{bmatrix} \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp1d} \\ \varepsilon_{loan} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} \nu_{gdp} \\ \nu_{cpi} \\ \nu_{rp1d} \\ \nu_{loan} \end{bmatrix}$$

Bond Yield Model

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{ffr} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp} \\ \varepsilon_{fx} \\ \varepsilon_{by} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & a_{46} & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & 0 & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{ffr} \\ \nu_{gdp} \\ \nu_{cpi} \\ \nu_{rp} \\ \nu_{fx} \\ \nu_{by} \end{bmatrix}$$

Effective Rates Model[15]

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{ffr} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp} \\ \varepsilon_{fx} \\ \varepsilon_{r} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & a_{46} & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ 0 & 0 & a_{73} & a_{74} & a_{75} & 0 & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{ffr} \\ \nu_{gdp} \\ \nu_{cpi} \\ \nu_{rp} \\ \nu_{fx} \\ \nu_{r} \end{bmatrix}$$

Stock Price Model

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{ffr} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp} \\ \varepsilon_{fx} \\ \varepsilon_{set} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & a_{46} & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{ffr} \\ \nu_{gdp} \\ \nu_{cpi} \\ \nu_{rp} \\ \nu_{fx} \\ \nu_{set} \end{bmatrix}$$

House Price Model

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{ffr} \\ \varepsilon_{ipr} \\ \varepsilon_{cpi} \\ \varepsilon_{nlr} \\ \varepsilon_{fx} \\ \varepsilon_{hp} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & a_{46} & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ 0 & 0 & 0 & a & a & 0 & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{ffr} \\ \nu_{ipr} \\ \nu_{cpi} \\ \nu_{nlr} \\ \nu_{fx} \\ \nu_{hp} \end{bmatrix}$$

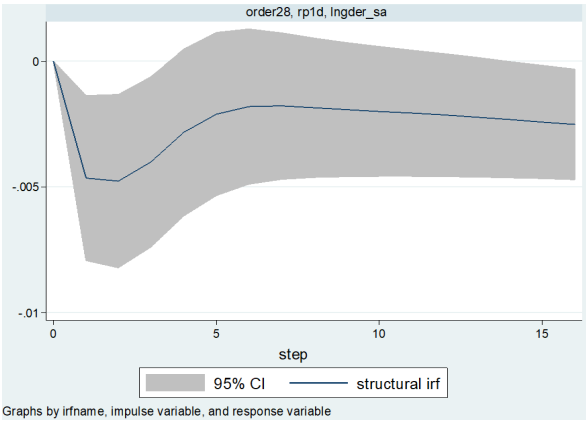
14. 1-day Repurchase Rate

15. For effective rates (r) we run three models with NLR, MRR, and D3M separately.

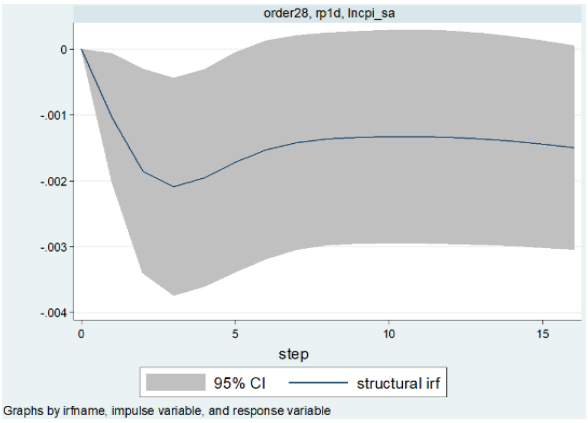
Starting from the macroeconomic model, the results of each variables can be found in Chart 2A. The results from positive policy rate shocks are consistent with macroeconomic theories, and are in line with Disyatat and Vongsinsirikul (2003). The rise in interest rates leads to the decline in output and prices. GDP and CPI are negatively significant for 8 quarters before reverting to mean. The response of loans from policy rate shock is also negatively significant. This is as expected since an increase in interest rate should deter any attempt from consumers to ask for loans.

Chart 2A. Impulse Response Function of RP1D to GDP, CPI, RP1D, and Loans

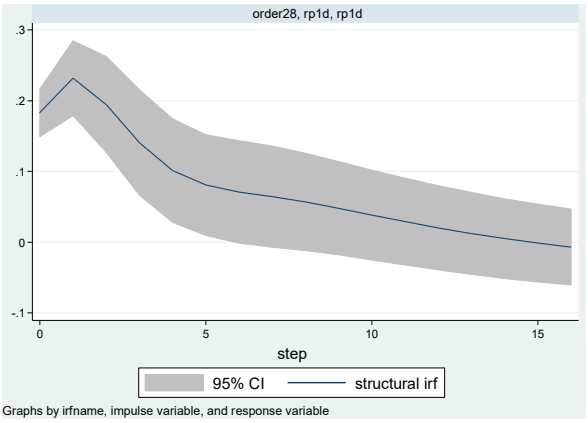
Gross Domestic Product
Impulse: RP1D, Response: GDP



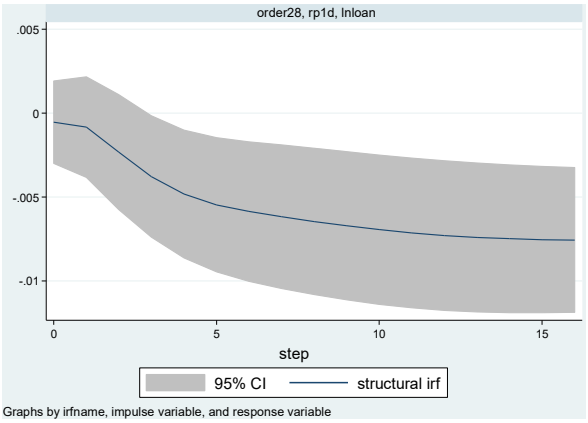
Consumer Price Index
Impulse: RP1D, Response: CPI



RP1D
Impulse: RP1D, Response: GDP



Loans
Impulse: RP1D, Response: Loans

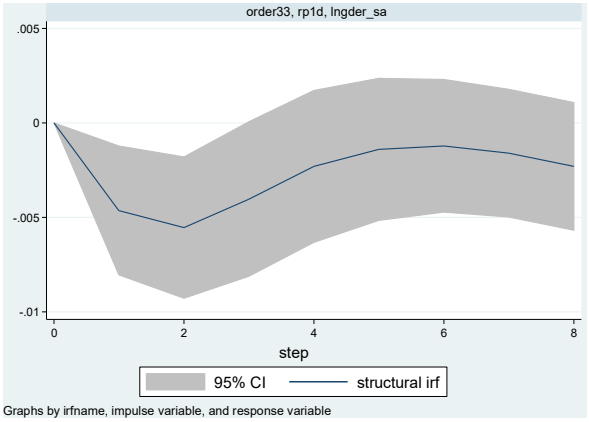


For bond yield, effective rates, and stock price models, the results of positive policy rate shock on variables that are used across three models such as GDP CPI and FX are similar with a minor difference in magnitude. To avoid repetition, we only show an example from stock price model in Chart 3A. The results are still in line with macroeconomic theories where a rise in interest rates leads to the decline in output and prices. The price puzzle causes CPI to be insignificant, but as shown in the macroeconomic model earlier, an inclusion of the loans variable proves that CPI decline significantly from an impact of policy rate shock. For an impact on FX, no evidence confirms that FX is significant from a policy rate shock, as would have been expected from the macroeconomic theory. In this case, uncovered interest parity (UIP) does not hold, and FX is highly susceptible to various factors in financial markets and dominates the impact from policy rate. For oil price and Fed Fund rate, both of them are

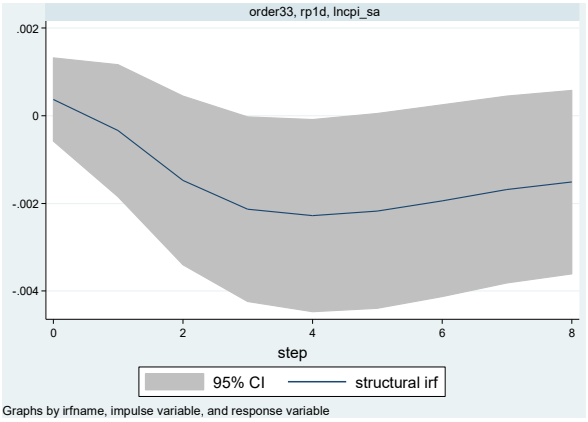
insignificant from policy rate shock as expected. Thailand is not a major player in oil markets, and its monetary policy actions should not affect the decision on the conduct of US monetary policy.

Chart 3A: Impulse Response Function of RP1D to GDP, CPI, RP1D, FX, DUBAI, and FEDFUND from Stock Price Model

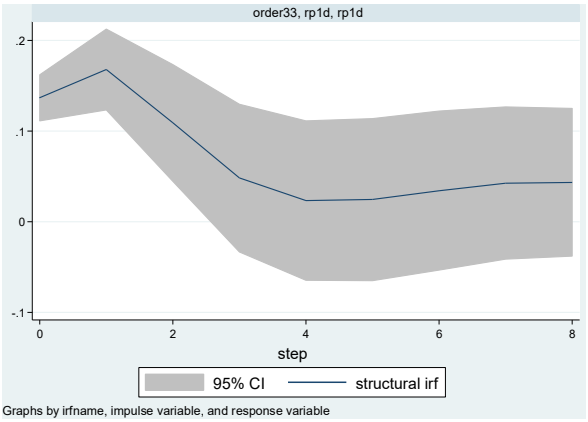
Gross Domestic Product
Impulse: RP1D, Response: GDP



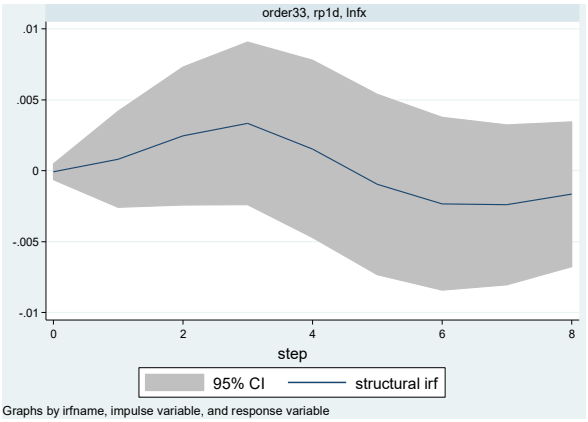
Consumer Price Index
Impulse: RP1D, Response: CPI



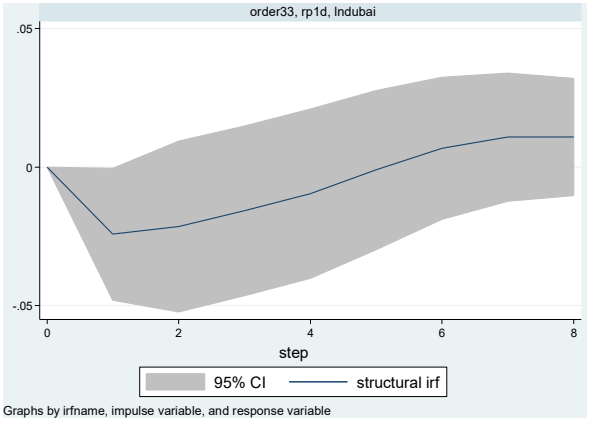
RP1D
Impulse: RP1D, Response: GDP



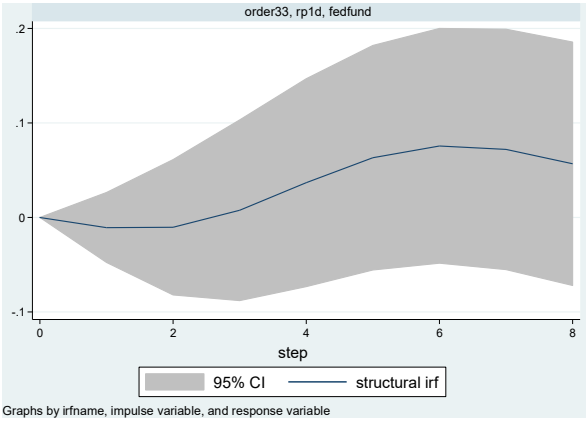
FX
Impulse: RP1D, Response: FX



Dubai Oil Price
Impulse: RP1D, Response: DUBAI



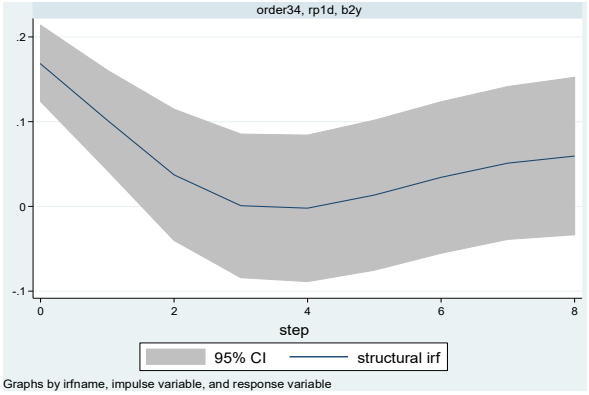
Fed Fund Rate
Impulse: RP1D, Response: FEDFUND



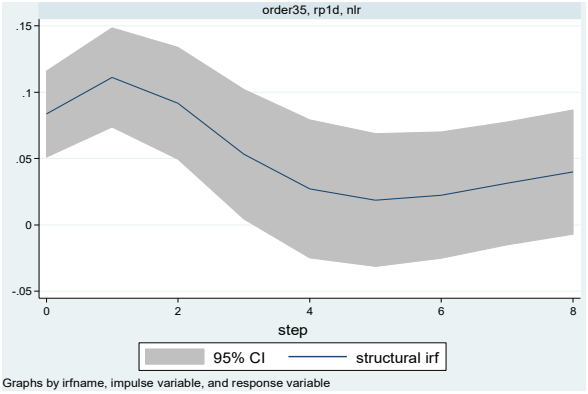
As for the impact of monetary policy shock on stock price, yield, and effective rates, the results are shown in Chart 4A. The positive shocks from RP1D to stock price are negatively significant in line with macroeconomic theory. An increase in policy rate should lead to a decline in asset prices. In this case, stock price responds negatively for 2 quarters directly from the shock of policy rate. For effective rates and yields, they are positively significant as expected. Policy rate drives other interest rates in the market to rise as well.

Chart 4A: Impulse Response Function of RP1D to SET, B2Y, NLR, MRR, and D3M from Stock Price, Yield, and Effective Rates Model

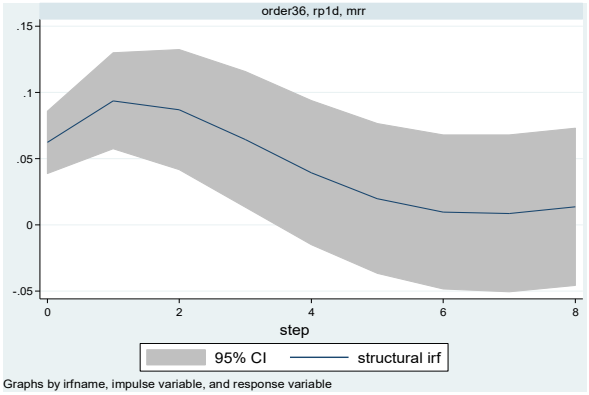
Bond Yield 2Y
Impulse: RP1D, Response: B2Y



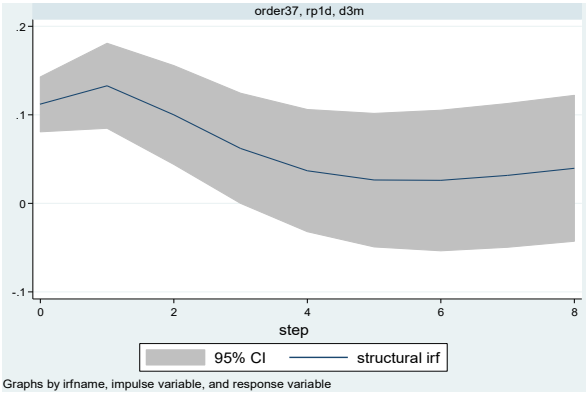
New Loan Rate
Impulse: RP1D, Response: NLR



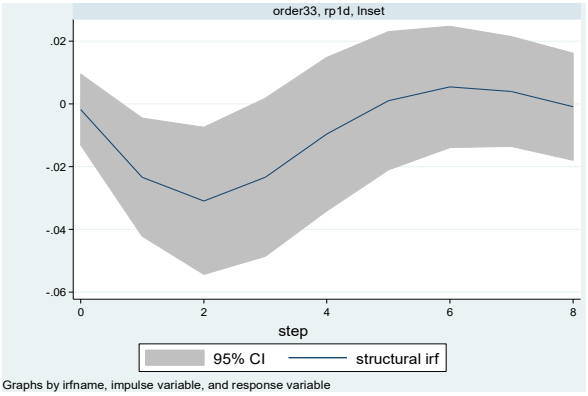
Minimum Retail Rate
Impulse: RP1D, Response: MRR



Deposit Rate
Impulse: RP1D, Response: D3M



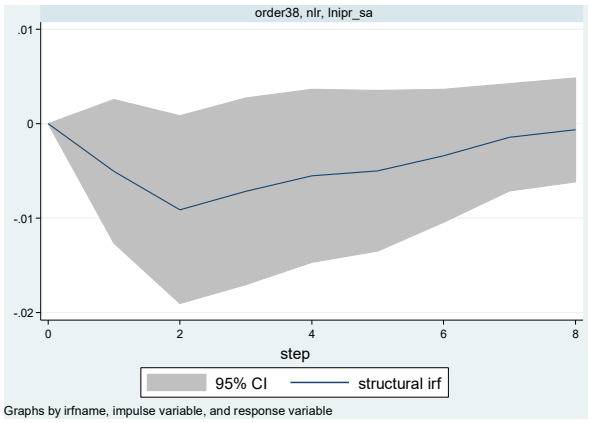
SET Index
Impulse: RP1D, Response: SET



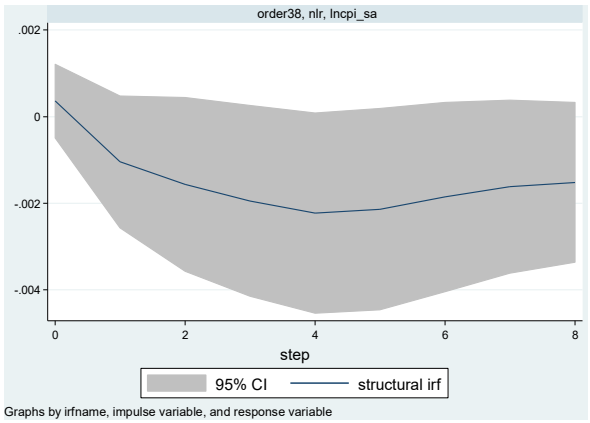
For house price model, adjustments are made on the restrictions and variables of the model to suit the behavior of housing market in Thailand as explained earlier in Section 4. NLR is the lending rate that is used as a proxy for policy rate, and GDP is replaced by gross fixed capital formation (IPR). The results are shown in Chart 5A. Even though the results show little significance from a lending rate shock for most variables of the model, its magnitude are considered to be in line with macroeconomic theories. A rise in interest rates deter any firms from making an investment, thus a decline in IPR. The price puzzle is also present in this model, and causes CPI to be insignificant. For an impact on FX, UIP does not hold, and is insignificant. Thus, the impact on oil price and Fed Fund rate is also insignificant as expected. Despite insignificance across variables in the model, our variable of interest of house price (HOUSEP) is significant for 2 quarters. It is in line with theory as rising interest rates drive down the value of asset prices.

Chart 5A: Impulse Response Function of NLR to IPR, CPI, NLR, FX, DUBAI, FEDFUND and HOUSEP from House Price Model

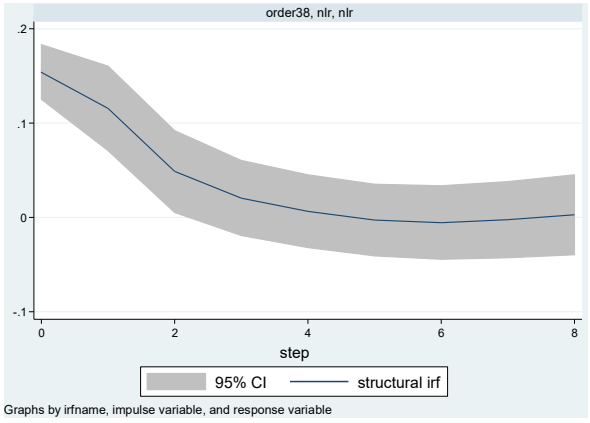
Gross Fixed Capital Formation
Impulse: NLR, Response: IPR



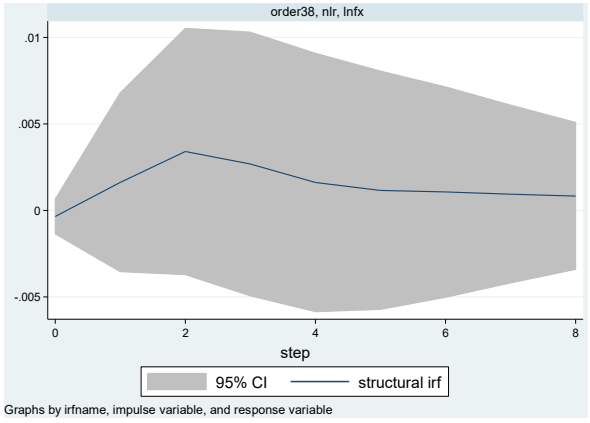
Consumer Price Index
Impulse: RP1D, Response: CPI



New Loan Rate
Impulse: RP1D, Response: GDP

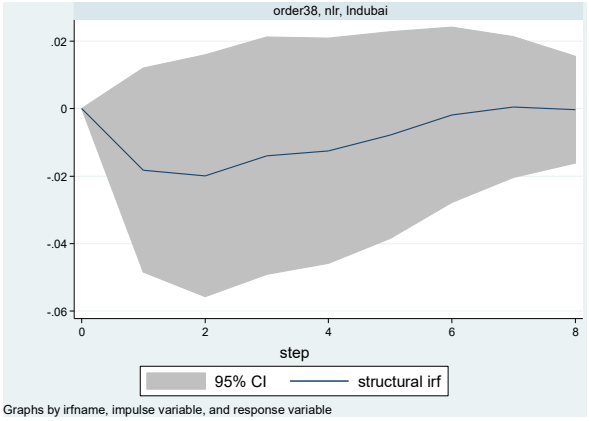


FX
Impulse: NLR, Response: FX



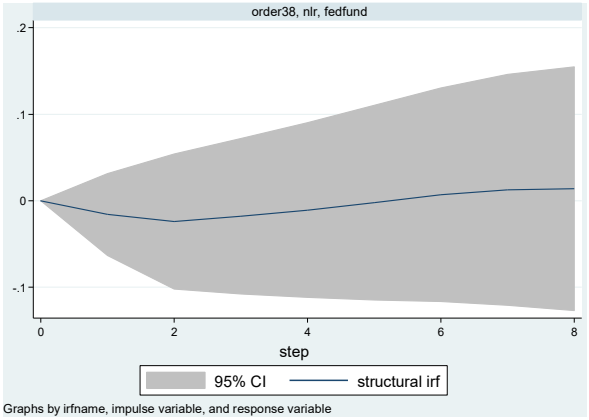
Dubai Oil Price

Impulse: NLR, Response: DUBAI



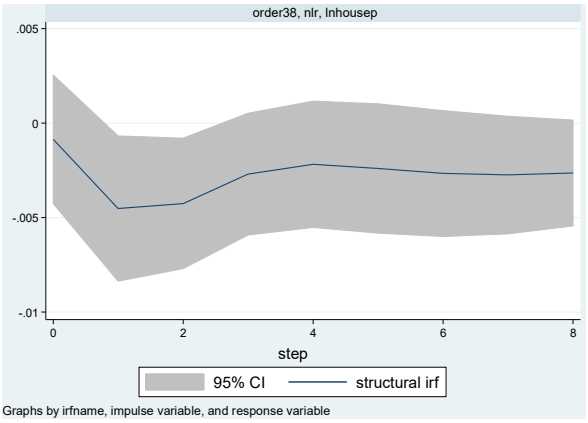
Fed Fund Rate

Impulse: NLR, Response: FEDFUND



House Price

Impulse: RP1D, Response: House Price



CHAPTER 8

THE IMPACT OF MONETARY POLICY ON INCOME INEQUALITY IN CHINESE TAIPEI

By

Dr. Han-Liang CHENG[1]

1. Introduction

Western economies have been experiencing rising income inequality in the aftermath of the financial crises. Since then, researchers have focused on explaining the rising trend and identifying the determinants of income inequality. Fiscal policy is the primary tool for governments to improve income distribution, and has attracted considerable attention as one crucial factor of income inequality. For instance, Afonso et al. (2010) finds higher redistributive public spending and better educational achievements improve income distribution. Similarly, Doerrenberg and Peichl (2014) show that social expenditure policies reduce more income inequality than progressive taxation. However, monetary policy that may also impact the distribution of income has not been widely discussed (Coibion et al., 2012; Saiki and Frost, 2014; Villarreal, 2014), and the impact of monetary policy on income inequality in emerging economies remains unexplored. This paper aims to assess the impact of monetary policy on income inequality in Chinese Taipei.

Earlier studies have presented a contradictory view on the impact of monetary policy. Mumtaz and Theophilopoulou (2017), Furceri et al. (2018), and Aye et al. (2019), for example, have reported that contractionary monetary policy raises income inequality. However, opposite results have also been documented. Villarreal (2014) shows that contractionary monetary policy in Mexico has decreased income inequality. Moreover, Inui et al. (2017) point out that there is no significant relationship between income inequality and monetary policy changes. The uncertainty regarding monetary policy effects arises because different distributional transmission channels and effects may counteract each other. For example, tight monetary policy decreases income inequality through the income composition channel, the financial segmentation channel, and the portfolio channel, while it increases income inequality via the savings redistribution channel and the earnings heterogeneity channel (more details are described in the next section). Therefore, the total effects of monetary policy on income inequality can be an ambiguous. When we take into account sources of household income, the relationship is more complicated. For example, if contractionary monetary policy leads to a tight labor market and a corresponding fall in wages, the households for which wages are the primary source of income will be more affected. Meanwhile, if monetary policy substantially causes asset prices to slump, high-income households' holding financial assets will be highly impacted. Income inequality may thereby be reduced.

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So far there has been no research on the impact of monetary policy on income inequality in Chinese Taipei. In this study, we investigate whether monetary policy shocks have any effect on income inequality in Chinese Taipei. We follow the approach proposed by Mumtaz and Theophilopoulou (2017), which implements a vector autoregressive (VAR) model and imposes sign restrictions for the identification of the monetary policy shock. Correspondingly, we interpolate the Gini index and the income share ratio series of an annual frequency into a quarterly series beginning from 1976 Q1 to 2017 Q4. This period includes a number of recessions and expansions, which allows clear identification of monetary policy shocks.

The results of the structural vector autoregression (SVAR) model, where the monetary policy shock is identified via a recursive Cholesky scheme, show that contractionary monetary policy does not affect income inequality, but does give rise to the well-known price puzzle, already recognized by Sims (1986). However, under sign restrictions, the model is able to estimate impulse response functions and demonstrate that a contractionary monetary policy shock would cause the Gini index and the income share ratio to significantly rise for a few quarters, with the income share ratio rising more markedly than the Gini index. In order to understand the possible reasons behind the income share ratio response, this paper considers how 10th – 90th percentile households' income responds to monetary policy shocks. The empirical results show that contractionary monetary policy reduces the income of households with a significant impact on the 10th percentile of households. This is because the income of the poorest households is most susceptible to business cycle swings resulting from monetary policy.

Even when including wealth variables (e.g., stock returns) into the VAR model, a tight monetary policy shock still only leads to a significant increase in income inequality in the short-run. Moreover, the other robustness tests, such as reordering the variables in the Cholesky decomposition, also show that contractionary monetary policy has a limited impact on income inequality.

In accordance with these facts, there is insufficient evidence to support the idea that contractionary monetary policy will have a large effect on income inequality in Chinese Taipei. Therefore, the distributional effects of tight monetary policy should not influence policy decisions.

The remainder of this paper is structured as follows. Section 2 explains the distributional effects and reviews the relevant literature. Section 3 discusses monetary policy framework and income inequality in Chinese Taipei and data sources. Section 4 describes the identification of monetary policy shocks. Section 5 provides the main results. Section 6 is the conclusion.

2. Distributional Effects and Literature Review

2.1 Distributional Impacts of Monetary Policy

The total distributional effects of monetary policy are determined by different transmission channels that monetary policy can have on income inequality. Coibion et al. (2012) classify the total distributional effects into five specific channels, and define them as follows:

1. Income Composition Channel:

   The income composition effect reflects heterogeneity in income sources between households (Gornemann et al., 2016; Coibion et al., 2017; Luetticke, 2018). If the decrease in capital gains and profits caused by tight monetary policy is larger than that in labor income, the value of assets of the wealthy group (e.g., firm owners) would decline, i.e., tight monetary policy could reduce income disparities through this channel.

2. Financial Segmentation Channel:

   The financial segmentation effect refers to how the reallocation of income is advantageous to financial market participants who are able to benefit from expansionary monetary policy shocks. Agents involved in financial markets typically earn more than agents who are not engaged in financial markets. Hence, tight monetary policy decreases income inequality via this channel.

3. Portfolio Channel:

   The portfolio channel represents the redistribution of income based on the structure of assets owned. Low-income households mainly hold currency, while high-income households usually have many types of securities. Hence, when tight monetary policy causes deflation and the financial market slump, this effect benefits low-income households while hurting high-income households, i.e., contractionary monetary policy can decrease income inequality through this channel.

4. Savings Redistribution Channel:

   The savings redistribution effect reflects the impact of unexpected inflation on nominal contracts. If the inflation unexpectedly goes down, borrowers may become worse off while savers benefit. Because savers are usually wealthier than borrowers, tight monetary policy shocks increase income inequality through this channel.

5. Earnings Heterogeneity Channel:

   Normally, the income of poorest households is most susceptible to business cycles, i.e., tight monetary policy increases income inequality via this channel.

Because of these different channels, the total distributional effects of monetary policy are uncertain. Tight monetary policy decreases income inequality through the first three channels (the income composition channel, the financial segmentation channel, and the portfolio channel), but it also increases income inequality via the last two channels. Hence, the overall income distributional effects of monetary policy are ambiguous (O'Farrell et al., 2016).

Furthermore, Nakajima (2015) summarizes the five channels of monetary policy into two main distributional channels: the inflation and income channels. The inflation channel includes the financial segmentation channel, the portfolio composition channel, and the savings redistribution channel. The income channel comprises the income composition channel and the earnings heterogeneity channel. Hence, Davtyan (2017) captures the general distributional effects of monetary policy by using prices and real output in the VAR model.

2.2 Divergence of Empirical Evidence Regarding Monetary Policy Distributional Effects

The empirical results from the distributional effects of monetary policy still appear contradictory. For example, Villarreal (2014) shows that contractionary monetary policy in Mexico has decreased income inequality via the income composition channel, and that even if different methods are used to identify monetary policy shocks, the results are still robust. Mumtaz and Theophilopoulou (2017) impose sign restrictions on impulse responses and find that contractionary monetary policy has increased income inequality in the UK through the income composition and earnings heterogeneity channels; Coibion et al. (2017) find that contractionary monetary policy tends to increase income inequality in the US through the income composition and earnings heterogeneity channels. Other related literature is summarized in Table 1.

Table 1
Empirical Evidence for Monetary Policy Distributional Effects

Study	Country	Period	Shock	Effect on Income Inequality	Channel
Villarreal (2014)	Mexico	2003–2012	M +	-	Income composition
Mumtaz and Theophilopoulou (2017)	UK	1969–2012	M +	+	Income composition; Earnings heterogeneity
Coibion et al. (2017)	US	1980–2008	M +	+	Income composition; Earnings heterogeneity
Furceri et al. (2018)	32 countries	1990–2013	M +	+	Earnings heterogeneity
Aye et al. (2019)	US	1980–2008	M +	+	--
Samarina and Nguyen (2019)	Euro area	1999–2014	M -	-	Income composition; Portfolio composition
Guerello (2018)	Euro area	2001–2015	M -	-	Income composition; Earnings heterogeneity
Cloyne et al. (2016)	UK and US	1975–2007, 1981–2007	M -	+	Income composition
Inui et al. (2017)	Japan	1981–2008	M -	Non-significant	Savings redistribution; Portfolio composition

Note: M – represents expansionary monetary policy; M + represents contractionary monetary policy.
Sources: Colciago et al. (2019) and author.

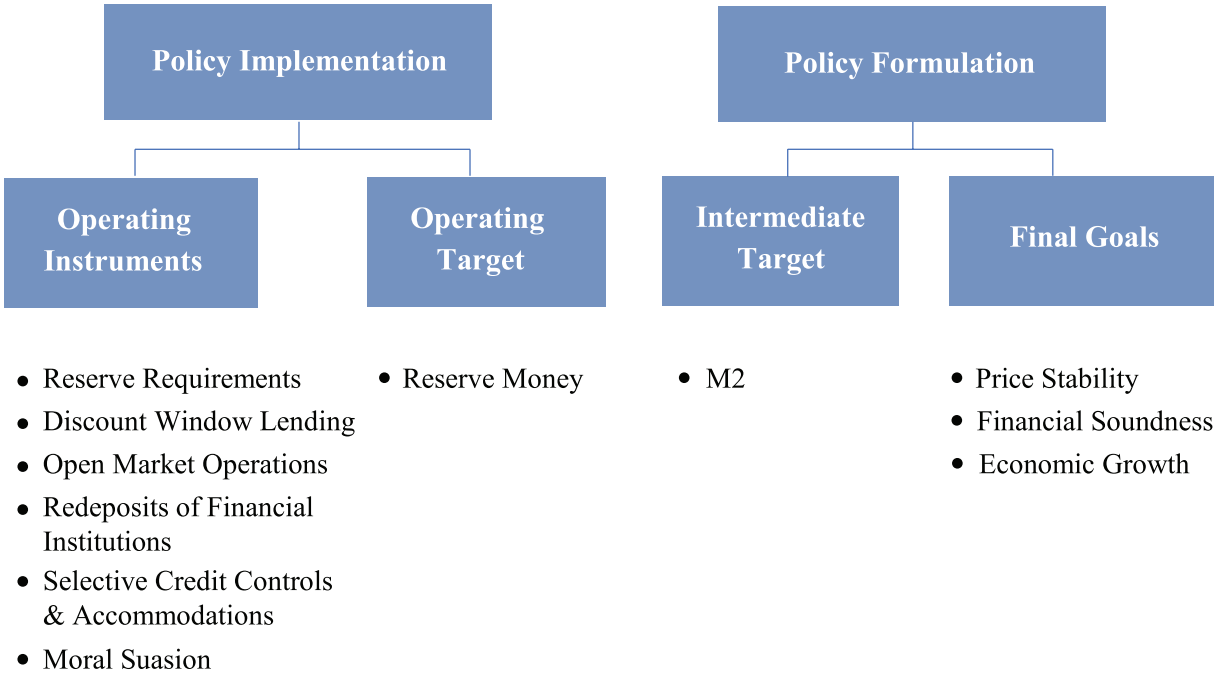
3. Monetary Policy Framework, Income Inequality and Data Sources

This section introduces the monetary policy framework, describes trends in income inequality in Chinese Taipei, and provides data sources.

3.1 Introduction of Chinese Taipei's Monetary Policy Framework

Since the early 1990s, the Central Bank, Chinese Taipei (CBCT) has adopted a flexible monetary targeting regime. For monetary policy formulation, the CBCT selects the monetary aggregate M2 as the intermediate target, and implements interest rate and exchange rate policies, to achieve the objectives such as maintaining price stability, promoting financial system soundness, and fostering economic development within the scope of the aforementioned objectives.

Chart 1
Basic Framework of Monetary Policy



In December each year, the CBCT estimates money demand of M2 using variables such as GDP growth and inflation forecasts for the following year and future uncertainties that could affect M2 growth, to determine the appropriate target range of M2. Setting a target range of monetary growth rather than a single growth target not only offers greater flexibility for monetary policy operation, but also helps better anchor mid- to long-term expectations.

When setting the M2 target range, the CBCT also considers other important macroeconomic and financial indicators, including inflation expectations, the output gap, interest rate and exchange rate movements, and credit conditions, and asset prices.

In respect of the interest rate policy, the CBCT holds quarterly Board Meetings and considers economic and financial conditions at home and abroad, such as the current price level, inflation expectations, and the output gap, to make policy rate decisions and to help achieve the final goals.

Even though the monetary policy framework of the CBCT is based on a flexible monetary targeting regime, we use interest rates as the main monetary policy instrument in this paper. First, this is because interest rates could cover more distributional channels than the monetary aggregate M2. For example, lower interest rates make borrowers better off by reducing their interest payments on debt, while savers holding deposits receive lower returns. Second, the CBCT also utilizes interest rates as a monetary policy instrument to achieve the final goals.

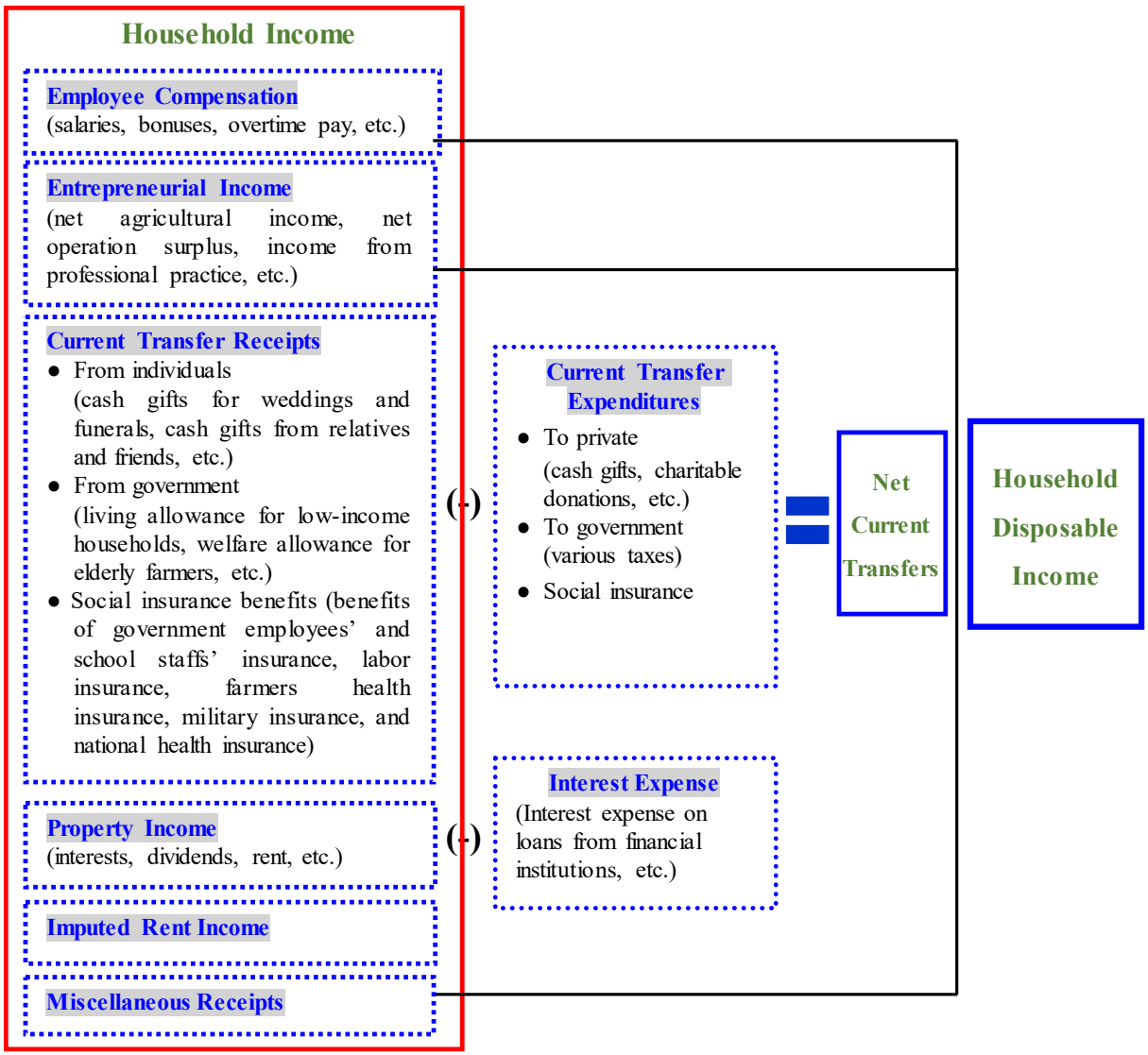
3.2 Trends in Income Inequality

3.2.1 Measures of Income Inequality and Historical Trends

Household disposable income is the international standard for measuring the distribution of income. According to the OECD definition, disposable income excludes (1) capital gains from trading in real estate and stocks, (2) financial assets (such as deposits, stocks, and funds), and (3) real estate (such as lands and houses). In Chinese Taipei, capital gains are not included in the measurement of household property income.

According to a survey of family income and expenditure made by the Directorate-General of Budget, Accounting and Statistics (DGBAS), the household disposable income is equal to the sum of employee compensation, entrepreneurial income, property income, imputed rent income, current transfer receipts, and miscellaneous receipts minus interest expense and current transfer expenditures (Chart 2).

Chart 2
Household Disposable Income



There are two primary ways to measure income inequality in Chinese Taipei: the Gini coefficient (or the Gini index) and the ratio of the income share of the highest 20% of households to that of the lowest 20% of households (hereafter referred to as the income share ratio, ISR). The latter is seldom adopted in other economies.

1. Gini Coefficient (or Gini Index):

   The Gini coefficient conducts a pairwise comparison of all households' disposable income, adds up the absolute value of the difference, and then normalizes it between 0 and 1. A Gini coefficient of one (or 100%) expresses maximal inequality, while a Gini coefficient of zero refers to perfect equality. The Gini index is the Gini coefficient multiplied by 100.

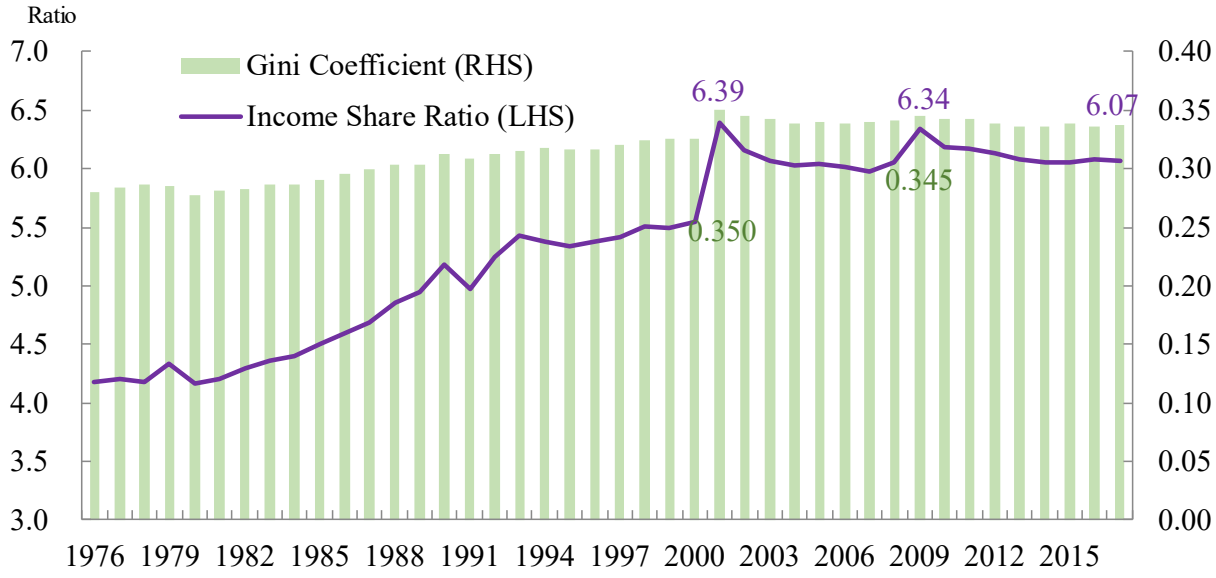
2. Income Share Ratio:

The income share ratio is obtained by dividing the household disposable income of the 20% of households with highest income by that of the 20% of households with lowest income. The larger the ratio, the greater the income inequality is. This makes the income share ratio easier to understand than the Gini coefficient because it can be calculated easily. However, it has the disadvantage of ignoring the middle 60% of household data.

The trend for the Gini coefficient in Chinese Taipei is roughly in line with the income share ratio. The Gini coefficient peaked in 2001 and 2009, at 35% and 34.5% respectively. Although it has had an upward trend for a long time, it has remained below the international warning line of 0.4 and has slightly declined since 2009 (Chart 3).

Chinese Taipei's income share ratio has been gradually increasing over the long- term. It reached its peaks during the dot-com bust of 2001 and the global financial crisis of 2009. The ratios for these periods were 6.39 and 6.34, respectively (Chart 3). Since the global financial crisis in 2009, the ratio has been on a downward trend, from 6.34 in 2009 to 6.07 in 2017.

Chart 3
Gini Coefficient and Income Share Ratio in Chinese Taipei



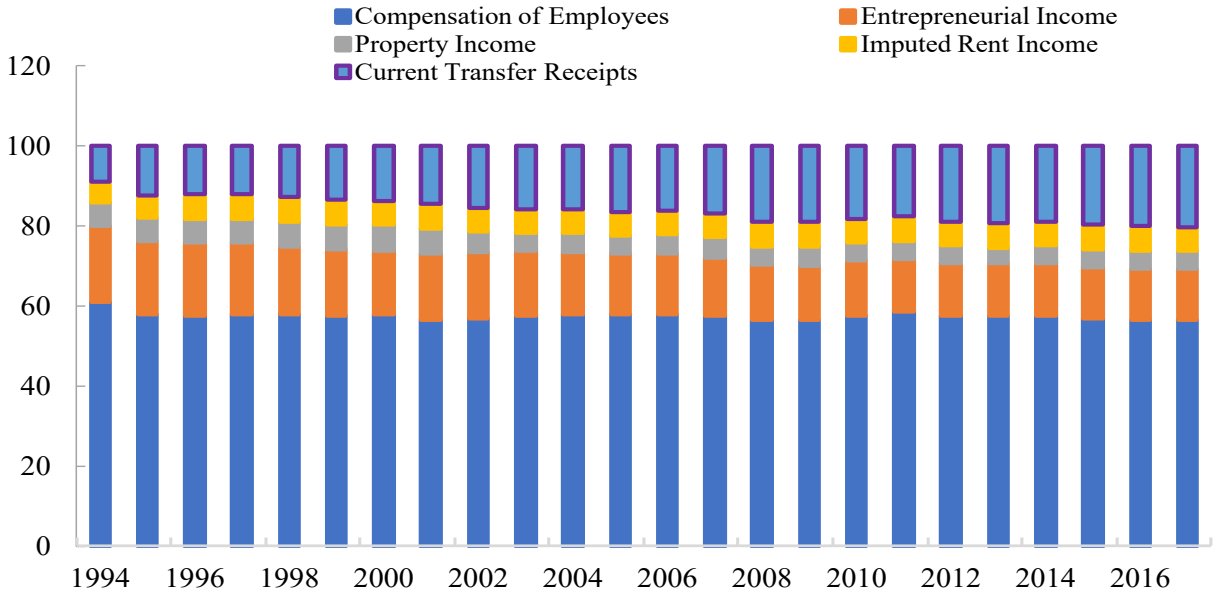
Source: DGBAS.

3.2.2 Sources of Household Income in Chinese Taipei

3.2.2.1 Structure of Household Income in Chinese Taipei and the Historical Trend

Total income receipts of households are composed of employee compensation, entrepreneurial income, property income, imputed rent income, and current transfer receipts.[2] Employee compensation is the most important income source, stably accounting for 60% of total income receipts (Chart 4). Entrepreneurial income, on the other hand, occupies a declining portion of the whole. With the trends in production offshoring and the deeper development of economic globalization, it has been difficult for small and medium enterprises to survive. Therefore, the proportion of entrepreneurial income has decreased year by year.

Chart 4
Structure of Main Household Income Sources



Source: *The Survey of Family Income and Expenditure,* DGBAS.

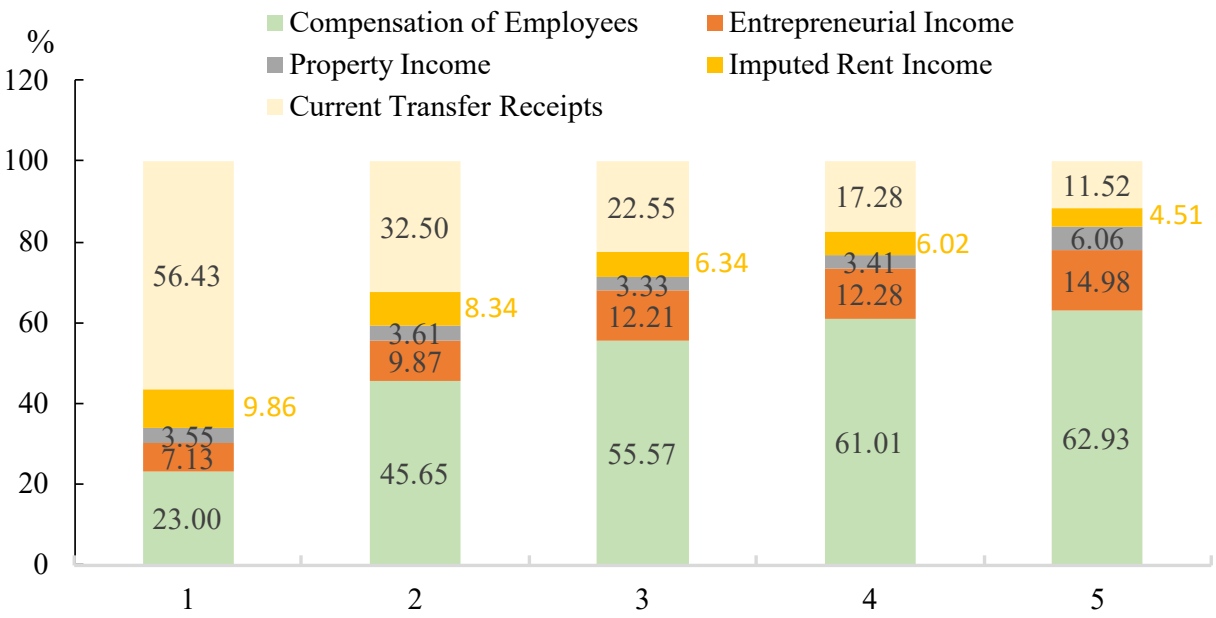
The shares of property income and imputed rent income have remained relatively stable over the years. Current transfer receipts accounted for less than 10% of household income sources in 1994 but have become the second-most important source of household income since 2004.

The rising trend in the proportion occupied by current transfer receipts has been due to the implementation of the National Health Insurance program, beginning in 1995, other social insurance programs, and pro-consumption policies and expanded transfer expenditures for underprivileged minorities in response to the 2009 global financial crisis.

According to the structure of household income quintiles in 2017, we find that as household income increases, the proportions of employee compensation, property income, and entrepreneurial income increase (Chart 5). In contrast, the proportions of current transfer receipts and imputed rent income decrease.

2. The share of miscellaneous receipts is ignored in this paper because it is small.

Chart 5
Structure of Main Household Income Source Quintiles in 2017

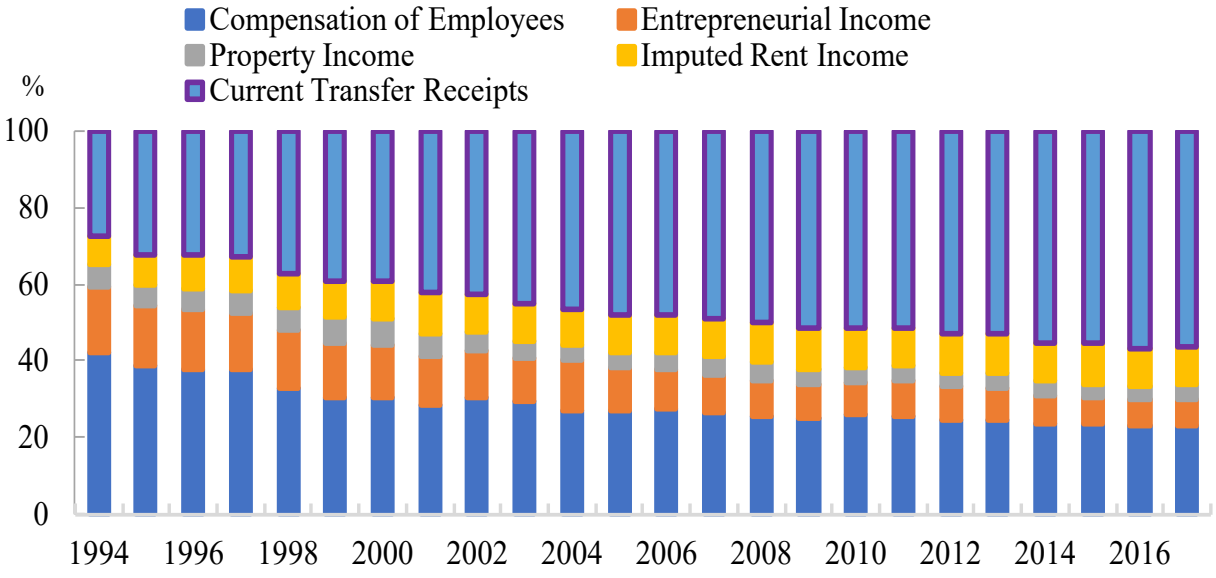


Source: *The Survey of Family Income and Expenditure*, DGBAS.

3.2.2.2 Sources of Household Income for the Top and Bottom Quintiles

Because of the increase in government transfer payments, current transfer receipts for the lowest 20% of households have increased year by year (Chart 6). The proportion occupied by employee compensation has shown a downward trend. Since 1998, the proportion of current transfer receipts has even exceeded the proportion of employee compensation, and has become the main source of household income for the lowest-income households.

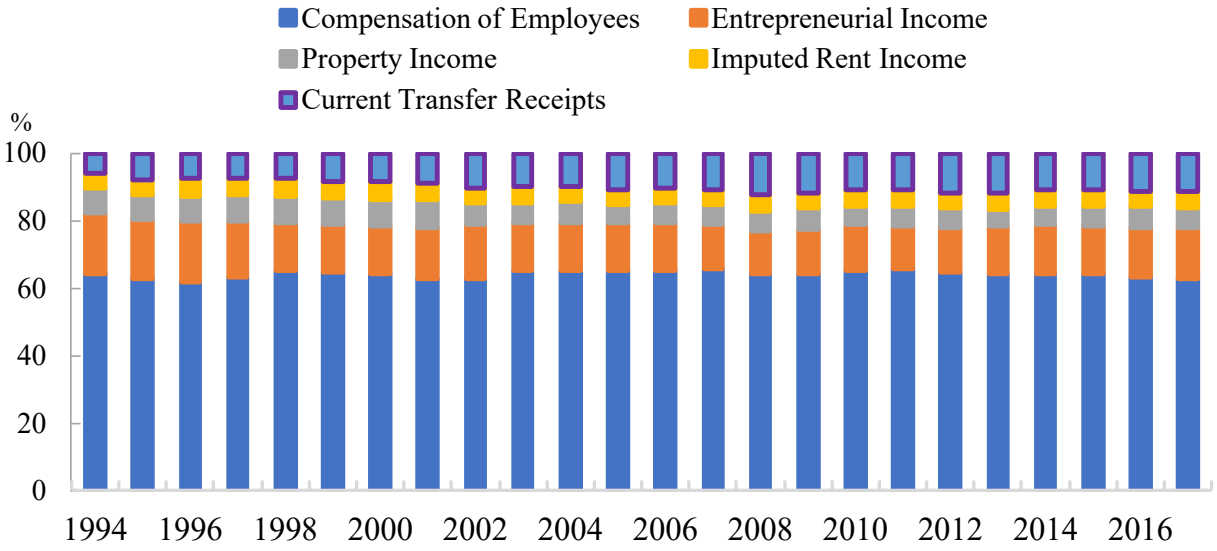
Chart 6
Main Sources of Household Income for the Bottom Quintile



Source: *The Survey of Family Income and Expenditure*, DGBAS.

The household income source structure of the top 20% of households has been quite stable over the years, for which employee compensation has accounted for about 60% (Chart 7). Although the proportion of current transfer receipts was relatively low in the early period, it has gradually approached that of entrepreneurial income. However, the gap between these two income sources has stayed constant in recent years. Current transfer receipts for the highest 20% of households have risen because of the increase in benefits of social insurance programs (including benefits of government employees' and school staffs' insurance, labor insurance, famers health insurance, military insurance, and national health insurance). Imputed rent income and property income both account for less than 10%.

Chart 7
Main Sources of Household Income for the Top Quintile



Source: *The Survey of Family Income and Expenditure*, DGBAS.

3.3 Data Sources

This study selects the household Gini index, real GDP, consumer price index, central bank policy interest rate, real effective exchange rate to capture the effects of monetary policy on income inequality for the small open economy of Chinese Taipei. The sample period is from 1976Q1 to 2017Q4. This long period includes several recessions and expansions during which the central bank implemented a variety of policies, allowing a stronger identification of monetary policy shocks (see Mumtaz and Theophilopoulou, 2017).

As an alternative measure of income inequality, the income share ratio is also considered.

Table 2
Variables and Data Sources

Variable	Definition	Data Source
Gini	Gini index	DGBAS
income share ratio	ratio of income share of the highest 20% to that of the lowest 20%	DGBAS
GDP	real GDP	DGBAS
CPI	consumer price index	DGBAS
R	discount rate (policy rate)	CBCT
REER	real effective exchange rate	BIS

The Gini index and the income share ratio are available only on a yearly frequency. The annual frequency data may cause information omission owing to the contemporaneous occurrence of different events within the same period, especially central bank decision-making behavior, thus it is difficult to analyze the true relationship between income inequality and other macro-variables.

Following Davtyan (2017), we use the method proposed by Boot et al. (1967) to interpolate the Gini index and the income share ratio series of an annual frequency into a quarterly series.

4. Identification of Monetary Policy Shock

4.1 VAR Model

To identify structural shocks using sign restrictions, we consider the following reduced-form VAR(P) model:

$$y_t = A(1)y_{t-1} + A(2)y_{t-2} + \cdots A(p)y_{t-p} + \varepsilon_t \text{ for t = 1,2,.....T,}$$

where y_t is an m×1 vector of endogenous variables. A(p) is an m × m matrix of coefficients, and ε_t is a zero-mean independent white noise process with positive definite covariance matrix $E[\varepsilon_t \varepsilon_t'] = \Sigma$.

Assume e_t, an m×1 vector of structural shocks (or innovations) following a standard-normal distribution with zero mean and unit variance. The forecast errors of a reduced-form VAR model are functions of innovations:

$$\varepsilon_t = Be_t,$$

where B is an m × m matrix of structural parameters.

The standard approach to this identification problem has been to use a Cholesky decomposition or to apply short-run or long-run restrictions to recover structural shocks.

We take log differences of all variables except for the policy interest rate and income inequality. Instead of income inequality level, the difference of inequality is used. Similar to the setting in Mumtaz and Theophilopoulou (2017), we set the lag length p equal to 4 in the specifications above.

Following Feldkircher and Kakamu (2018), we impose the recursive ordering of the difference of income inequality, real GDP growth rate, inflation, policy rate, and REER growth rate. The ordering implies that income inequality does not react within the same quarter to an increase in the policy rate,[3] and that the policy rate responds to real GDP deviation and changes in inflation. Moreover, the REER growth rate is allowed to react immediately to a monetary policy shock. The restrictions on the contemporaneous response of these variables help identify a monetary policy shock.

4.2 Sign Restrictions

In some cases, recursive structures and long-run zero restrictions can be justified by economic theory. However, they are inconsistent with most theoretical models. For example, DSGE models do not produce any zero restrictions or recursive structures. For more details, see Danne (2015).

Sims (1992) points out that the price puzzle results from monetary policy endogeneity. Policy authorities may be aware that inflationary pressure is going to arrive and tighten monetary policy to dampen the pressure, causing a rise in prices concomitant with by monetary tightening. In other words, the price puzzle arises through the misspecification of the systematic part of monetary policy. Sims (1992) suggests incorporating a commodity price index into the VAR model because this then contains information about future inflation and solves the puzzle.

Instead of imposing hard restrictions on the model coefficients, sign restrictions do not require assumptions regarding relationships between variables and only impose relatively weak prior beliefs on variable x's responses for a certain period, while leaving the response of the main variable of interest open. Uhlig (2005) avoids the price puzzle by imposing sign constraints on impulse responses.

In other words, sign restrictions are imposed on a set of orthogonalized impulse response functions (see Uhlig, 2005). In addition to limiting the sign of the responses, the duration of restrictions can also be set. In theory, the duration can be set for anything from the first period to the end of the impulse response functions.

There is no clear rule for choosing the restriction horizon. Imposing a shorter sign restriction horizon might cause spurious effects, while imposing a longer horizon exerts an implausibly long period effect following the monetary policy shock. Choosing a horizon of half a year[4] is the most common.

3. Creel and Mehdi (2019) also assume that income inequality does not react within the same quarter to an increase in the interest rate.

4. The standard for the sign restriction horizon in the literature is half a year. Another common sign restriction horizon is one year (Melolinna, 2012). For example, Scholl and Uhlig (2008) chose half a year and one year as their sign restriction horizons to assess the impact of monetary policy on the exchange rate.

Following Mumtaz and Theophilopoulou (2017), we assume that a contractionary monetary policy shock does not lead to an increase in inflation or real GDP growth, or decreases in the policy rate or REER growth during the half-year after the shock, while imposing no restrictions on the response of the income inequality.

Table 3
Sign Restrictions of the Model

Variable	Δln GDP	Δln CPI	R	Δln REER
Sign Restrictions	≤ 0	≤ 0	≥ 0	≥ 0

The identification of structural shocks given a set of sign restrictions can be summarized as follows (for further details, see Uhlig, 2005; Danne, 2015):

(1) Run an unrestricted VAR and get $\hat{A}$ and $\hat{\Sigma}$.

(2) Extract the orthogonal innovations from the model using Cholesky decomposition. The Cholesky decomposition here is just a way to orthogonalize shocks, rather than an identification strategy.

(3) Calculate the impulse responses at horizon k =1, ..., K.

(4) Randomly draw an orthogonal impulse vector α.
$\alpha = \tilde{B}a$ and $||a||=1$, where $\tilde{B}\tilde{B}' = \Sigma$. $\tilde{B}$ is obtained by a given rotation or QR decomposition of Σ.

(5) Multiply the responses from Step 3 by α; if the impulse response functions satisfy the sign restrictions, keep the draw. Otherwise, discard the draw.

(6) Repeat Steps 2–5. Stop after obtaining 5,000 impulse response functions that satisfy the restrictions. Error bands are then calculated using the draws kept.

5. Empirical Results

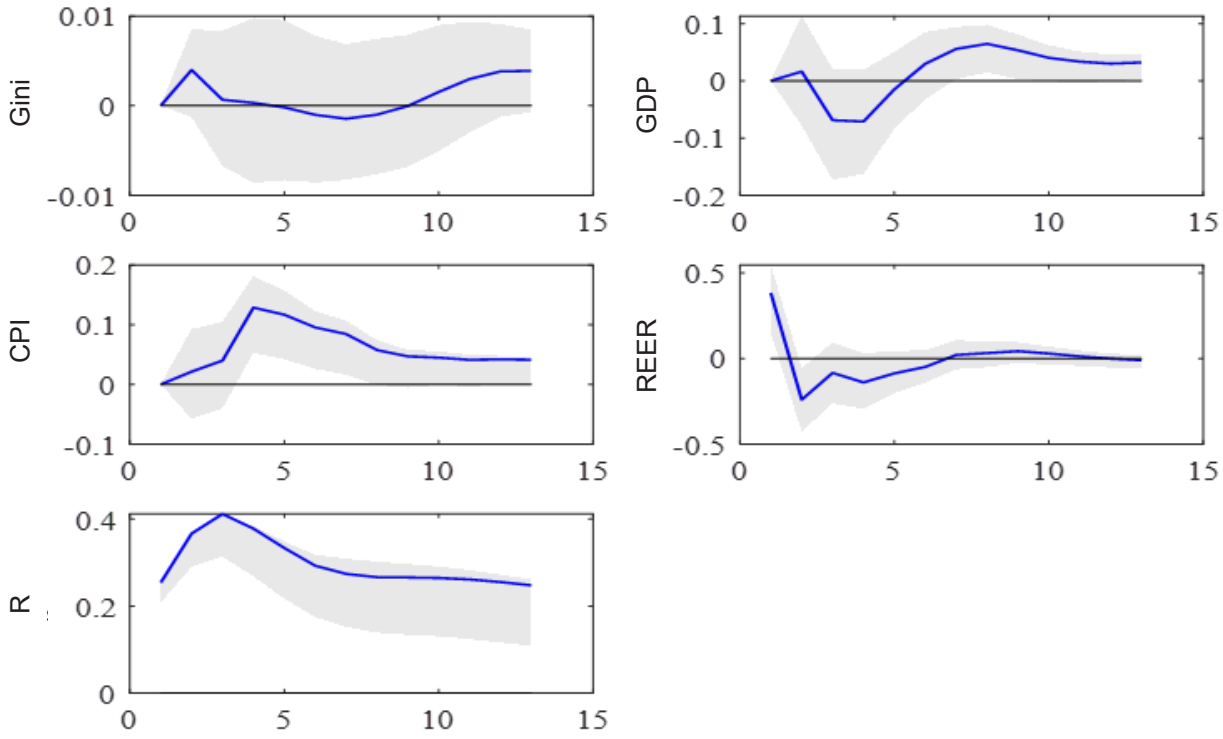
This section primarily presents the impulse response functions of the recursive structural VAR model and sign restrictions; heterogeneity of responses to monetary policy shocks; and robustness test.

5.1 Impulse Response Functions of the Recursive Structural VAR Model and Sign Restrictions

First, we use a Cholesky decomposition for identification and observe the impact of monetary policy on the Gini index and income share ratio. Chart 8 and Chart 9 show that when the initial rise in the policy rate is above 20 basis points, the impact remains close to 40 basis points after one year. We see that the GDP growth rate gradually declines in the quarters following a contractionary monetary policy shock, but the response is not significant. The REER growth rate first rises, then becomes negative. Income inequality does not respond significantly to contractionary monetary policy shocks.[5]

Moreover, the inflation rises significantly around one year. From this, there emerges a huge price puzzle. The long positive reaction of the price casts considerable doubt on the notion of successful identification of a monetary policy shock.

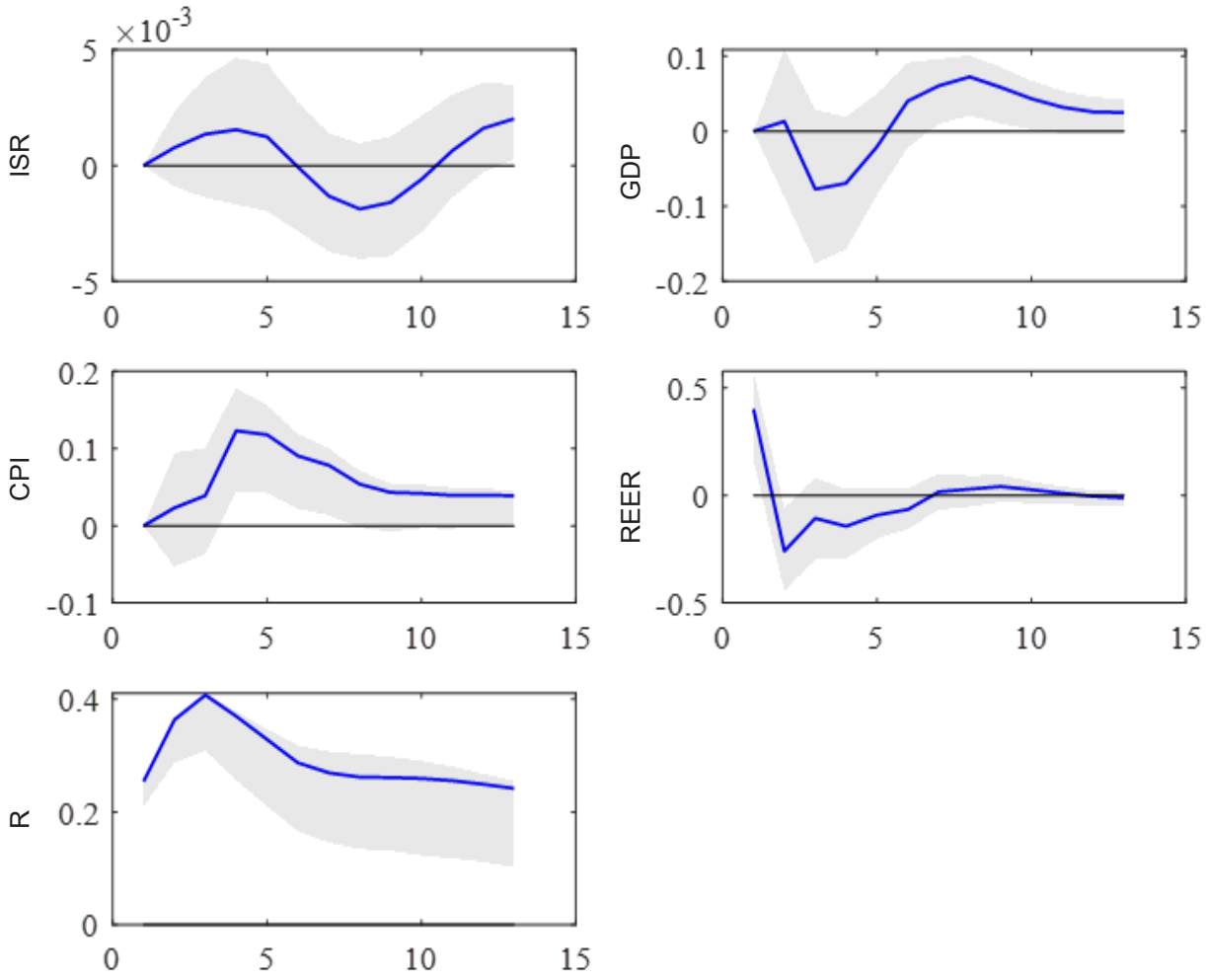
Chart 8
Impulse Responses of SVAR (The Difference of Gini Index)



Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock; the gray shaded area is the 68% error band.

5. We have tried to add the trend term into the VAR model, but the results remain the same.

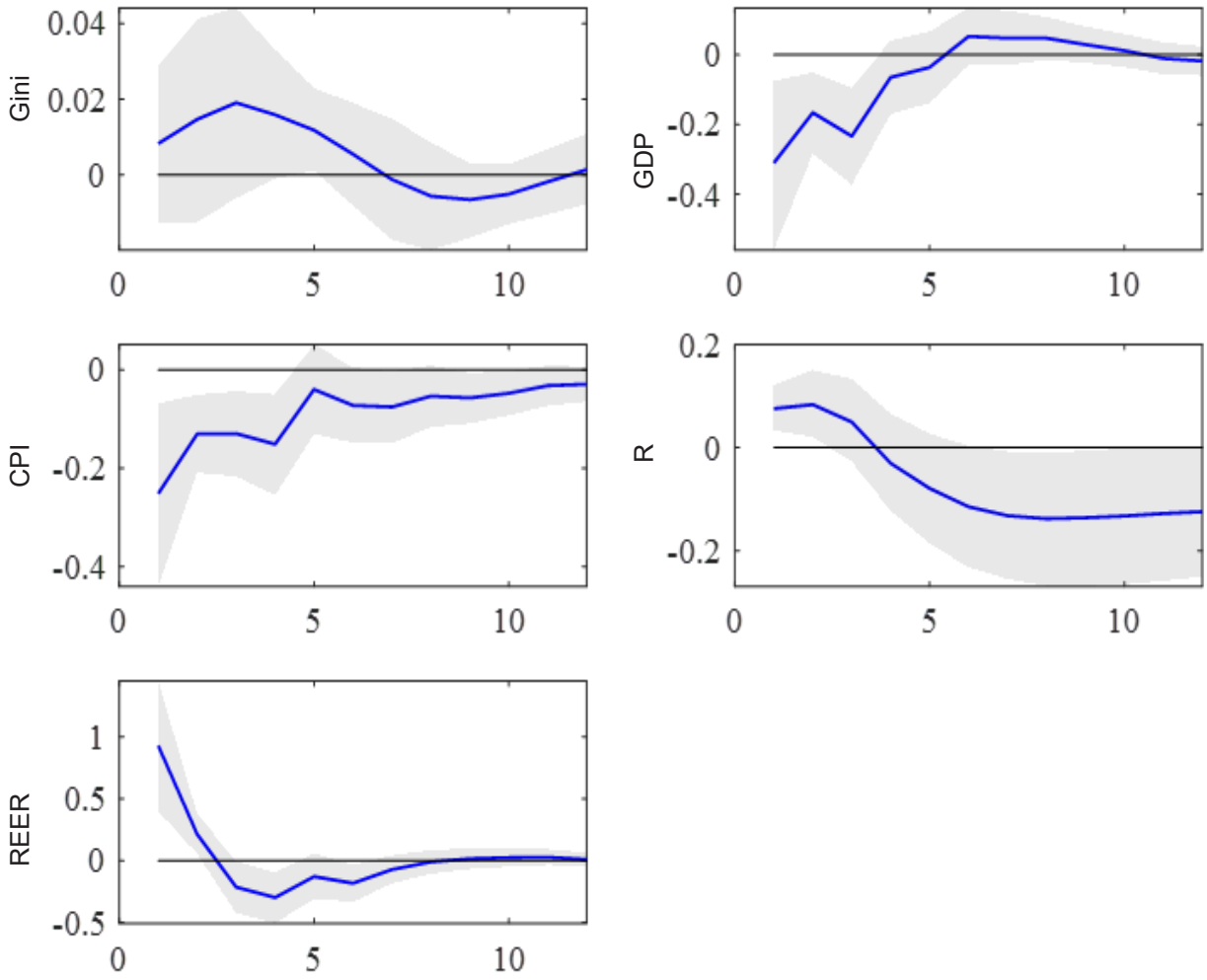
Chart 9
Impulse Responses of SVAR (The Difference of Income Share Ratio)



Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock; the gray shaded area is the 68% error band.

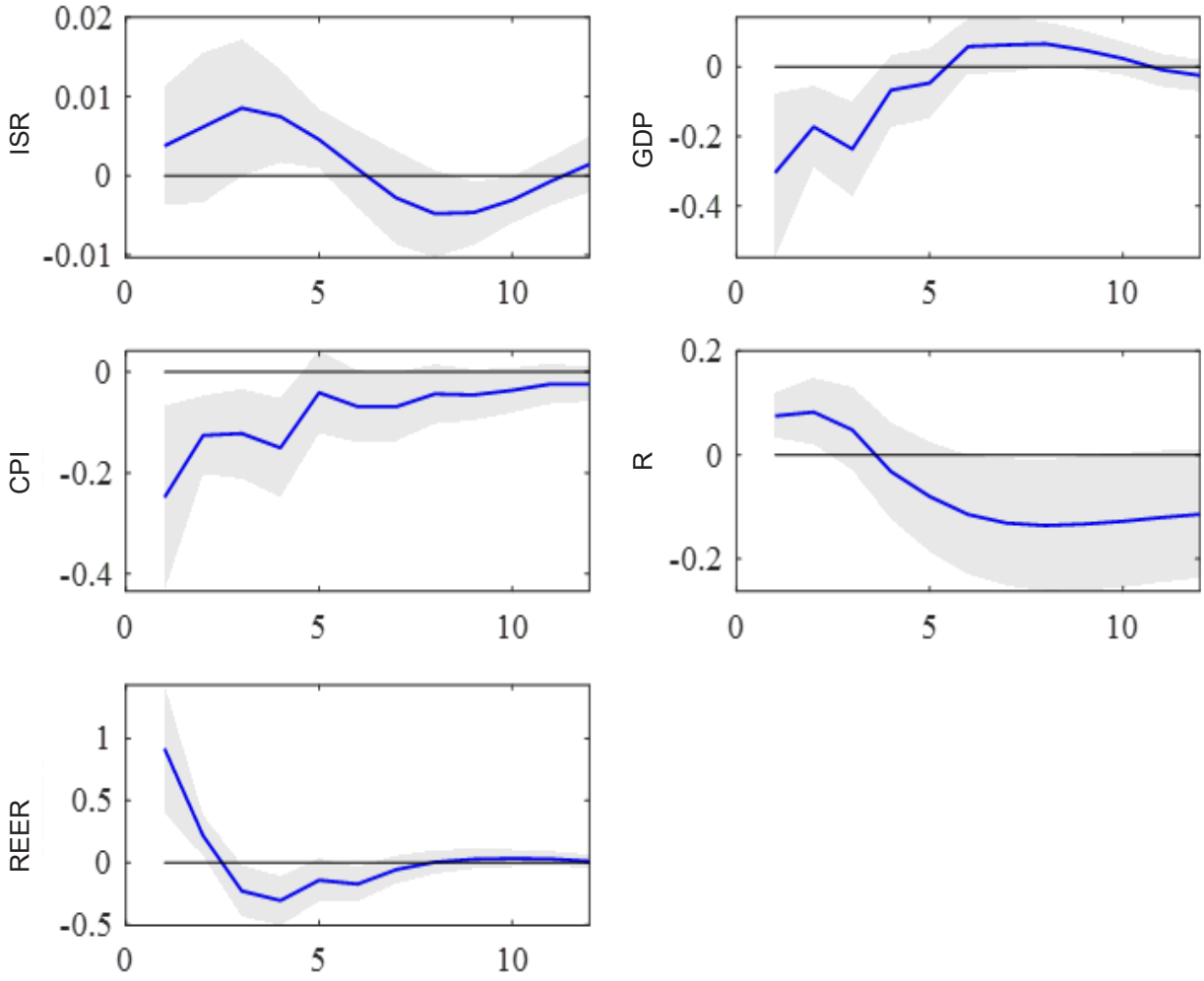
Charts 10 and 11 show that under the sign restrictions, when the contractionary monetary policy shock occurs in the initial period, the policy rate increases by about 0.1 percentage points, the GDP and CPI quarterly growth rates decreases by about 0.3 and 0.2 percentage points, respectively, and the REER growth rate increases by about 1 percentage point. In addition, policy rate increases also cause Gini index and income share ratio differences to significantly increase around the 5th quarter following a shock. Moreover, the income share ratio is more significantly affected by contractionary monetary policy than the Gini index.

Chart 10
Impulse Responses of Sign-Restricted SVAR (The Difference of Gini Index)



Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock; the gray shaded area is the 68% error band.

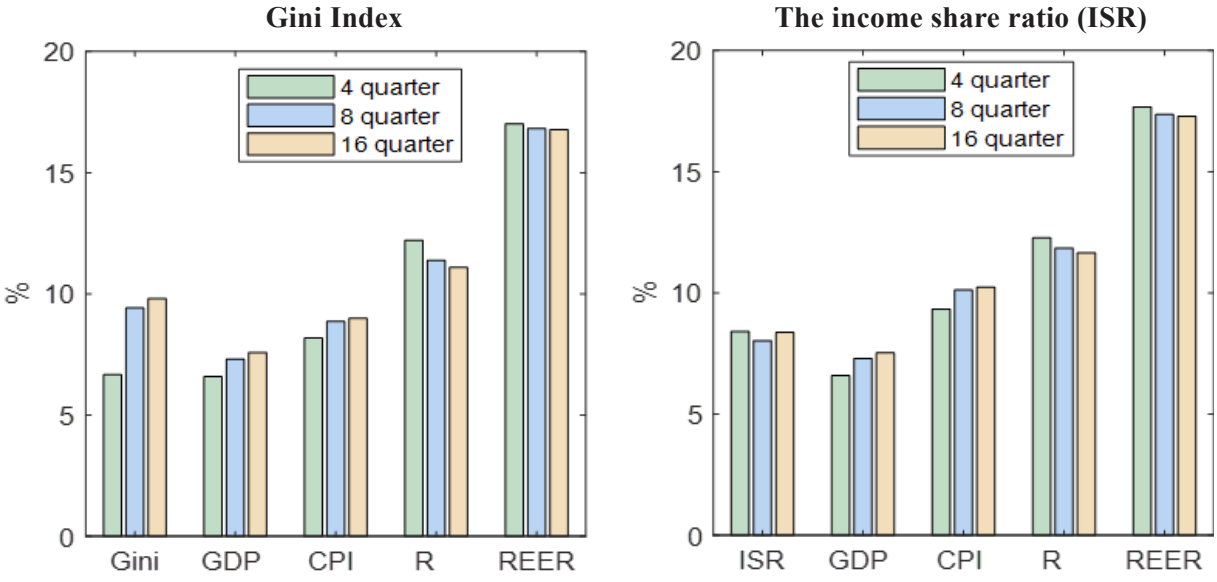
Chart 11
Impulse Responses of Sign-Restricted SVAR
(The Difference of Income Share Ratio)



Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock; the gray shaded area is the 68% error band.

In addition to plotting the impulse response functions of the variables, we also determine the effect of monetary policy shocks on forecast error variances. Chart 12 shows, under the sign restrictions, the effect of the monetary policy shock on forecast error variance decompositions (FEVD) for each variable on the 4th, 8th, and 16th quarter forecast horizons. Monetary policy shocks have a great effect on the REER growth rate and policy interest rate, and account for about 17 percent and 12 percent of forecast error variance, respectively. The proportion of monetary policy shock within forecast error variances for the Gini index increases with forecast horizon, while the income share ratio does not change markedly.

Chart 12
Contribution of Monetary Policy Shock to Forecast Error Variances



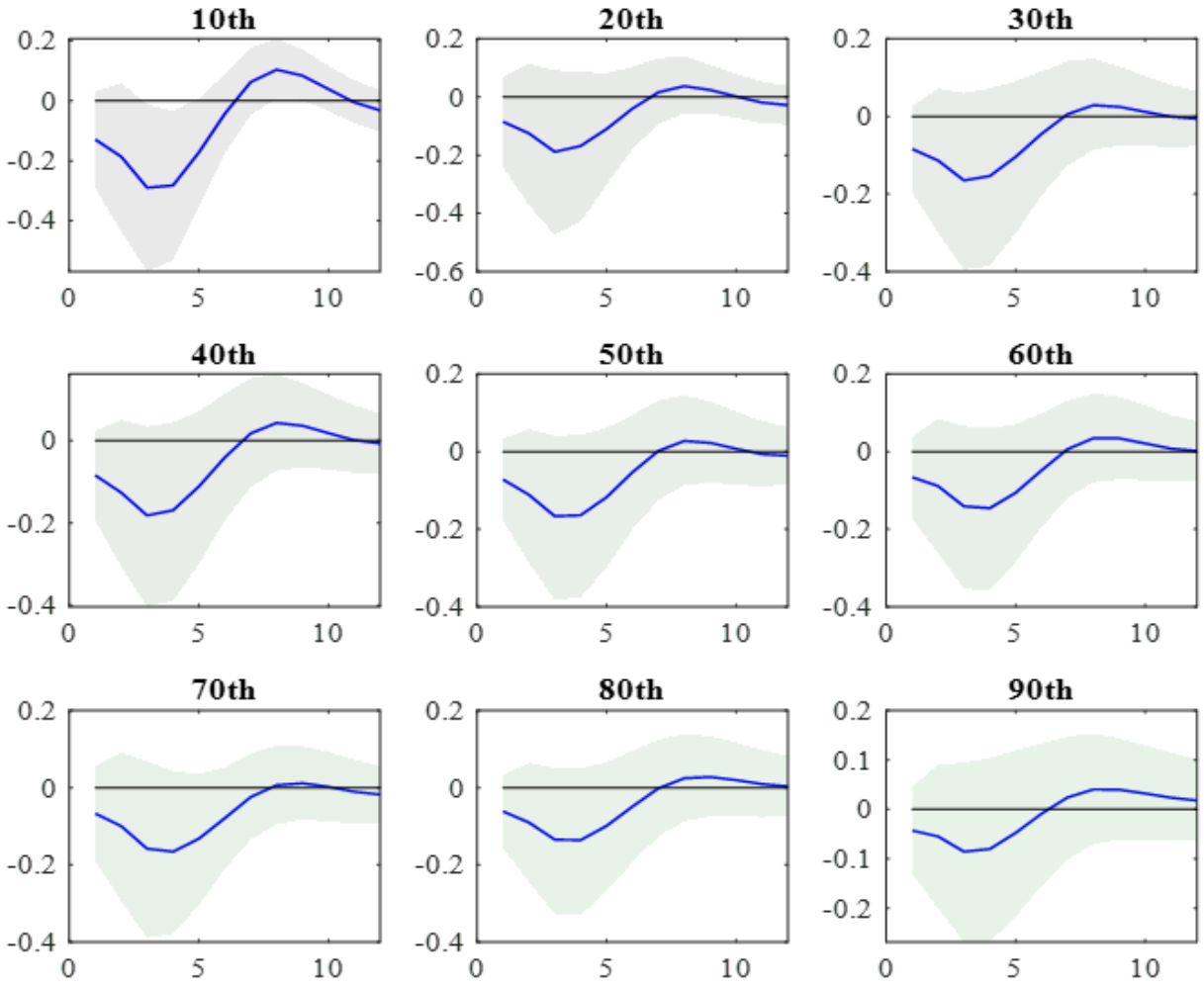
5.2 Heterogeneity of Response to Monetary Policy Shocks

As mentioned earlier, the income share ratio is more affected by contractionary monetary policy than the Gini index. In order to understand the possible reasons behind responses to the income share ratio, we consider how the 10th - 90th percentiles of household disposable income growth respond to monetary policy shocks. Each shock is identified using the identification scheme discussed in the previous section. However, the response of household disposable income growth is left open by the identification procedure.

Chart 13 shows that the income of low-income households is more significantly affected by the contractionary effect of a rise in policy interest rates; the decline in disposable income growth is larger than that for high-income households and the statistical effect is significant at the 4th quarter. The 10th percentile household disposable income decreases more than 0.2 percentage points around one year, while that for the 90th percentiles decreases less than 0.1 percentage points. This deteriorates income distribution and increases income inequality. A possible reason for this result is that low-income households primarily engage in replaceable work. When a recession happens, they are more likely to be laid off and vulnerable to impacts from recession. Thus, low-income households are more affected by the contractionary effect of a rise in policy interest rates. High-income households, on the other hand, have better ability to respond to monetary policy shocks; and because they mostly engage in high-tech work, which is less replaceable, the impact is relatively moderate and insignificant.

In conclusion, the deterioration of low-income households' disposable income contributes to the way (as we noted in the previous section) the income share ratio significantly responds to contractionary monetary policy for a few quarters.

Chart 13
Impulse Responses of 10th - 90th Percentile Households by Disposable Income to Contractionary Monetary Policy Shocks

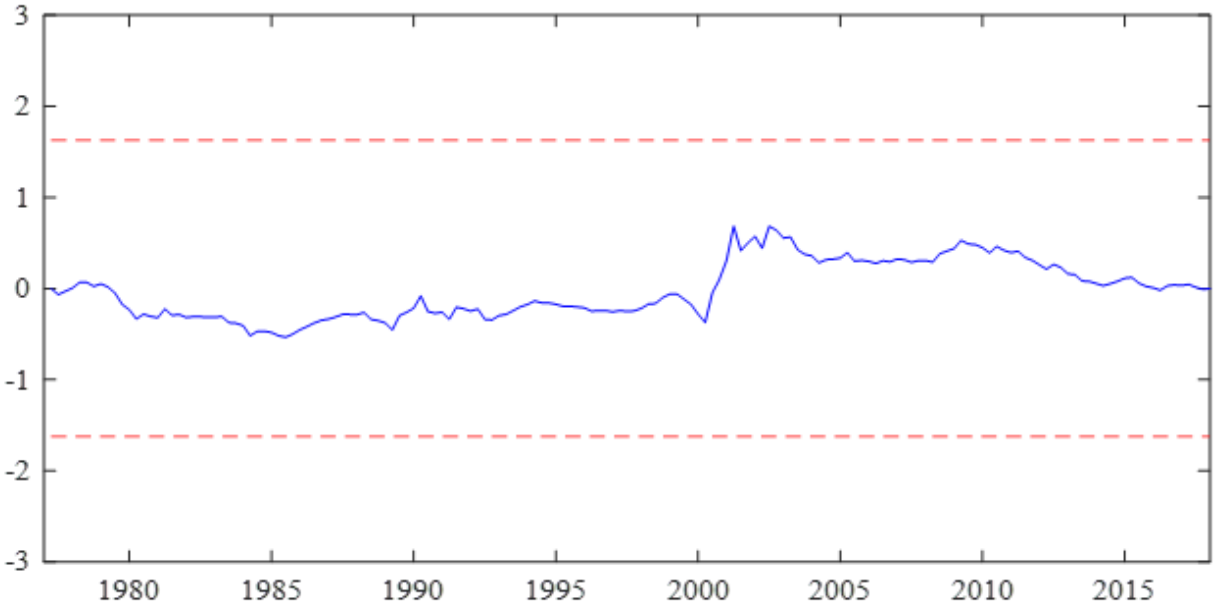


Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock; the gray shaded area is the 68% error band.

5.3 Structural Change Test

There were several economic episodes during the 1976-2017 period, such as the Asian Financial Crisis and the Global Financial Crisis. As a result, VAR regression coefficients may be unstable. Since the difference of the income share ratio in response to contractionary monetary policy is significant for a few quarters, we use an income share ratio regression equation in the VAR model to perform a recursive CUSUM structural change test for test robustness of the regression coefficient. At a 1% significance level, the results suggest that structural change may have occurred in 2000Q1, but this is not statistically significant (Chart 14).

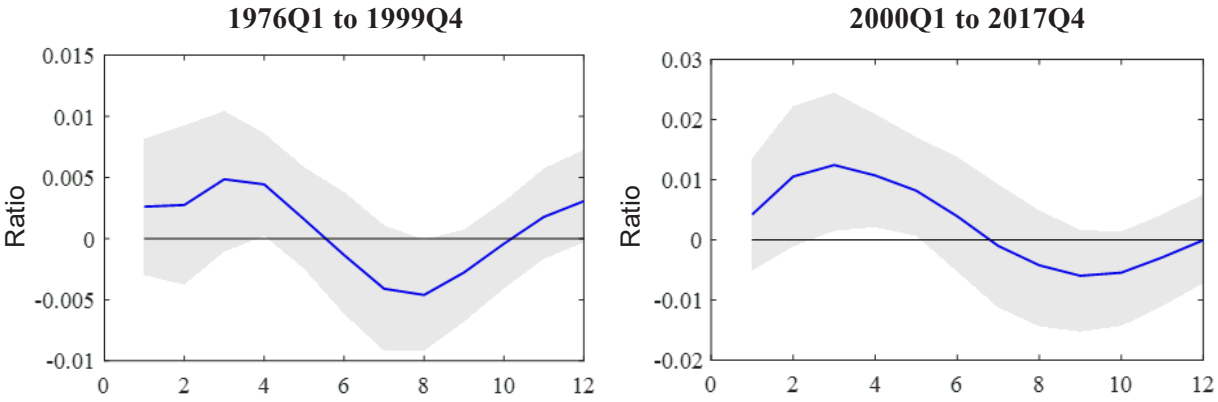
Chart 14
Recursive CUSUM Structural Change Test



Note: The red dotted line is the critical value for a 1% significance level.

Furthermore, we estimate a VAR model with the same sign restrictions from 1976Q1 to 1999Q4 and from 2000Q1 to 2017Q4, respectively. The results suggest that the pattern of income share ratio difference in monetary policy impulse responses is approximately similar, and the impulse responses reach the significance level at around 1 year (Chart 15). Furthermore, the impact of monetary policy on income share ratio became larger after 2000.

Chart 15
The Difference of Income Share Ratio Impulse Response Before and After 2000



Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock;the gray shaded area is the 68% error band.

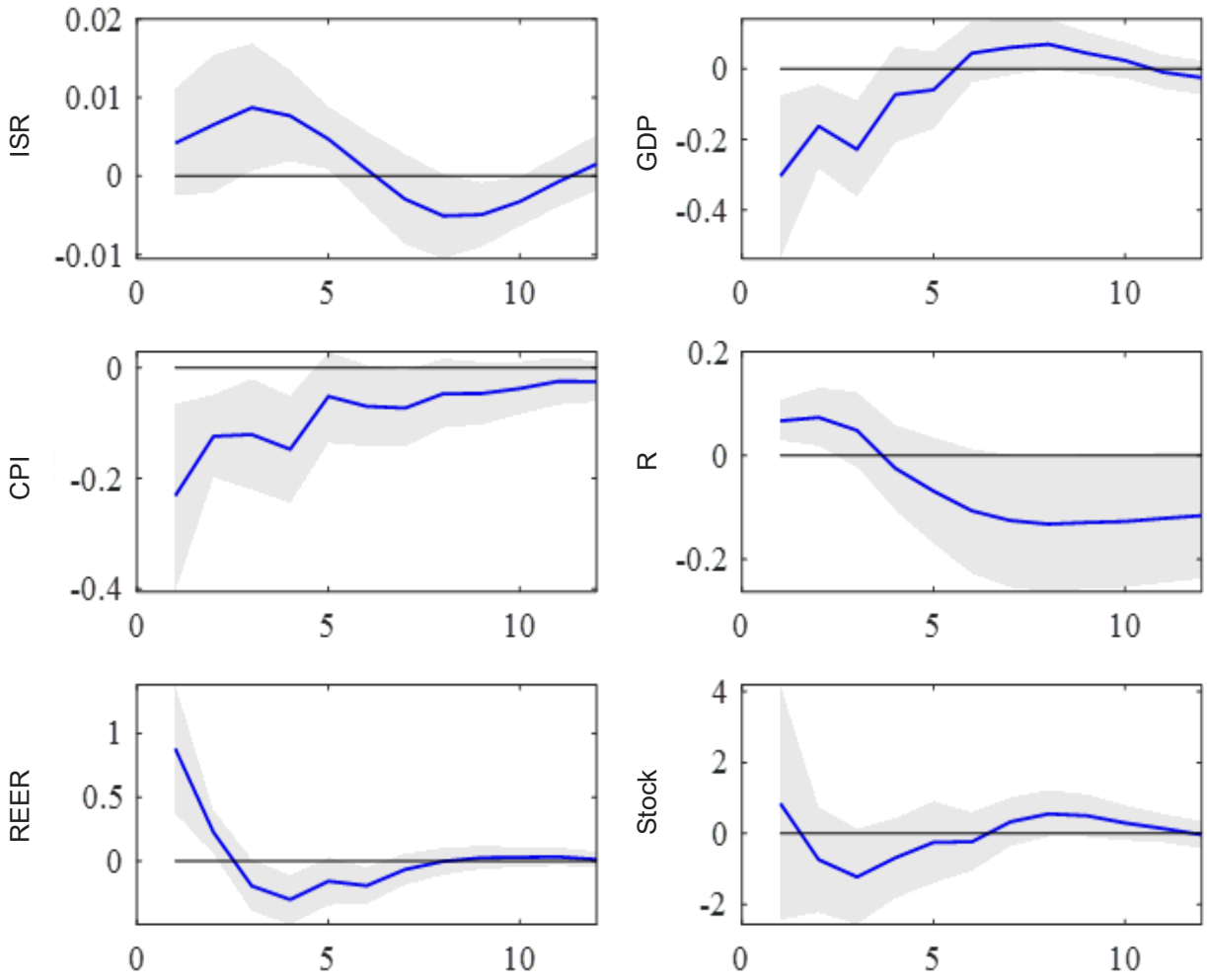
5.4 Robustness Test

Although capital gains are not included in the sources of household disposable income sources, property income (interest, dividends, rent income, etc.) appears to be closely related to the stock market. High-income households have more financial assets such as stocks. If interest rates rise, stock prices fall and companies' willingness to pay dividends is dampened. Furthermore, if stock prices go down, property prices (like real estate) may fall as a result of a wealth effect which would also reduce rental income. All of these cause a decrease in high-income households' property income, which may narrow the household disposable income gap and reduce income inequality.

This section further investigates the role that financial asset prices play in monetary policy. Considering a short housing price series and the absence of housing price wealth effect in Chinese Taipei (see Chen and Wang, 2011), this study aims to incorporate stock return into the VAR model, while not imposing any sign restrictions, to investigate the possible effects.

Chart 16 shows that contractionary interest rate policy does not cause significant stock market volatility. Therefore, the impact of a monetary shock on property income is negligible. Thus, the income share ratio and confidence interval responses are nearly identical when stock price variables are not taken into consideration (see Chart 11). As mentioned above, interest rate policy does not cause significant effects on income inequality via influencing asset prices. This is due firstly to the fact that the Gini index calculation excludes capital gains and secondly, to the fact that monetary policy effects on asset prices are limited.

Chart 16
Impulse Responses of Sign-Restricted SVAR (Income Share Ratio)



Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock; the gray shaded area is the 68% error band.

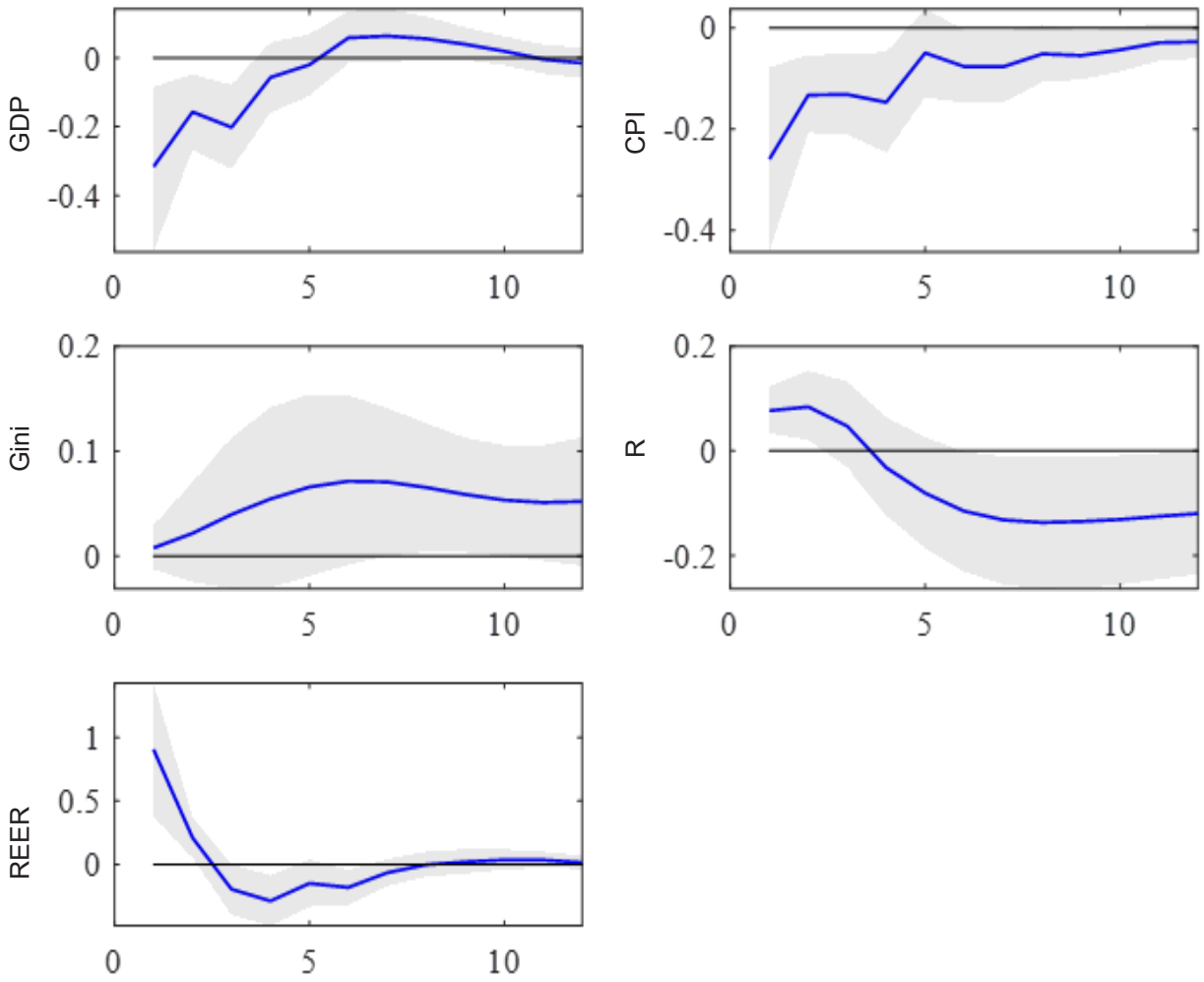
Furthermore, following Mumtaz and Theophilopoulou (2017), we reorder the variables in the Cholesky decomposition as real GDP growth rate, inflation, Gini index/income share ratio, policy interest rate, and REER growth rate.[6] We use the same sign restrictions mentioned earlier to investigate the effects of monetary policy on the Gini index and the income share ratio.

Charts 17 and 18 show that hikes in interest rates temporarily worsen the Gini index and income share ratio in some quarters, and the effect on the income share ratio remains relatively significant.

This result is robust, even if the recursive order is the same as in section 5.1. The monetary policy distributional effects are relatively limited in Chinese Taipei.

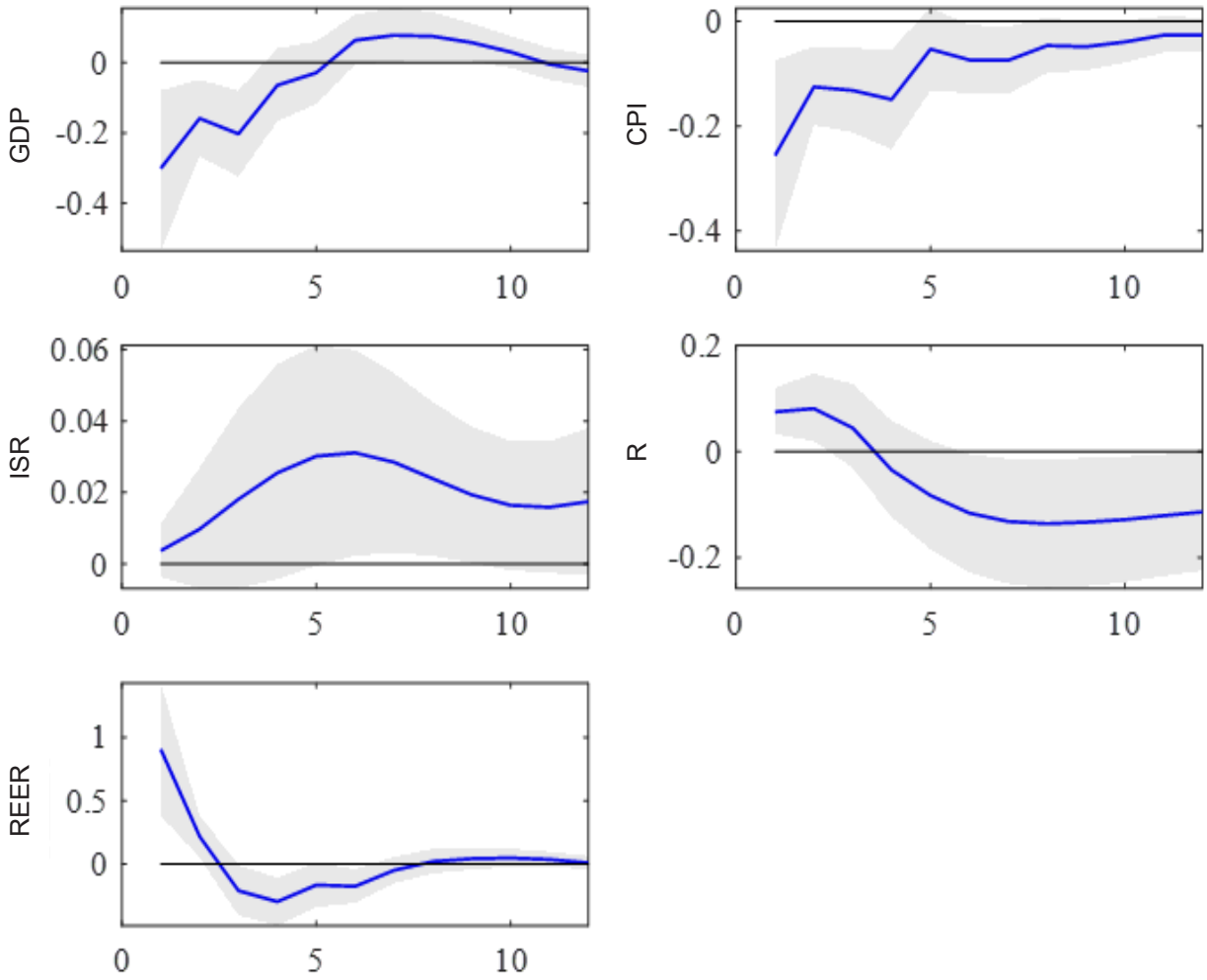
6. We take the log differences of all variables except for policy rate and income inequality.

Chart 17
Impulse Responses of Sign-Restricted SVAR (Gini Index)



Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock; gray shaded area is the 68% error band.

Chart 18
Impulse Responses of Sign-Restricted SVAR (Income Share Ratio)



Note: The blue line is the impulse response to a one standard deviation contractionary monetary policy shock; the gray shaded area is the 68% error band.

6. Conclusion

Past research has focused on the impact of fiscal policy on income inequality, while the distributional effects of monetary policy have not been widely discussed. This paper examines the impact of Chinese Taipei's monetary policy shocks on income inequality using the recursive structural VAR model and sign restrictions.

The recursive structural VAR model shows that raising interest rates does not affect income inequality, but does cause a price puzzle to appear. However, after imposing the sign restriction, the price puzzle disappears. Our results indicate that a contractionary monetary policy shock leads to a significant increase in the income share ratio over a few quarters.

In order to understand the possible reasons behind the responses of income inequality, we further explore the response of the disposable income of the 10th to 90th percentile households to monetary policy tightening. The results show that the impact of monetary policy shocks on 10th percentile household income at around one year is significant. Low-income households are more sensitive to changes in monetary policy.

In addition, we consider the possible role of stock prices, and the results are similar. We also find that contractionary monetary policy has a slight impact on income inequality in our robustness check.

In summary, there is insufficient evidence to support the idea that monetary policy has a significant effect on income inequality in Chinese Taipei. Two policy implications can be drawn from the study. First, the distributional effects of monetary policy tightening should not influence policy decision. Second, because low income households tend to have lower education levels and engage in lower-end jobs, they are more susceptible to the business cycle and economic structural changes. To reduce income inequality in Chinese Taipei, the government should consider policies that would promote education, reinforce the labor market system, and ensure more taxation fairness. Details of the measures are as follows:

1. Education policy: OECD (2011) shows that education is a more effective policy tool for reducing wage inequality. A more equitable distribution of educational opportunities has resulted in a more equitable distribution of labor income. Therefore, policies that increase the level of education and promote equal access to education help reduce inequality.
2. Labor market policy: The government could consider increasing fiscal expenditure on measures such as subsides for vocational training or enhancing job search support.
3. Tax policy: The tax system should be re-examined for equity; the government could re-assess tax measures that benefit mainly high-income groups.

Finally, an interesting area for future research would be to see if an expansionary monetary policy has any effect on income inequality since contractionary and expansionary monetary policy may have asymmetric effects.

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CHAPTER 9

THE DISTRIBUTIONAL IMPACT OF MONETARY POLICY ON INCOME INEQUALITY: A CASE IN VIETNAM

By

Tran Huu Tuyen[1], Trieu Kim Lanh[2], Le Phuong Thao[3]

1. Introduction

During the last two decades, Vietnam has dramatically reduced the level of poverty. Income inequality has become an important public topic in Vietnam, as well as around the world. The gap between the rich and the rest of the population has been increasing vastly over more than 40 years in the world. In Vietnam, average incomes are rising and the number of people who are living in poverty has fallen steadily and significantly in recent years (Oxfam, 2017; World Bank, 2014). The official poverty line in Vietnam is based on income and is used basically for targeting social programs. Since June 2016, the poverty line has been applied: the rural poverty line was VND700,000 per capita per month; and in the urban areas, this was VND1,000,000 per capita per month. Rising income inequality has been a deep concern in recent years. World Bank data shows that income inequality has increased in the last two decades in Vietnam. More importantly, the rich holds the largest share of income. From the data of the Vietnam Household Living Standard Surveys (VHLSS)[4], the gap between the richest quintile and the rest has also been widening since 2004 (Oxfam, 2017). However, average incomes of the bottom 40 grew at 9 percent each year over the last twenty years up to 2012. In the period of 2000-2018, the Gini Index of Vietnam reached its peak point, which was 39.3 in 2010, placing it in the middle of the global Gini distribution. Concerns about inequality have arisen although the economic growth of Vietnam is changing positively and rapidly together with slight increases in income inequality. These concerns in part may reflect the substantial disparities in economic conditions of geographical areas and ethnic groups (World Bank, 2014). This aggravates economic inequality further by the poverty of voice and opportunities. In Vietnam, ethnic minorities[5], small-scale farmers, migrant workers, and women are more likely to be poor and face the most discrimination (Oxfam, 2017). The population that experiences poverty is mainly in the North West and North East, in the border areas of the North Central and South Central Coasts, and some parts of the Central Highlands (World Bank, 2014).

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3. Monetary Policy Department, State Bank of Vietnam.
4. Vietnam Households Living Standard Surveys are conducted by the General Statistics Office of Vietnam (GSO) with technical assistance from the World Bank. The VHLSS is carried out every two years. The lastest survey is the 2016 VHLSS.
5. Ethnic minorities are about 15 percent of the Vietnam's population, but account for 70 percent of the extreme poor (Oxfam, 2017; World Bank, 2014).

Studying the relationship between economic growth and income inequality is still an important topic in Vietnam, as well as around the world. More researches on monetary policy and income inequality are needed to provide recommendations in reducing inequality and poverty.

2. Overview of Monetary Policy Management of the State Bank of Vietnam and Inequality Income in Vietnam

2.1 Monetary Policy Management of the State Bank of Vietnam

According to Article 3 Law on the State Bank of Viet Nam (SBV), the national monetary policies are national-level decisions on monetary affairs made by state authorities, including decisions on the currency value stabilization represented by the inflation target, use of proper instruments and measures to fulfill the set objectives. Every year, based on the guidance of the National Assembly and the Government, the SBV issues Directives setting orientations, key tasks for the whole banking sector, including targets of monetary policy management. In general, monetary policy is conducted in an active, flexible and effective manner, closely coordinating with fiscal policy and other macroeconomic policies to control the inflation, stabilize the monetary and financial system, stabilize the macroeconomy, and contribute to the economic growth at a sustainable level, ensuring the liquidity of credit institutions as well as stabilizing the monetary and foreign exchange markets. With the implementation of strong solutions since 2012, inflation has been well-controlled below the goal set by the National Assembly while the economic growth rate has reached an impressive level (Table 1) (Dang, 2018; N. H. Vu, Tran, Nguyen, Phan, & Le, 2019).

Table 1
The indicators of Inflation and Economic Growth between Target and Actual Value, 2001 – 2018

Year	CPI		GDP Growth Rate	
	Target	Actual Value	Target	Actual Value
2001	5	-0.3	7.5 - 8	6.9
2002	5	4.2	7 - 7.5	7.1
2003	3	3.2	7 - 7.5	7.3
2004	< 5	7.7	7.5 - 8	7.8
2005	< 6.5	8.3	8.5	8.4
2006	8	7.4	< 8	8.2
2007	< 8.2 - 8.5	8.3	8.2 - 8.5	8.5
2008	< 8.5 - 9	23.1	7*	6.3
2009	< 15.7*	6.7	5	5.3
2010	< 7.8*	9.2	6.5	6.4
2011	7.15*, 17*	18.7	7 - 7.5	6.2
2012	< 10	9.1	6 - 6.5	5.2
2013	8	6.6	5.5	5.4
2014	7	4.1	5.8	6.0
2015	< 5	0.6	6.2	6.7
2016	< 5	2.7	6.7	6.2
2017	About 4	3.5	6.7	6.8
2018	About 4	3.5	6.7	7.1

Note: * changing the target in year.
Source: SBV (2004-2017), ARIC (2019) and GSO (2019).

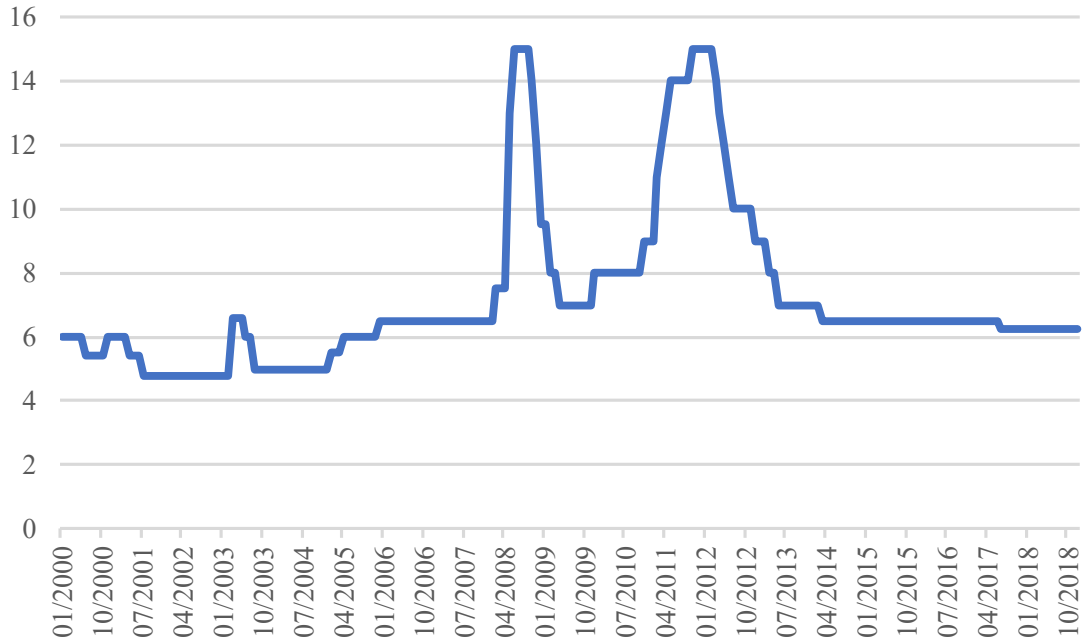
To conduct monetary policy, the State Bank of Vietnam uses monetary policy instruments, including refinancing, interest rates, foreign exchange rate, compulsory reserves, open-market operations and other instruments and measures as regulated by the Government[6]. All the instruments are conducted in a proactive, flexible and cautious manner. In this research paper, we will focus on related instruments such as policy interest rate (in the context of the SBV's interest rate policy), foreign exchange rate and credit policy.

6. Article 10, Law on the State Bank of Vietnam 2010.

2.1.1 Policy Interest Rate

According to Pham Chi Quang et al. (2018), policy interest rates include refinancing rate, rediscount rate, overnight lending rate, base interest rate[7], open market operation (OMO) reverse repo rate, SBV bill rate. The significance of the above-mentioned interest rates as policy rates varies depending on each specific period. The rates are managed in close relation with relevant business processes and they move in parallel with one another when the State Bank of Vietnam makes changes on monetary policy management. The refinancing rate, rediscount rate and overnight lending rate were managed more actively during 2005-2014 and have gradually stabilized in recent years along with the stable trend of other interest rates as reflected by SBV's interest rate policy in general. At the end of 2018, the refinancing rate was 6.25 percent per annum, the rediscount rate was 4.25 precent per annum while the overnight interbank lending rate was 7.25 percent per annum. As all policy rates move along with each other, the policy rate used to run the model is the refinancing rate.

Figure 1
Refinancing Rate of SBV, 2000 - 2018



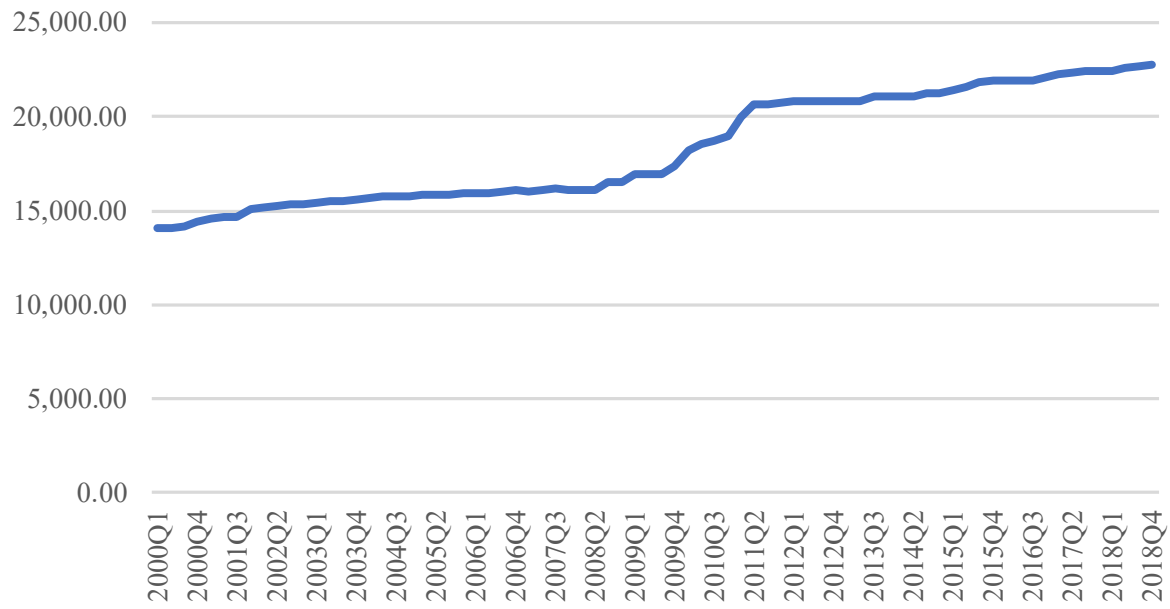
Source: IFS (2019).

7. Base interest rate was used as policy interest rate mainly during 2000-2010. It was introduced in 2000 with the original target as an indicator for credit institutions setting lending rate cap. However, from 2002-2008, following interest rate liberalization, the base rate was considered only as a reference. In 2008, the base rate once again worked as cap for both deposit and lending rate set by credit institutions with the regulation requirement that VND deposit and lending rate could not exceed 150 percent of the base rate. As other interest rate instruments were proven to be more effective, the use of the base rate gradually faded. Since 2010, the State Bank of Vietnam has stopped announcing the monthly base interest rate.

2.1.2 Exchange Rate Management

In general, exchange rate management is conducted in a uniformed and flexible manner. There was an important change in exchange rate policy in 2016. Before 2016, the exchange rate was regulated based on the average interbank exchange rate and trading band. From 2016, the central exchange rate (USD/VND) has been used. The central exchange rate is announced on a daily basis based on developments in the domestic and international markets, macroeconomic and monetary balances and monetary policy objectives. Different from the previous interbank exchange rate which was only adjusted upon specific events, the central exchange rate has been conducted on a daily basis, moving in both directions (upward and downward) which contribute to the trimming down of foreign currency speculation and reducing the dollarization in the economy. Other than that, the buying/selling exchange rate, forward foreign exchange purchases/sales with credit institutions are also actively used. In short, the exchange rate policy is well managed, consistent with other policies such as liquidity management, VND, and USD interest rates, communication policy, in order to enhance the transparency and effectiveness of foreign exchange policy in particular and, monetary policy in general. Therefore, in recent years, the exchange rates have been relatively stable, with flexible movements in accordance with the changes in the market conditions and the legitimate demands for foreign currencies have been met fully and promptly. The SBV's net purchases of foreign currencies have constantly supplied the State's foreign exchange reserves.

Figure 2
Exchange Rate, VND per USD (Average), 2000-2018



Source: ARIC (2019).

2.1.3 Credit Policy

In line with other monetary policy instruments, the credit growth target has been used since 2010. During 2010-2011, only a credit growth target for the whole banking system was applied, but since 2012, both credit growth targets for the banking system and credit growth limit for each credit institution have been managed. Specifically, the credit growth cap is set on the basis of economic growth and inflation target set by the National Assembly and the Government. The credit growth ceilings for individual credit institutions are allocated based on their financial soundness, their demand and their ability to expand credit activities in a safe manner. The SBV also requires credit institutions to constantly improve credit quality, concentrate credit capital on the production domains, especially on the prioritized areas under the Government's directions and strictly controlling credit for risky areas. In the specific year (2011-2012), credit to non-production sectors to total outstanding credit was reined to less than 22% (by 30/6/2011), 16% in 2012 (but some borrowers and borrowing purposes were removed from the non-production sectors). This ratio was abandoned in 2013 as the SBV changed the regulation from limiting credit in non-production sectors to encouraging credit institutions to channel credit to prioritized areas.

For the purpose of this research, the variable "claim on the private sector" is used to represent the effect of credit policy on the private sector.

Figure 3
Claims on the Private Sector, y-o-y%, 2000-2018

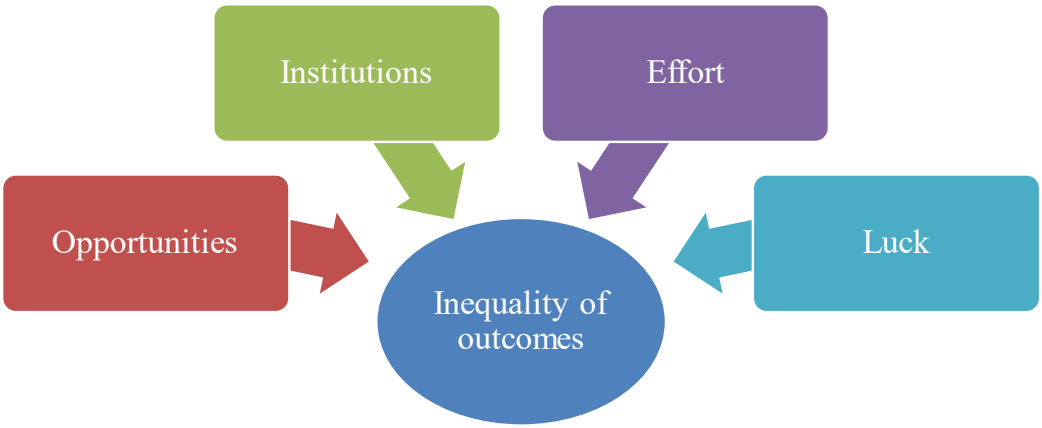
Source: ARIC (2019).

2.2 Income Inequality in Vietnam

According to the Longman Dictionary, inequality is an *"unfair situation, in which some groups in society have more money, opportunities, power, etc. than others"* (Longman, 2019). This is a concept very much at the heart of social justice theories. Many people understand the definition of inequality in different dimensions. Some authors distinguish "economic inequality" mostly meaning "income inequality", "monetary inequality", or more widely, "living conditions inequality" (United Nations, 2015; N. H. Vu et al., 2019). Regarding economic inequality, there are two approaches or views to consider . The first view is only concerned with the inequality of outcomes and the second view is concerned with the inequality of opportunity. The inequality of outcomes occurs when there is inequality in individuals' possession of material wealth or overall living economic conditions such as inequalities in income/wealth, education, health and nutrition. The second approach of income inequality is concerned with human well-being, which should be defined and measured through beings and doings valued by people and the freedom to choose or to act. There is the difference in age, gender, family background, disability, climatic conditions, societal conditions[8], customs, and convention, among other factors, so equalizing income should not be the goal, because not all people convert income into well-being and freedom in the same way. On the other hand, what should be equalized is not a means of living, people have the actual opportunities of living to pursue their own lives (United Nations, 2015; N. H. Vu et al., 2019).

From the point of view of income and expenditure, the inequality of outcomes is the result of the interaction between inequality of opportunities, societal institutions, effort, and luck. Opportunities mean the individual circumstances at birth which are different from one another, for example, genders, ethnic groups, place of birth, and the income or education levels of parents. Societal institutions are the economic and political rules and organizations of society. The effort is an attempt by every individual in every action. Finally, luck also plays a key role in determining the individual's achievement and inequality of outcomes (World Bank, 2014).

Figure 4
A Framework for Understanding Inequality of Outcomes



Source: World Bank (2014).

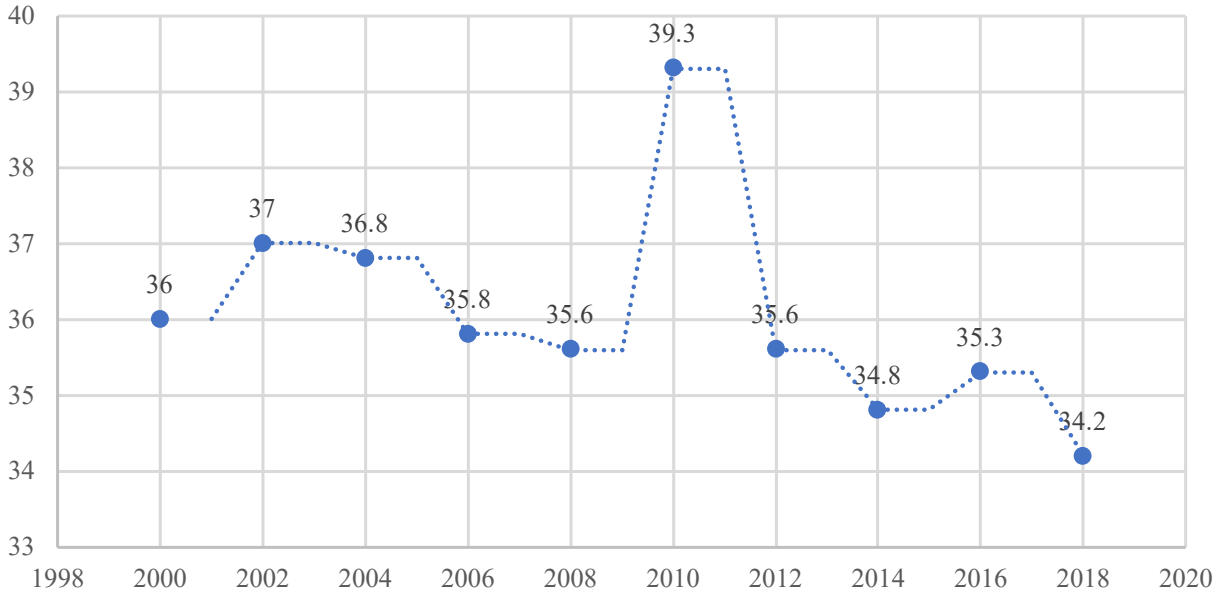
8. Health care, education systems, the prevalence of crime, community relationships.

Finally, although there are two approaches to inequality, development theory has largely been concerned with inequalities in standards of living which means that it is defined in terms of the traditional outcome-oriented view (United Nations, 2015; N. H. Vu et al., 2019).

Inequality is a broader concept than poverty and it is defined over the entire population, not just a portion of the population. The simplest way to measure inequality is by dividing the population into fifths (quintiles) from the poorest to the richest and reporting the proportions of income (or expenditure) that accrue at each level. There have been various measures of inequality developed since 1983, but the following measures are generally used: (i) Decile Dispersion Ratio, (ii) Gini Coefficient of Inequality, (iii) Generalized Entropy Measures (or Theil Indexes), (iv) Atkinson's Inequality Measures, and (v) Measuring Pro-poor Growth (Haughton & Khandker, 2009; N. H. Vu et al., 2019). Among the indicators measuring inequality above, the Gini Index is a popular measure, which ranges from 0 to 1. If the result of the Gini Index is 0, it means that there is perfect equality, or vice-versa, it is perfect inequality. Usually, the typical range of the Gini Index is between 0.3 to 0.5 for per capita expenditure. Although the Gini Index coefficient is easy to understand and has many desirable properties[9], it cannot be easily decomposed to show the sources of inequality (Haughton & Khandker, 2009; N. H. Vu et al., 2019).

The income inequality of Vietnam using the Gini coefficient estimated by the World Bank and updated in December 2016 stood at 35.3 percent. Figure 5 shows that the inequality trend appears to be increasing. From 1992-2016, the average Gini coefficient was 35.6 percent per year by the World Bank estimate. The trend reached a peak of 39.3 percent in 2010 before dropping to a low of 34.8 percent in 2014 (CEIC, 2019b; N. H. Vu et al., 2019; World Bank, 2018).

Figure 5
Gini Index of Vietnam, 2000-2018



Source: World Bank (2019), CEIC (2019b).

9. Such as mean independence, population size independence, symmetry, and Pigou-Dalton Transfer sensitivity.

Table 2 reveals that the increase in inequality occurred entirely in the rural areas instead of urban areas, especially at the Central Highlands and Mekong Delta with an increase in the Gini Index by approximately 2 percent. The data confirmed by the Theil index also reinforces this circumstance of Vietnam's inequality (Table 2) (N. H. Vu et al., 2019; World Bank, 2018).

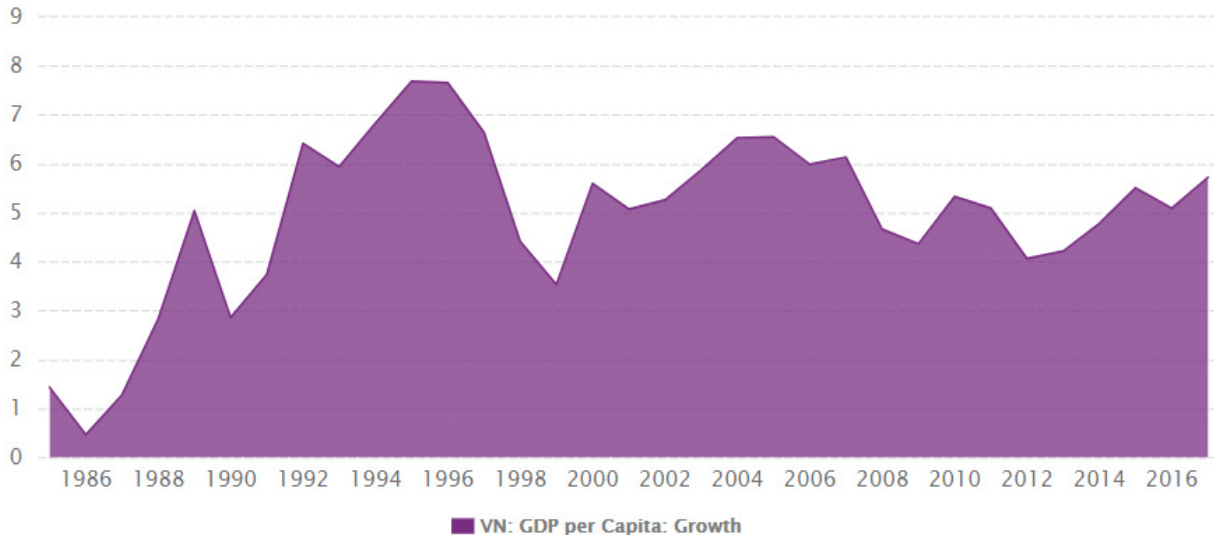
Table 2
Trends in Inequality, 2010-2016

	Gini Coefficient				Theil Index			
	2010	2012	2014	2016	2010	2012	2014	2016
National	**39.3**	**35.6**	**34.8**	**35.3**	**29.4**	**22.9**	**21.6**	**22.3**
Urban	38.6	31.7	33.1	32.9	27.8	21.4	19.7	19.5
Rural	33.2	34.4	31.0	31.8	20.0	17.4	16.5	17.7
Region								
Red River Delta	40.1	34.4	33.6	32.8	29.7	20.9	20.3	19.3
Midlands and Northern Mountains	37.1	36.6	37.0	36.4	23.9	23.4	25.0	23.9
Northern and Coastal Central	34.0	33.3	33.2	33.9	20.9	19.6	19.6	20.9
Central Highlands	36.7	37.9	38.9	39.7	23.0	25.2	26.3	27.3
Southeast	39.8	33.3	31.1	30.9	31.6	20.5	18.0	17.4
Mekong Delta	31.7	30.3	28.7	30.6	17.8	17.6	14.5	17.3

Source: World Bank (2018).

Vietnam's GDP per capita growth which is updated yearly, is estimated by the World Bank, averaging 5.095 percent during the period of 1985-2017. From Figure 6, it can be noted that the GDP per capita growth of Vietnam reached a maximum of 7.685 percent in 1995 and a minimum of 0.469% in 1986 (at 427.356 USD). In 2017, GDP per capita growth in Vietnam was reported at 5.726 percent in December (at 2,389 USD). The income of Vietnam has been increasing considerably overtime. Meanwhile, the income inequality trend has also been steadily increasing. Although the inequality trend is decreasing in the urban areas and going up in the rural, the income inequality of the urban areas is still higher than those of the rural at about 1.1 percent (Table 2).

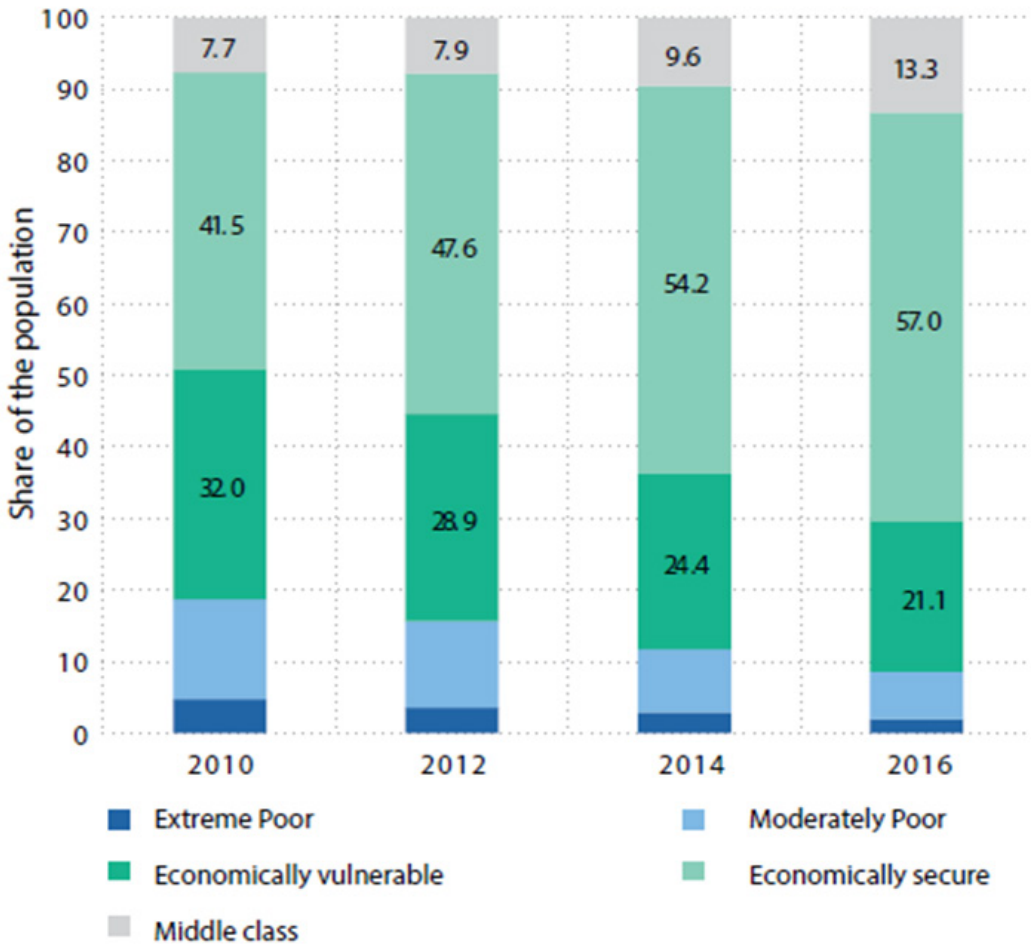
Figure 6
GDP Per Capita Growth (%)



Source: World Bank (2019), CEIC (2019a).

Figure 7 reveals that the population by economic class changed sharply in 2010 compared with 2016. Following that, the share of households classified as economically secure and middle class increased from less than 50 percent in 2010 to 70 percent in 2016. The population classified as economically vulnerable, moderately poor and extreme poor decreased quickly from 50.8 percent in 2010 to 29.7 percent in 2016, which shows that the households not only managed to escape poverty but could progress out of the economic insecurity to a place in the consumer class. The consequence is that poverty reduction in Vietnam has had encouraging results, providing robust evidence of upward movement, but nonetheless, there is the potential of increasing income inequality (N. H. Vu et al., 2019; World Bank, 2018).

Figure 7
Population by Economic Class, 2010-2016



Source: World Bank (2018).

3. Related Literature

3.1 Related Papers of Monetary Policy and Income Inequality

In empirical research, most studies focused on the impact of monetary policy on income inequality and their findings can be divided into three groups as follows: (i) monetary policy does not affect income inequality significantly (Inui, Sudo, & Yamada, 2017; O'Farrell, Rawdanowicz, & Inaba, 2016), (ii) contractionary monetary policy increases income inequality (Coibion, Gorodnichenko, Kueng, & Silvia, 2012; Davtyan, 2016; Furceri, Loungani, & Zdzienicka, 2016; N. H. Vu et al., 2019), and (iii) expansionary monetary policy increases income inequality (Bivens, 2015; Furceri et al., 2016; N. H. Vu et al., 2019). Other researches, however, derived different results from the abovementioned three groups (Davtyan, 2016; Domanski, Scatigna, & Zabai, 2016; Saiki & Frost, 2014).

Table 3
Some Related Researches on Monetary Policy and Income Inequality

No.	Author	Objectives	Methodology	Data
1	N. H. Vu et al. (2019)	Examining the impact of monetary policy on income inequality in Vietnam	VAR	Vietnam, quarterly, 2000Q1 - 2015Q4
2	Inui et al. (2017)	Studying the distributional effects of monetary policy	DSGE model LLP[10] approach	Japan, micro-level data of households, quarterly, 1981Q1-2008Q4
3	O'Farrell et al. (2016)	The effects of monetary policy on inequality over the business cycle via its impacts on returns on assets, the cost of debt servicing and asset prices	Analyzing two-way interactions	Selected advanced economies, 2007-2015
4	Coibion et al. (2012)	Analyzing the effects and historical contribution of monetary policy shocks to consumption and income inequality in the United States	VAR	The U.S., micro-level data on income and consumption, quarterly, 1980Q1-2008Q4
5	Furceri et al. (2016)	The effect of monetary policy shocks on income inequality	VAR	A panel of 32 advanced and emerging market countries, 1990-2013
6	Bivens (2015)	Comparing the distributional consequences of Fed policy on two counterfactuals: (1) a fiscal stimulus with roughly the same boost to output as low-interest rates and LSAPs[11] produced and (2) no macroeconomic stimulus at all	Analyzing and OLS	The U.S., 1979-2011
7	Domanski et al. (2016)	Exploring the recent evolution of household wealth inequality in advanced economies by looking at valuation effects on household assets and liabilities	Analyzing and simulation	Advanced economies, micro-level data, 1810-2010
8		Employing contemporaneous restrictions with ex-ante identified monetary policy shocks as well as log run identification	VAR VECM	The U.S., annually, 1979-2012
9	Saiki and Frost (2014)	The impact of unconventional monetary policy (UMP) on inequality	VAR	Japan, quarterly, 2008Q3-2014Q1

10. The Local Linear Protection proposed by Jorda (2005).
11. Large-scale asset purchases known as "quantitative easing".

Table 4
The Results of Related Researches

No.	Author	Income Inequality		
		Contractionary Monetary Policy	Expansionary Monetary Policy	Unconventional Monetary Policy
1		Increase	Decrease in short-term	
2	Inui et al. (2017)		Insignificant	
3	O'Farrell et al. (2016)	Insignificant	Insignificant	
4	Coibion et al. (2012)	Increase		
5	Furceri et al. (2016)	Increase	Decrease	
6	Bivens (2015)		Decrease	
7	Domanski et al. (2016)		Increase	
8	Davtyan (2016)	Decrease		
9	Saiki and Frost (2014)			Increase

For the VAR model results, N. H. Vu et al. (2019) stated that monetary policy (variables used were money supply shock and policy rate) and economic growth were the main factors that affected income inequality in Vietnam for the period 2000-2015. The impact magnitude was quite big and stable while the impact orientation could be explained by economic theories. There was no statistical evidence for other factors such as inflation, unemployment rate, and education status to confirm the contribution of these variables to the change of the Gini index.

Meanwhile, Inui et al. (2017) find that monetary policy shocks do not have statistically significant impacts on inequalities across Japanese households in a stable manner. O'Farrell et al. (2016) demonstrate that the effects of monetary policy on inequality through financial channels tend to be small and vary significantly for 8 OECD countries. Coibion et al. (2012) show that contractionary MP tends to raise inequality in earnings and total income in the USA. Furceri et al. (2016) find that contractionary (expansionary) monetary actions increase (reduce) income inequality. Bivens (2015) finds that expansionary monetary policy could reduce inequality if the economy is close to full employment, but that the relative distributional effects of recent Fed policy actions are small. Domanski et al. (2016) find that the impact of low-interest rates and rising bond prices on wealth inequality may have been small, while rising equity prices may have added to wealth inequality. A recovery of house prices appears to have only partly offset this effect. Davtyan (2016) finds that contractionary monetary policy decreases income inequality in the country. Saiki and Frost (2014) argue that unconventional monetary policy raises income inequality in Japan in the short-run.

3.2. Related Papers of Economic Growth and Income Inequality

Except for the publication of N. H. Vu et al. (2019) which study the impact of the monetary policy and income inequality in Vietnam, there are other researches which delve into economic growth and income inequality.

In general, the other papers were conducted domestically (Vietnam) and looked at economic growth and income inequality. Some papers delved into the impact of foreign direct investment on income inequality (Nguyen & Nguyen, 2019) while others were about economic growth and inequality or imparity. The results show that there is an insignificant impact on economic growth and inequality (Le, 2010b) and vice-versa. Some reveal a positive relationship (T. S. Vu, 2010). Almost all suggest some recommendations and policy implications based on the detailed analysis of the statistical data on GDP per capita, income trend of quintiles, the gap of the rich and the poor and public resource allocation which are still not rationalized (Le, 2010a; Ngo & Nguyen, 2005; Pham, 2010). Almost all the research uses the Gini Coefficient Index as a variable proxying for income inequality.

Table 5
Some Related Researches on Economic Growth and Income Inequality in Vietnam

No.	Author	Objectives	Methodology	Data
1	Nguyen and Nguyen (2019)	Studying the relationship between FDI and income imparity	FEM	50 cities and provinces in Vietnam, 2006-2015
2	Pham (2010)	Estimating income inequality among provinces, finding out the reasons for inequality, regressing to study the relationship between income growth and economic growth, fiscal policy	Cross regression, data analysis	61 provinces and cities in Vietnam, 2000-2008
3	T. S. Vu (2010)	Examining the effect of economic growth on income inequality	OLS	Vietnam, 1998-2006
4	Le (2010b)	Employing the impact of income inequality on economic growth in Vietnam	Regressing 3 models with variables: GDP growth rate, Gini index, the gap of the richest quintile and the poorest one, some socio-economic variables	Vietnam, 1998-2006
5	Le (2010a)	Summarizing the theory and practice economic growth and income inequality, analyzing and recommending to promote sustainable economic development.	Analyzing the date of income and GDP: Gini index, GDP per capita, quintiles	Vietnam, 1993-2006
6	Ngo and Nguyen (2005)	Systemizing the tripartite relationship between economic growth, poverty, and income inequality. Then next, analyzing the mentioned relationship, suggesting recommendations aimed at pro-poor growth and friendly distribution.	Analyzing 3 factors: economic growth, poverty, and income inequality through 2 phases: 1992-1993 and 1997-1998	Vietnam, 1992-1998

Nguyen and Nguyen (2019) study the relationship between foreign direct investment and income inequality by using the data of 50 cities and provinces in Vietnam. They measure income imparity through the population-weighted coefficient of variation (PW-CV) of Kyriacou and Roca-Sagalés (2012). The results show that FDI flows affect income imparity in the form of reverse U. This is the updated research on income imparity in Vietnam.

Pham (2010) measured income inequality through the concept of convergence in the Neoclassical Growth Model according to Barro and Sala-i-Marti (1992). Pham (2010) used the GDP per capita, in comparison with the price of 1994, of 61 provinces and cities for the period of 2000-2008 and the results show that there was no convergence between β and δ in Vietnam over these years. The poor areas did not tend to grow faster than the rich ones as implicated by the Solow growth model. The results also suggest that it was necessary to adjust fiscal policy in order to allocate public resources more optimally.

T. S. Vu (2010) examined the effect of economic growth on income inequality in Vietnam for the period 1998-2006 using the OLS regression and came to two conclusions that: (i) in terms of the total economy, inequality had the positive relationship with economic growth in Vietnam; (ii) in terms of the scope of the economic areas, there is a positive relationship between the income inequality level and economic growth in the economic areas which better developed, especially the Red River Delta, Mekong Delta, Southeast, and Central Highlands.

Le (2010a) measured income inequality via the Gini index and conducted a detailed analysis of the relationship between economic growth and income inequality for the period of 1993-2006. The results reveal that the impact of economic growth on inequality in Vietnam may be derived from various channels as follows: (i) the conversion from the centralization of a planned economy to a market mechanism, (ii) the rapid economic growth due to industrialization and urbanization, (iii) integration of international economy and opening of the economy, and (iv) the formation of beneficiary groups because of the give-receive mechanism.

Le (2010b) used an econometric model to find out the effect of income inequality on economic growth for the period of 1996-2006 in Vietnam. The results show that income inequality caused insignificant economic growth because some indicators such as the possibility of capital inclusion, education, healthcare, and population reproduction showed a negative effect, albeit some being positive.

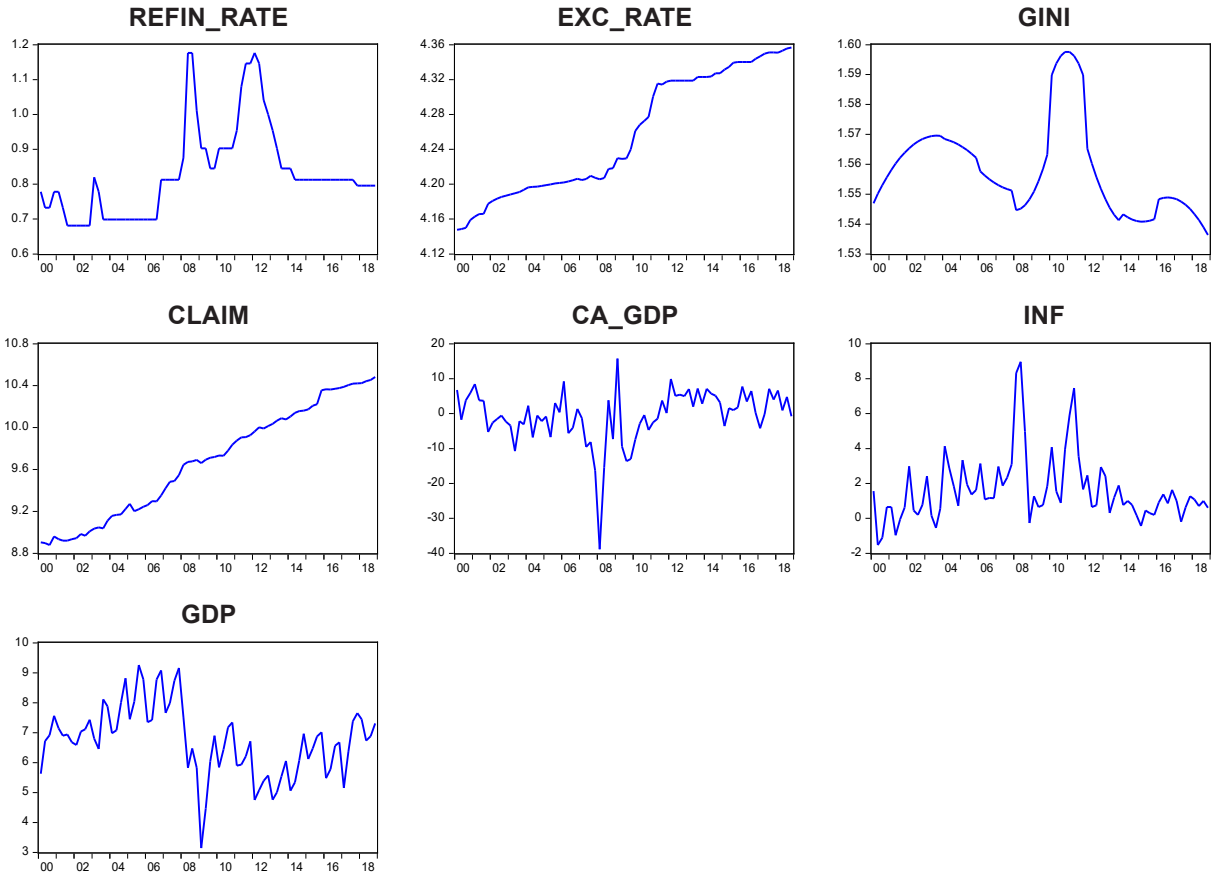
Ngo and Nguyen (2005) divided the paper into 2 sections. Section 1 have a generalization of the tripartite relationship between economic growth, poverty and income inequality using Vietnam data. Section 2 was an analysis of the tripartite relationship by statistical data and the matrix indicators. The analysis was conducted for the period of 1992-1998 and looked at two phases, especially during the “Doi Moi” period.

4. The Distributional Effect of Monetary Policy in Vietnam: A VAR Model Approach

4.1 Data

Data used in the empirical analysis are collected from various sources, including CEIC, ADB, IFS, SBV, and GSO for the period from 2000-2018. Data is available quarterly except for the Gini Index which is calculated every 2 years. We interpolated the Gini Coefficient Index from every 2 years into quarterly data. All variables are shown in the logarithm form, ratio to GDP or growth rates, depending on the variables. Figure 8 shows the fluctuations of variables used in the model and Table 6 provides the summary statistics of the variables.

Figure 8
Fluctuation of Variables



Source: Team's calculations.

Table 6
Summary Statistics

	REFIN_RATE	EXC_RATE	GINI	CLAIM	CA_GDP	INF	GDP
Mean	0.831012	4.256549	1.557969	9.672745	-0.498513	1.628547	6.732263
Median	0.812900	4.229746	1.554144	9.702850	0.204000	1.089872	6.833000
Maximum	1.176100	4.356876	1.597575	10.48212	15.76100	8.968726	9.261000
Minimum	0.681200	4.147779	1.536322	8.879096	-38.83400	-1.535088	3.140000
Std. Dev.	0.131936	0.069632	0.015634	0.522543	7.608439	1.919280	1.175646
Skewness	1.197710	0.089242	1.116166	-0.033272	-1.826658	1.785025	-0.131905
Kurtosis	3.909346	1.375206	3.656770	1.630053	10.06744	6.961553	3.301219
Jarque-Bera	20.78901	8.460739	17.14641	5.957079	200.4356	90.05735	0.507709
Probability	0.000031	0.014547	0.000189	0.050867	0.000000	0.000000	0.775805
Sum	63.15690	323.4977	118.4057	735.1286	-37.88700	123.7696	511.6520
Sum Sq. Dev.	1.305541	0.363645	0.018333	20.47884	4341.626	276.2726	103.6608
Observations	76	76	76	76	76	76	76

Source: Team's calculations.

4.2 Methodology

To estimate the distributional effect of monetary policy on Vietnam's economy, we employ the vector autoregressive (VAR) model with the following variables: ***refin_rate, exc_rate, gini, claim, ca_gdp, inf,*** and ***gdp.*** The Gini Index is a proxy for income inequality, refinancing rate and claim to private sector representatives for changes in monetary policy. In the recent past, SBV has seldom adjusted its policy rates. Therefore, changes in monetary policy are not fully reflected by fluctuations in policy rates. In comparison with other policy rates, the refinancing rate is the most suitable proxy for SBV's monetary policy stance. Moreover, claims of the private sector is one of the best proxies of the monetary policy stance in Vietnam. The ratio of the current account to GDP and nominal exchange rate of USD/VND represent the external sector. The economic growth rate and inflation rate are also included. The VAR model takes the following form:

$$x_t = (d(refin\_rate_t), d(exc\_rate_t), d(gini_t), d(claim_t), ca\_gdp_t, inf_t, d(gdp_t))'$$

where:

$refin\_rate_t$ is the logarithm of the refinancing rate at the end of a quarter

exc_rate_t is the logarithm of the average exchange rate

$gini_t$ is the logarithm of the Gini coefficient index

$claim_t$ is the logarithm of the total credit to the private sector

ca_gdp_t is the ratio of the current account to GDP

inf_t is the growth rate of the consumer price index

gdp_t is the real gross domestic product growth rate

We estimate the two VAR models with some significant restrictions, including VAR Basic (4 variables) and VAR Full (7 variables).

4.3 Empirical Results

Before employing the VAR models, it is important to test whether the variables used in the model are stationary or not. This step makes sure that the variables are not subject to spurious correlation. The results of the unit root test is shown in Table 7. The ratio of the current account to GDP and inflation rate is stationary at level. All other variables are stationary at 1st difference at 1% or 5% significance levels.

Table 7
VAR Unit Root Test Result

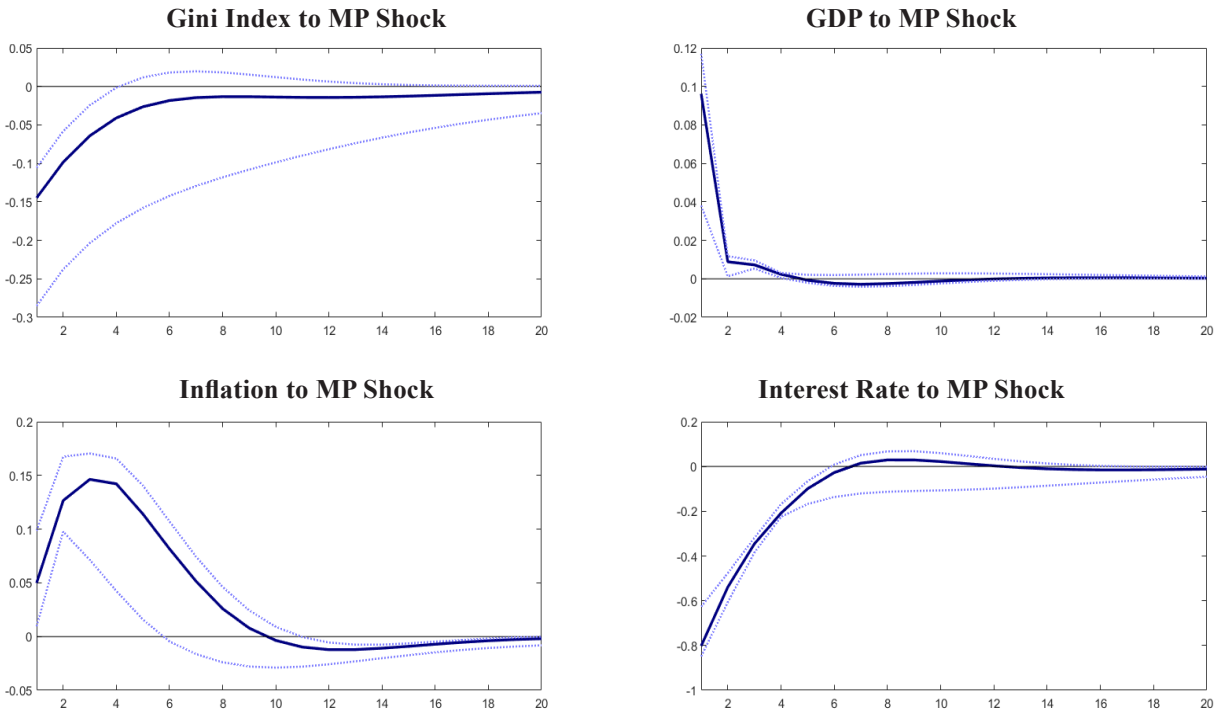
	At level		At 1st difference		Conclusion
	t-statistic	p-value	t-statistic	p-value	
refin_rate	-2.613024	0.0949	-6.927330	0.0000	Stationary at 1
exc_rate	-0.788966	0.8160	-6.021114	0.0000	Stationary at 1
gini	-2.335657	0.1638	-5.149823	0.0001	Stationary at 1
claim	0.008988	0.9560	-8.580858	0.0000	Stationary at 1
ca_gdp	-5.166897	0.0000			Stationary at 0
inf	-5.030616	0.0001			Stationary at 0
gdp	-1.674883	0.4392	-3.349543	0.0164	Stationary at 1

Source: Team's own calculations.

The optimal lag is checked by the lags criteria test. The stability of the model is checked by the AR root test while the autocorrelation phenomena is checked by the LM test to determine the consistency and efficiency of VAR. The impulse response function (IRF) is used to analyze the response of the Gini index to shocks (Figure 9).

In general, the IRF results show that an expansionary monetary policy leads to higher economic growth and inflation rate. These results are as predicted by economic theories. Moreover, a shock to monetary policy by decreasing the policy rate or increasing money supply has a positive effect on $(gini_t)$. More specifically, the Gini Index in Vietnam decreases in the first four quarters. This effect is statistically significant for the first four quarters. It is hard to understand the transmission channels, but the Gini Index is statistically significant when inflation increases, thus we can assume that the transmission channel may occur through the inflation channel.

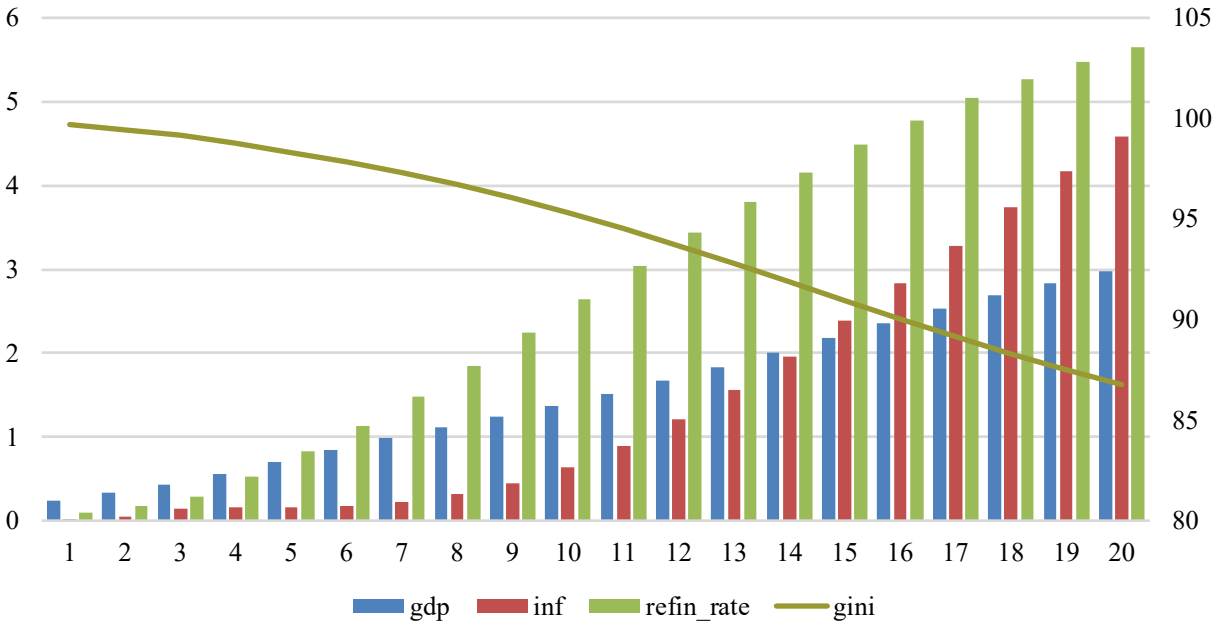
Figure 9
Impulse Response Function Var Basic (4 Variables)



Source: Team's calculations.

To clarify the contribution of the shocks to the variance of Gini Index, the variance decomposition results are calculated (Figure 10). The results show that the refinancing rate shocks explain most of the variation in the Gini Index, followed by inflation. Hence, the variance decomposition results support the above findings and confirm the importance of monetary policy in variances of the Gini Index in Vietnam.

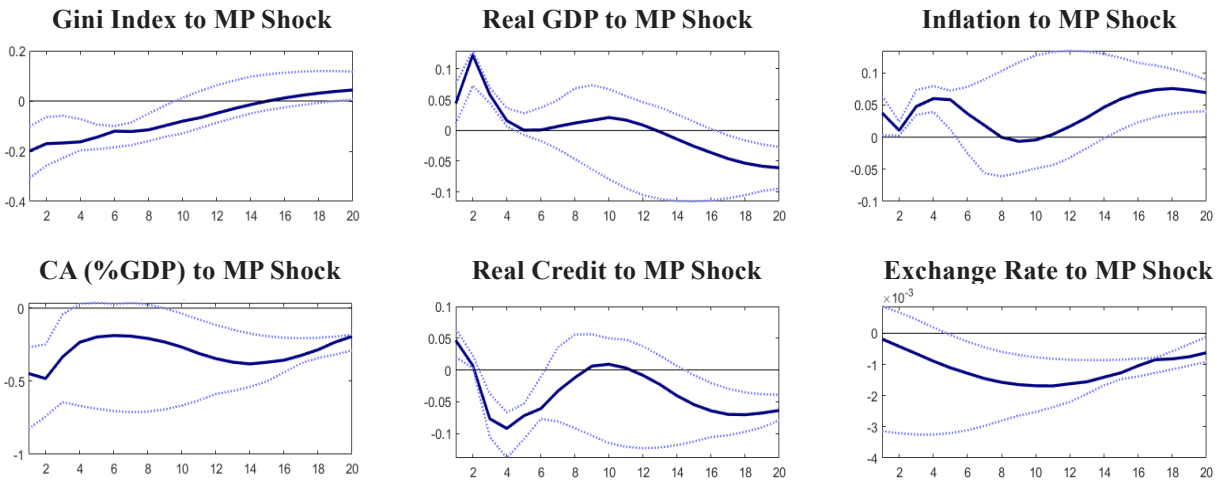
Figure 10
Variance Decomposition VAR Basic (4 Variables)



Source: Team's own calculations.

In terms of the VAR full model with seven variables, economic growth and inflation have a similar response to an expansionary monetary policy. Interestingly, the Gini Index decreases for the first nine quarters after monetary policy shock occurs (Figure 11). Moreover, lower interest rate implies higher real claims, even if the positive impact on credit lasts only two quarters, and after that it becomes negative. The current account to GDP decreases all the time, implying that Vietnam borrows from the rest of the world. As a consequence of the current account deficit, the exchange rate decreases only in the longer term.

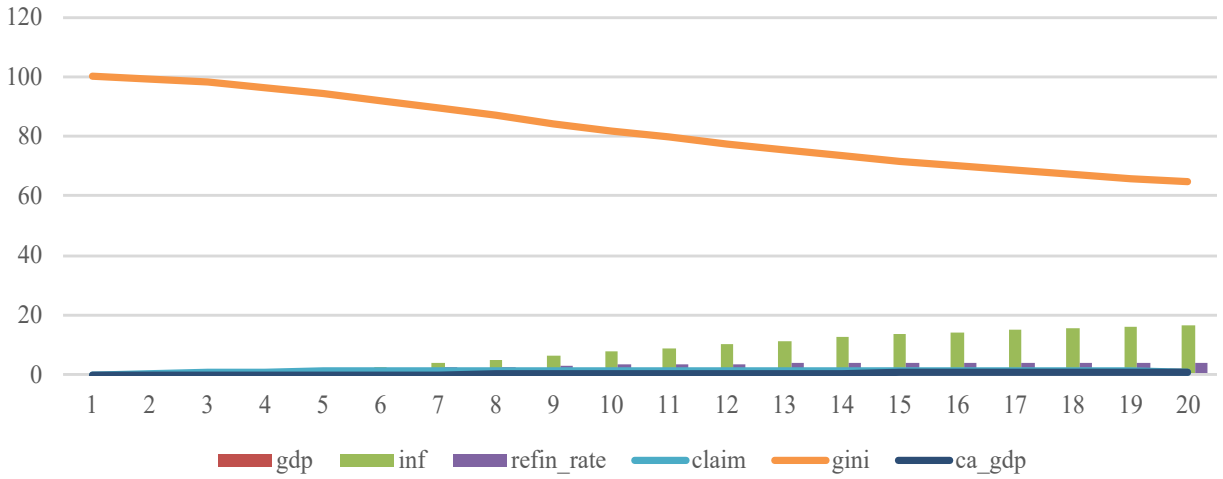
Figure 11
Impulse Response Function VAR Full (7 Variables)



Source: Team's own calculations.

When the model includes more variables, inflation explains most of the volatility of the Gini Index, followed by fluctuations in the refinancing rate (Figure 12). Hence, both VAR models confirm the importance of monetary policy in the variability of the Gini Index. Overall, the research concludes that changes in monetary policy (represented by refinancing rate) have a positive effect on the Gini Index in the case of Vietnam. In other words, a tightening monetary policy has an adverse effect on income inequality in Vietnam. It is concluded that the distributional effect of monetary policy exists in the Vietnamese economy.

Figure 12
Variance Decomposition VAR Full (7 Variables)



Source: Team's own calculations.

5. Conclusion and Recommendations

The VAR models and the impulse-response analysis are employed in this study to examine the effects of monetary policy shocks on income inequality for the period from 2000-2018 in Vietnam. The study has the following main findings:

Firstly, the empirical results imply that changes in monetary policy have significant impacts on income inequality in Vietnam. By implementing an easing monetary policy through the decreasing of interest rates or increasing money supply, the SBV could improve income inequality in Vietnam.

Secondly, both the inflation rate, credit, and economic growth show a positive relationship with monetary policy shocks. In other words, these macroeconomic variables would increase when the central bank conducts expansionary monetary policy. This is corroborated by economic theories.

Thirdly, the study does not find strong evidence on the relationship between the external sector which is represented by the exchange rate and the ratio of the current account to GDP and income inequality in Vietnam.

As a result of these conclusions, there are significant recommendations for the SBV in implementing monetary policy as follows:

Firstly, given the strong effects of refinancing rates and money supply on income inequality, the SBV may consider paying more attention to the income inequality factor in the future, especially when making decisions related to monetary policy adjustments.

Secondly, besides policy rates, the SBV should consider continuing its current interest rate policies, such as: interest rates ceiling on VND deposit with terms less than 6 months, VND short-term lending rate cap applicable for some prefered sectors since these interest rates has contributed to Vietnam's considerable progress in credit access index, which in turn support the equality target. Moreover, the Vietnam Bank's social policies and services should be further improved to help boost the Government's strategies to eradicate poverty and improve social welfare.

Thirdly, the SBV should facilitate microfinance institutions that can operate efficiently in the provision of banking services to the low-income group which normally face a lot of difficulties in accessing services from commercial banks. Moreover, in context of implementing the National Financial Inclusion Strategy, the SBV should provide strong support to the trend of digitalizing of banking services, encourage credit institutions to exploit smart data to be able to provide safe, convenient and personalized financial products and services at reasonable prices with advanced technology, particularly for low-income and vulnerable people, small and micro-sized enterprises.

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