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Effect of Monetary Policy Shocks on Inequalities

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Abstract

This study focuses on estimating the effect of monetary policy shocks on income and consumption inequality for the case of five emerging economies- Brazil, Russia, India, China and South Africa, using quarterly data from 1991-2015 and understand the most significant channel of transmission of monetary policy shocks on inequality. The study follows the SVAR methodology for estimation. The results show that the monetary policy shocks have minor effect on both inequalities. Although the effect is minor, income inequality's response to a contractionary monetary policy shock is seen to be positive for atleast four quarters among all the countries. The positive effect of contractionary monetary policy on income inequality for a significant period of time indicates that the channel of transmission is through earnings heterogeneity channel and savings-redistribution channel among all the five countries. The effect of monetary policy on income inequality is seen to be most long lasting in the case of Russia. Consumption inequality is seen to respond negatively to contractionary monetary policy shock for India and China but has positive response for Brazil and South Africa. In South Africa, the effect is seen to be marginal and positive. For the case of Russia, the effect is seen to be almost nil for the consumption inequality model.

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List of Abbreviations

Abbreviation	Denomination
<i>ADF</i>	Augmented dickey fuller
<i>AIC</i>	Akaike information criterion
<i>GDP</i>	Gross domestic product
<i>GCIP</i>	Global consumption and income project
<i>BRICS</i>	Brazil Russia India China South Africa
<i>GMM</i>	Generalised method of moments
<i>IRF</i>	Impulse response function
<i>MPI</i>	Monetary policy instrument
<i>SVAR</i>	Structural vector auto regression
<i>SWIID</i>	Standardized world income inequality database
<i>VAR</i>	Vector auto regression
<i>PPP</i>	Purchasing Power Parity

Chapter 1

Introduction

Inequality does matter. Today, this has been one of the most important concerns among economies. The need for a more inclusive economic growth has put this topic as a top priority in most of the international economic agenda. Several researches have also highlighted that trends in inequalities are higher in the emerging economies than in advanced economies. Most of the policy plans in many countries have special focus towards creating an egalitarian society. As a result, several researchers had begun to study the distributional effects of policies.

In today's globalized world, trade policies, liberalized policies have been identified as factors causing inequality in income. Little emphasis has been given to monetary policy. This could be because of the fact that monetary policy aims at inflation stability and output gap stability. Hence, there has not been much focus by policy makers to address the issue of inequality through monetary policy measures. Distributive effects of monetary policy have been considered by researchers only in recent times, particularly since late 1990s. The earliest contribution to this area of research is that of Romer and Romer (1999)[21], which aimed to study the impact of the monetary policy on the wellbeing of the poor. Ever since, there has been increased interest among monetary economists to study in greater detail the effects of monetary policy on different kinds of inequality. This interest has widened recently, post the Great Recession of 2008 and the emergence of 'Unconventional Monetary Policy'.

Authors have pointed out different ways through which monetary policy can affect inequality in a country. Literature points out five channels in which monetary policy impacts inequality, viz; the income composition channel, the financial segmentation channel, the portfolio channel, the savings redistribution channel and the earnings heterogeneity channel. The impact of monetary policy on inequality through various channels has been briefly described below.

- **The Income Composition Channel:** This channel states that heterogeneity in sources income between households induces increase in inequality due to an expansionary monetary policy. Households which mainly depend on labor income are generally low income households and high income households depend mainly on business and

financial income. Hence an expansionary monetary policy by lowering interest rates increases business profits and asset prices and does not leave a very significant increase on wage income, thereby widening the gap between the rich and poor.

- **The Financial Segmentation Channel:** This channel states that economic agents who indulge in financial markets often have higher incomes than those who do not engage in financial markets. Hence, there is already a gap in income between those who engage in financial market (high income households) and those who don't engage (low income). Therefore, an expansionary monetary policy, with an increase in money supply, will benefit the economic agents who engage in financial markets and wealth will get redistributed to them. Also, an expansionary monetary policy leads to higher asset prices which in turn create positive wealth effects. In addition to increasing income inequality, this channel is also seen to increase consumption inequality through expansionary monetary policy.
- **The Portfolio Channel:** This channel shows the impact of monetary policy on high income and low income households based on their portfolio holdings. Low income households; in general, poses greater liquid assets in their portfolio whereas high income households hold less cash and more of financial market assets in their portfolio. Since the low income household poses more of cash, they are subject to an 'inflation tax'. Devaluation in money falls as a burden on low income households causing an increase in income inequality. Expansionary monetary policy shock causes an increase in consumption inequality through disproportionate burdening of inflation on low income households.
- **The Savings Redistribution Channel:** This channel states that expansionary monetary policy decreases inequality by examining the burden of inflation which is unequally distributed. An unexpected expansionary monetary policy causes inflation which will prove as a disadvantage for savers and benefit borrowers by lowering the real value of assets and liability. Since low income households constitute more of borrowers and high income households constitute more of savers, expansionary monetary policy causes decrease in income inequality. Expansionary monetary policy is seen to decrease consumption inequality also through this channel.
- **The Earnings Heterogeneity Channel:** This channel again brings about the explanation for how expansionary monetary policy causes decline in inequality and is related to the income composition channel. This channel focuses on earnings from labour. The main focus of this channel is the different response of heterogeneous labour earnings to monetary policy shocks. If, for example, unemployment falls disproportionately on low-income households due to a contractionary monetary policy shock, this shock induces an increase in income inequality.

Understanding the effects of monetary policy on income inequality has gained focus among researchers today. This paper focuses on understanding the effect in the emerging market economies, by addressing the following questions:

1. Do shocks in monetary policy significantly affect income and consumption inequalities among the major emerging economies- Brazil, China, India, Russia and South Africa?
2. If yes, then what is the nature of the effect?

In order to address these questions, the thesis uses a cross country SVAR analysis for comparison of results. In order to provide some insight into panel dynamics of this issue, the paper also estimates a panel VAR analysis.

The rest of the report is organized in the following manner. Chapter 2 reviews the empirical literature related to this paper, chapter 3 discusses the data and methodology and chapter 4 gives a brief of the issues faced during the research so far and chapter 5 gives conclusion of the thesis.

Chapter 2

Review of Literature

As mentioned in the previous section, this topic is fairly recent in the literature. The earliest work in this area has been of Romer and Romer (1999)'s "Monetary Policy and the Wellbeing of Poor" [21]. The paper investigates the effect of monetary policy on poverty and inequality in the short and long run. The study also highlights the different primary channels in which monetary policy can impact inequality. The authors analyze this effect using two different data sets namely, a time series data for US and a cross sectional data that analyses a panel of 76 countries for the same purpose. The study uses data on income share of the poorest fifth of the 2 population as a measure of inequality. Until then, studies focused mainly on macroeconomic policy on inequality, relationship between poverty and inflation, effects of unemployment on income distribution etc. Hence, this was the first paper to focus on the monetary policy aspect of inequality. The study points out that the results of the effect in the short run and long run go in opposite directions. For the case of US, it is seen that expansionary monetary policy creates a reduction in income inequality and poverty in the short run, while in the cross section case, a reduction in income inequality and well-being of poor is seen when there is a contractionary monetary policy. This is largely a primary study; first of its kind, which does not talk about monetary policy shocks. In addition to this, the study mainly identifies that inflation is the main channel through which monetary policy affects inequality.

After this paper, there has not been much of research in this area largely, until 2012, where there was a seminal paper that was published by Coibion et al (2012) on "Innocent Bystanders Monetary Policy and Inequality in the US" [3]. It is in this paper that the effect of shocks in monetary policy on inequality was focused upon, which brought about a different perspective in this literature. It was also after this that the interest in this topic had intensified. Several studies had followed. Although this paper also focuses on the US case, the paper also adds on to the existing literature by looking at the effect of shocks in monetary policy and inequality- both income and consumption inequality. The inequality measures are based on Household Consumer Expenditure Survey. Since this study deals with shocks in monetary policy, there is a need to first identify the monetary policy shocks in the economy. For this purpose, they authors follow the methodology of Romer and Romer (2004). Since inequality had been calculated based on Survey, quarterly data has been obtained. The study points out that there has been decrease in inequality (both income and

consumption) after an expansionary monetary policy shock and vice versa. Coibion et al (2012) also highlights a number of reasons for this result by focussing on the effect of monetary policy on different percentiles of income distribution, labor earnings, expenditure and consumption distribution. Results point to contractionary monetary policy shocks having heterogeneous effects on labor earnings which raise labor incomes at the upper end of the distribution while lowering that of those at the bottom end of the distribution, thereby proving that the main channels through which the monetary policy in US affects inequality is the earnings heterogeneity channel and the income composition channel.

Post this; there have been several authors who have shown interest in this area. One such paper is that of Villerreal (2014) [28] who conducted a similar study for the case of Mexico. This study also contributed to a large extent by bringing about a change in its course. This study, like the Coibion et al (2012) study, uses survey data to measure inequality and hence analyses a quarterly data of inequality and interest rates. They also focus on the impact of monetary policy shocks on inequality. But unlike the Coibion et al (2012) case, they use both a theoretical DSGE model and an empirical SVAR model for identifying monetary policy shocks. This study points out that there has been an increase in income inequality due to an expansionary monetary policy shock and vice versa implying that the financial segmentation channel is more significant. This has led to a contradiction in the results obtained by that of Coibion et al (2012) for US. This contradiction in results has drawn the attention of various researchers trying to resolve this ambiguity.

Various researches have conducted studies that have proved in favour of both these studies. Studies such as Mumtaz and Theophilopoulou (2017) [19], Furceri et al (2018) [7], Lenza and Slacerek(2018) [15], Park (2018) [20] and Samarina and Nguyen (2019) [23] etc have shown results on line with Coibion et al (2012) and Saiki and Frost (2014) [22], Domanski et al (2016) [5], Davtyan (2017) [4], SánchezFung (2015) [27] etc have shown results on line with Villerreal (2014).

This ambiguity has led to increased focus on understanding the reasons behind this ambiguity. Studies have pointed out that this difference is primarily due to differences in economic structure among different countries. Villerreal (2014) explains that this is a result of existence of threshold effects. He points out that in a sticky price model with the introduction financial frictions, it is found that financial frictions increase the weight placed on inflation, relative to that placed on output, in the central bank's loss function. This implies that the Phillips curve is flat, thereby increasing the cost of stabilizing inflation. The existence of a financial friction threshold beyond which the benefits of stabilizing inflation exceed its costs, in an economy is also one of the main determinants of the result. In the case of US and Mexico, as of Coibion et al (2012) and Villerreal (2014), it is pointed out that given the financial development between the United States and Mexico, and more importantly the vastly different levels of financial access and use in both countries, it is conceivable that the level of financial frictions in Mexico is such that inflation stabilization is welfare enhancing, whereas the opposite occurs in the United States. Various other studies have pointed out that factors such as existence of inflation threshold, position of business cycle etc also have an impact on the result obtained.

Due to the lack of consensus in the results obtained by the studies, there has been increased number of studies that focus on different methodology for the US case specifically. There has also been an increased interest in studying the impact of monetary policy on inequality among advanced economies. Various single country cases and panel of advanced economies have been analysed so far. However, little emphasis has been given on emerging economies. The research on emerging economies with respect to monetary policy and its impact on inequality has been very limited and only based on single country cases. No panel data analysis has been done so far. Here again the results have been mixed and so are the approaches towards handling the problem.

Furceri et al (2018) find out that there has been a reduction in inequality due to expansionary monetary policy shocks (on the line with Coibion's study), on analysing the data for 32 advanced and emerging economies. They also find that the effect is larger in countries with greater share of labour income and smaller redistribution policies and also significantly varies over time depending on the type of shocks, state of business cycle, and initial level of inequality and share of labour income. The effects of monetary policy on inequality has been analysed using Jorda (2005) VAR model.

Sánchez-Fung (2015), on an analysis for the case of China finds out using VAR approach that expansionary monetary policy leads to an increase in the Gini coefficient. The study uses multiple indicators of monetary policy such as inflation, real money gap and lastly monetary overhang measure derived from a money demand function.

Park (2018) analysed the issue for the case of Korea using VAR model with Block Exogeneity. Results from the research shows that a contractionary monetary policy shock causes an increase in the income inequality after a time lag of one year, however there it is also observed that the extent to which monetary policy shocks influence inequality in Korea is minute. The results also show that it is the earnings heterogeneity channel that is the most significant for the case of Korea.

Moura and Schmidt (2018 [24]) analysed the case of Brazil using a Bayesian VAR. The study uses capital-labour ratio as a proxy variable for income distribution and a section of monetary policy variables including interest rate, GDP, exchange rate and inflation rate. The study finds out that there is a significant positive effect of contractionary monetary policy shock on income distribution and the effect lasts for over a year.

The existing empirical literature on monetary policy and its effect on inequality mostly focus on the case of advanced economies where the inequality is perceived to be higher. However, the emerging economies are also faced with the problem of inequality, given that these economies are subject to a lot of volatility in economic growth and inflation. Given this, it is important to also focus on the effect of monetary policy on inequality for emerging economies as well. There are five major emerging economies in the world, according to both nominal and PPP adjusted GDP growth rate- Brazil, Russia, India, China and South Africa; often referred to as the BRICS economies. No research on monetary policy and its effect on

inequality in these countries have been studied so far. Individual studies on the economies performances of economic policies have been extensively done, but very few have focused on studying inequality among the economies.

Jawadi et al. (2015) [12] have studied the macroeconomic impact of Fiscal and Monetary Policy among the BRICS nations using a Panel VAR approach. The study uses quarterly data from 1991 to 2013. The study uses Interest rate and growth rate of money supply as the measure of Central Bank's monetary policy intervention. Results show that monetary contractions lead to a fall in real economic activity and tighten liquidity market conditions.

2.1 A note on Methodology Specified in Literature:

As far as methodology is concerned, there have been several methodologies pointed out by the literature. Table 2-1 shows the summary of data and methodology used in literature so far. Most common in the recent papers have been the VAR and SVAR. The biggest challenge in estimating VAR is finding the appropriate identification scheme. Theory points out various options that exist- recursive identification scheme (short-run restrictions), long-run restrictions, sign restrictions, looking for proxy of structural shocks, etc. The studies in literature also point out various options. Mertens (2019) [17] uses a proxy SVAR model. This methodology uses constructed series of shocks as “proxies” of the true structural shocks, whereas the literature has so far treated the series as the true structural shocks. By accepting the series as proxies, it is considered that they can actually be slightly different from reality. Similarly Lenza and Slacerek(2018) use a Bayesian SVAR, Moura and Schmidt (2018) use a Bayesian VAR, Park (2018) use a VAR with Block Exogeneity etc. for the same purpose.

Authors	Country Sample	Inequality Measure	Method	Impact of expansionary Monetary Policy on Inequality
Coibion (2012)	U.S.	Survey	Local Projections	Decrease
Furceri et al (2018)	32 Advanced and Emerging Economies	Gini	Local Projections	Decrease
Davtyan (2017)	U S	Gini	VAR, VECM	Increase
Domanski et al (2016)	France,Germany, Italy, Spain,U.S.,U.K.	Survey	Microsimulation	Increase

Lambrecht (2015)	Panel of OECD countries	Variables from the databases of Roine et al. (2009), Schularick and Taylor (2012), and the Top World income Database	VAR	Decrease
Lenza and Slacerek(2018)	France, Germany, Italy and Spain	Survey	BSVAR	Decrease but Negligible
Mertens(2019)	U S	Income distribution using World Inequality Database	Proxy SVAR	Decrease
Moura and Schmidt (2018)	Brazil	Capital-Labour Ratio	Bayesian VAR	Decrease
Mumtaz and Theophilopoulou (2017)	U K	Survey	SVAR	Decrease
Park (2018)	Korea	Survey	VAR with Block Exogeneity	Decrease
Saiki and Frost (2014)	Japan	Survey	VAR	Increase
Samarina and Nguyen (2019)	10 European Economies	Survey	PVARX	Decrease
Sánchez-Fung (2015)	China	Gini	VAR	Increase
Villerreal (2014)	Mexico	Survey	SVAR	Increase
Romer and Romer (1999)	Panel of 76 mixed countries	Average income of the poorest quintile of population	Cross Sectional Regressions	Increase

Table **2-1**: Summary of Data and Methodology

2.2 Monetary Policy in the BRICS

India's monetary policy history has been outlined by Goyal (2014) [9] in the paper titled "History of Monetary Policy in India since Independence". The study points out that from 1991 to 1998, the major objective of the Central Bank of India has been to target inflation and to build credit supply for growth and the instruments have been CRR, SLR and selective credit control. After 1998, the major objective of the monetary policy has been inflation targeting and economic growth. From 1998 onwards, there has been an introduction of repo rates, which have been the major instrument of operation since then.

The main nominal anchor for China's monetary policy has been the nominal exchange rate, which was pegged to the dollar from the mid-1990s until July 2005. Geiger (2008) [8] mentions that there are two sets of monetary policy instruments in China- Central Bank Based and Non-Central Bank based. The instruments of the Central Bank can be of four types- reserve requirements, interest rates, open market operations and Central Bank bills. The paper also mentions that the interest rate transmission channel is blurred in the Chinese economy.

South Africa's monetary policy has been outlined by van der Merwe (1999) [18] in the paper titled "Monetary Policy Operating Procedure in South Africa". The inflation targeting regime has been under practice from the nineties. Under different periods, different monetary policy instruments have been used. Cash Reserve Ratio, Bank Lending rates have been major instruments until 1999. In the late 90's JIBAR (Johannesburg Interbank Average Rate), an interbank rate was introduced and is has been the policy instrument from then.

Brazil has had periods of hyper-inflation in the 1990's and has undergone serious economic problems during the 1990s. Libânio (2010) [16] mentions that inflation targeting regime has been adopted in the late 1990s, as a response to financial or currency crises that caused the abandonment of previous monetary arrangements. Ever since Brazil's Central Bank has adopted the inflation targeting regime, the major instrument of monetary policy has been the SELIC rate which is the Central Bank's short term interest rate. The same case has been faced by Russia, with periods of very high inflation in the country since the break of the Soviet Union. As a result Russian federation suffered a period of financial crisis in August 1998. Ponomarenko (2012) [14] mentions that the crisis of 1998 which was due to unsustainable public finance in Russia and capital outflows from emerging countries, hit the Russian economy hard and determined the need to change the Central Bank of Russia's monetary policy. Central Bank of Russia uses monetary base and monetary targeting M2 and key rate (interest rate) as its policy instrument.

To sum up, results from the studies analyzing the effects of monetary policy are ambiguous. Not only do the results vary with different countries. Several studies have focused only on single country case, which also gives us ambiguous results within countries, particularly with advanced economies such as US. Also, there has been very little light thrown upon the emerging economies case. The little research that has been done is mostly based on single country case. The contribution of my research to the existing literature is that it throws

light on the monetary policy's effect on income and consumption inequality for five emerging economies, individually by estimating an SVAR model. The literature on this topic points out that there is ambiguity in the effect of monetary policy on inequality. By conducting a cross country analysis of five countries, this results obtained are seen to reduce the ambiguity and bring a more robust conclusion for the case of emerging economies. This thesis also bridges the gap in the literature by including multiple macroeconomic variables, without restricting it to just interest rate. Through the cross country analysis, this thesis aims in addressing the two research questions, to overcome the ambiguity in the literature and to reach a more concrete conclusion in estimation of the effect of monetary policy on income and consumption inequality among emerging economies.

Chapter 3

Data and Methodology

3.1 Data

Data for inequality has been hugely debated in the literature. While a number of authors have pointed out that the best way to measure inequality is to calculate individual gini indices using Household Survey Data, it is quite difficult to get hold of Survey data for most emerging economies. Besides, most of panel data studies have used gini indices from inequality databases. The gaining raise of inequality studies have led to increase in the number of gini index databases coming into existence. This study uses the inequality database of Global Consumption and Income Project (The GCIP database for Inequality), a project of the United Nations and had been launched in 2015. The database is fairly new and has not been touched upon by papers in the literature so far. Most of the papers in the literature of monetary policy and inequality use the SWIID database, which is the database for income inequality for most of the countries in the world. The reason why the GCIP database was preferred over the SWIID for this study is because the GCIP database also provides data for consumption inequality. Very few studies have focused on the effect of monetary policy on consumption inequality. Also, since this study focuses on emerging economies, it makes it all the more necessary to look at the effect on consumption inequality. There is growing importance of consumption inequality in today's world since it reflects typical income and does not fluctuate from year to year as in the case of income. Consumption theories also point out that people tend to smooth their consumption over time, while income does not remain constant and is subject to fluctuations. Hence, this paper focuses on understanding the effects of monetary policy on income and consumption inequality to give a wholesome picture. The data in the database is based on underlying surveys, present estimates of monthly real consumption and income for arbitrarily specified quintiles of the population, for more than 160 countries in the world from 1960-2015, providing annual data.

3.1.1 Inequalities in the BRICS

The income inequality and consumption inequality for the BRICS nations is described in figure **3-1** and figure **3-2** respectively. From figure **3-1**, it can be seen that in South Africa, there has been persistent high income inequality for the entire period, with the gini index consistently remaining above 0.5. Similarly, in the case of Brazil, consistent periods of high

income inequality can be observed with the gini index remaining above 0.5 until 2006 and from there onwards, a gradual fall can be observed, but it continues to remain closer to 0.5 until 2015. India's income inequality has been fairly consistent income inequality remaining between 0.4 and 0.5. It remains constant from 1971 to 1984, closer to 0.4 and after 1984, there is a small increase in income inequality, still remaining below 0.5, and remains constant there on until 2015. Income inequality in China is seen with a low gini index until 1984, attaining its lowest value in 1984. From there on, there is a sharp increase in income inequality until 2015, with the gini index remaining above 0.5 until 2015. Among the five countries, Russia is seen to have the lowest income inequality until 1988. From 1988, there is a continuous increase in income inequality until 1996 and then begins to gradually decline until 2015. Russia's gini index has largely remained below 0.5 like the case of India.

Figure 3-2 shows the consumption inequality for BRICS. The picture looks more or less similar to income inequality in the BRICS. South Africa's consumption inequality has been very high starting from 1974, and continues to increase till 2010 and then begins to decrease from thereon, but still continues to remain high until the end of the period. Brazil's consumption inequality remains between 0.4 and 0.5 during the entire period. It remains closer to 0.5 from 1990 onwards and begins to decline from 2003, still remaining above 0.4. India's consumption inequality shows a gradual increase throughout the period. It remains low, with the gini index remaining between 0.3 and 0.4. Although it remains low, there is an increasing trend in the recent years. China's consumption inequality also shows a similar picture, with an increase from 1984 and continues to increase until the end of the period. Initially there gini index remains low, below 0.3 and from 2002 it remains closer to 0.5. Russia too shows an increasing trend with the gini index remaining between 0.4 and 0.5 from 1993 to 2001 and begins to decrease in the recent years.

South Africa is regarded as the most unequal country by the World Bank report due to its high levels of inequality rising in the recent years. South Africa's main problem is the level of unemployment among youth which is seen to be higher than the unemployment levels of other emerging market economies. In the case of China, the rise in inequality is attributed more towards the divide between the rural and urban workforces and incomes associated with that. Rural incomes are seen to be lesser when compared to urban incomes and hence an increase in the urban employment levels can lead to an increase in income inequality. Russia's raise in income inequality is seen to be intense during the nineties, attributed to the transition of the Russian economy from communism to capitalism. This transition is seen to have boosted inequality rise in the economy. In India also, as in the case of South Africa, unemployment remains the major problem which causes income disparities. Population levels in the country are very high accounting to high unemployment levels and also underemployment levels in the economy, leading to low labor productivity. In addition to this, the employment in the urban areas is high paying than the rural areas, creating spatial differences in income. The same is the case with Brazil. Fewer employment opportunities, lack of technological access and education opportunities have led to an increase in income disparities between rural and urban households.

Although a number of other reasons have been seen as major contributors of income

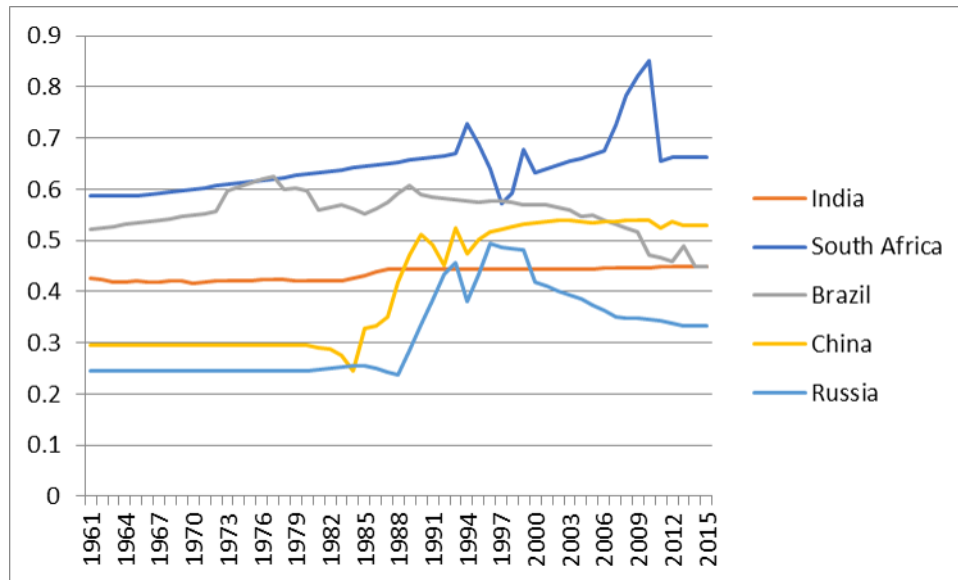


Figure 3-1: Income Inequality among the BRICS nations from 1961-2015

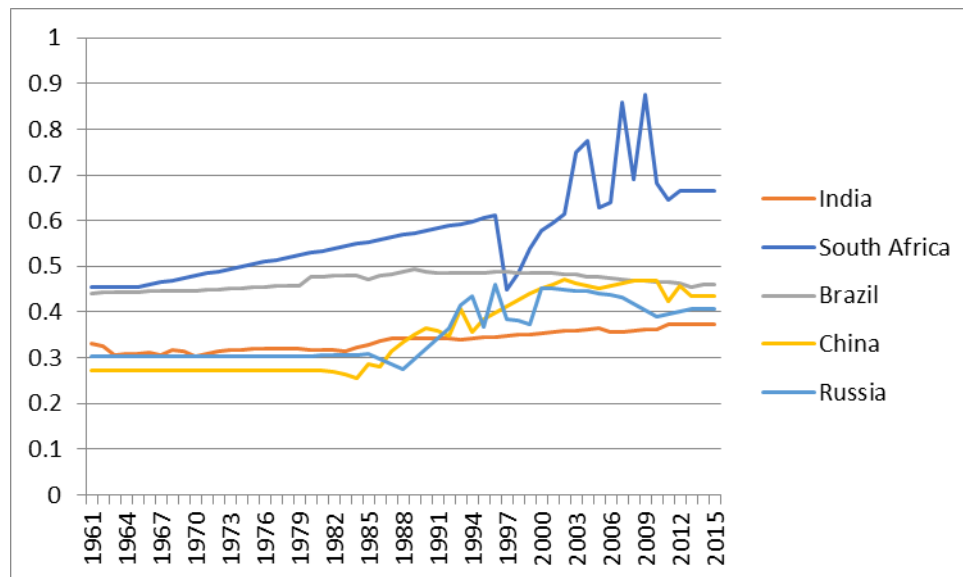


Figure 3-2: Consumption Inequality among the BRICS nations from 1961-2015

inequality increase in the five economies, it is also interesting to see the effect of monetary policy on inequality and the fact that inequality is increasing post the 2008 financial crisis is also an added motivation to study the monetary policy effects on income inequality.

For the analysis, the all the data used for all the variables have been used on quarterly basis, which in the case of inequality variable has been obtained based on interpolation for the time period 1991 Q1-2015 Q4. The reason to use quarterly data after interpolation is to ensure enough data points while estimation of the panel analysis. Monetary policy instruments for each country have been obtained from the central bank databases of all the countries. In addition to the monetary policy instrument, there are few other variables that are included in the analysis- inflation, real exchange rate and real GDP growth. In most of the cases, quarterly data have been readily available from OECD database for the above said time period. For inflation, quarterly data has been readily available from OECD database for India, China and Brazil while for Russia and South Africa, the database did not have quarterly data for the time period of analysis. Therefore, the quarterly data was extracted from World Bank database annual data through interpolation. Similarly, for real exchange rate, quarterly data from OECD database was extracted for India, South Africa and Russia. For China and Brazil, World Bank annual data was interpolated to extract quarterly data. For real GDP, quarterly data for all the countries except China and India were available in the OECD database. For India, the quarterly data was extracted from the government database from MOSPI. Chinese quarterly real GDP data was not readily available in any of the websites and hence the data was interpolated from World Bank annual database. The interpolation of annual data to quarterly data is done using EViews software using the linear interpolation method.

3.2 Methodology

The paper will focus on estimating a Structural Vector Auto Regression Model for estimating the effect of monetary policy on income and consumption inequality. Stock and Watson (2001) [26] in their paper titled 'Vector Auto Regressions', outline a monetary policy VAR, that is the most often referred to as a standard monetary policy VAR model in the literature. The VAR includes the variables such as federal funds rate, a proxy for the US monetary policy, Unemployment rate and the inflation rate in the US economy to estimate a VAR model. Various studies that followed have begun to include exchange rate, real GDP growth rate into the VAR model for monetary policy. Today, the VAR model is one of the most used models in order to understand the monetary dynamics in the case of time series data. The VAR model was first introduced into the macro literature by Sims (1980) [25] and has been an interesting methodology to work with macro data among economists. The main advantage of the VAR model is that it allows us to use more than one variable at a time, unlike the AR (p) model. The VAR model mainly deals with answering questions about how the economy responds to certain types of shocks or for the purpose of business cycle analysis. More particularly, it deals with answering 'response' or the 'what if' scenarios in the economy. The response to identified shocks among different variables is captured by the

Impulse Response Functions or the IRFs. The IRFs are graphs that show the response of one variable to a shock in the other. The paper's main objective is to understand the effect of shocks in monetary policy on income and consumption inequality. This is to be studied based on the analysis of IRFs based on the SVAR estimation.

Although there are several papers that estimate VAR methodology for monetary policy, little emphasis has been given on the effect of monetary policy on inequality. The paper attempts to study the effect of monetary policy shocks on inequalities on the basis of the standard monetary policy VAR. The variables in the VAR estimation are Inflation, Real Exchange Rate, Real GDP growth rate, Monetary Policy Variable and Inequality Variable. The standard monetary policy VAR of Stock and Watson (2001) model uses unemployment, which is not used here in this paper. The data for unemployment for the countries proposed to study does not have enough data published for unemployment. Therefore, this paper chooses to drop unemployment variable and include real exchange rate and real GDP growth rate in addition to monetary policy variable and inflation. Monetary Policy variable shows the tool of monetary policy in a particular country. It varies from interest rates to repo rates depending upon the kind of instrument that was in practice during that particular time period. Income and Consumption inequality data obtained from GCIP database has been interpolated to obtain quarterly data in order to increase the number of observations. The VAR model with p lags will look as follows:

$$y_t = c + \phi_1 y_{t-1} + \dots + \phi_p y_{t-p} + \epsilon_t \quad (3-1)$$

Where c denotes a (5x1) vector of constants, ϕ_j an (5x5) matrix of autoregressive coefficients, with $j = 1; 2 \dots p$ and y_t is the (5x1) vector of variables. The (5x1) vector ϵ_t is a vector such that $\epsilon_t \sim i.i.d : N(0; \Omega)$. Thus, a VAR model is a system in which each variable is regressed on a constant and p of its own lags as well as on p lags of each of the other variable. In the matrix form, the VAR model can be represented as follows.

$$\begin{pmatrix} y_{1,t} \\ y_{2,t} \\ y_{3,t} \\ y_{4,t} \\ y_{5,t} \end{pmatrix} = \begin{pmatrix} \phi_1^1 & \phi_2^1 & \phi_3^1 & \phi_4^1 & \phi_5^1 \\ \phi_1^2 & \phi_2^2 & \phi_3^2 & \phi_4^2 & \phi_5^2 \\ \phi_1^3 & \phi_2^3 & \phi_3^3 & \phi_4^3 & \phi_5^3 \\ \phi_1^4 & \phi_2^4 & \phi_3^4 & \phi_4^4 & \phi_5^4 \\ \phi_1^5 & \phi_2^5 & \phi_3^5 & \phi_4^5 & \phi_5^5 \end{pmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \\ y_{3,t-1} \\ y_{4,t-1} \\ y_{5,t-1} \end{pmatrix} + \begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \\ \epsilon_{3,t} \\ \epsilon_{4,t} \\ \epsilon_{5,t} \end{pmatrix} \quad (3-2)$$

Where, the y_t vector denotes the dependent variables namely inflation, real exchange rate, real GDP growth rate, monetary policy and inequality measure respectively.

In order to analyze the effect of shocks, the IRFs are used. The IRF's generated from the VAR analysis shows how the components of the dependent variables vector react in response to a shock that is injected to the systems by changing one of the ϵ 's for one period and then returning to zero thereafter. The pathway in which the variable returns to equilibrium is called the Impulse Response Function. A disadvantage of the IRFs that are estimated using the VAR approach is that it is assumed that the shock occurs in only one variable at a time.

Such an assumption may be reasonable if the shocks in different variables are independent. If they are not independent, the error terms consist of all the mixed influences and variables that are not directly included in the set of Y variables. To get over this problem, this paper also estimates an SVAR model and studies the Structural IRFs to get a clearer picture. SVARs can be used to address the questions of the type- How does the economy respond to different economic shocks? Or what is the contribution of the different shocks to the business cycle? Such questions can be studied using the Structural Impulse Responses. The SVAR(p) model is represented of the form:

$$A_0 y_t = c + A_1 y_{t-1} + \dots + A_p y_{t-p} + B u_t \quad (3-3)$$

Where A_j is a (5x5) matrix, u_t is the (5x1) vector of structural innovations characterized by $u_t (0; In)$, with B, a (5x5) diagonal matrix that specifies which variable is directly affected by the shock, and to which extent.

Shocks identified by the SVAR have been identified as coming from distinct independent sources and are assumed to be uncorrelated. Mostly commonly used SVAR method in the literature is the recursive identification method. The main aim is to overcome the problem of the VAR approach, i.e.; ensure that the shocks remain uncorrelated. The method of recursive identification uses simple regression technique to construct a series of uncorrelated structural shocks obtained directly from the reduced form shocks. Assuming that there exists an inverse of matrix A_0 , the equation (3-3) can be rewritten as follows:

$$y_t = A_0^{-1} c + A_0^{-1} A_1 y_{t-1} + \dots + A_0^{-1} A_p y_{t-p} + A_0^{-1} B u_t \quad (3-4)$$

$$= c^\sim + \Psi_1 y_{t-1} + \dots + \Psi_p y_{t-p} + \epsilon_t \quad (3-5)$$

Equation 3-5 is a vector autoregressive representation of the structural dynamic equation system, meaning that the VAR can be looked as a reduced form of a structural model. Where,

$$\begin{aligned} c^\sim &= A_0^{-1} c \\ \Psi_i &= A_0^{-1} A_i \quad \text{with } i = 1 \dots p \\ \epsilon_t &= A_0^{-1} B u_t \end{aligned}$$

In addition, the (5X1) vector ϵ_t is a vector

$$\begin{aligned} E(\epsilon_t) &= 0 \\ E(\epsilon_t \epsilon_\tau) &= \Omega \quad \text{for } t = \tau \\ &= 0 \quad \text{if otherwise} \end{aligned}$$

The methodology of SVAR requires the usage of restrictions in order to identify the parameters. Unique identification of structural parameters is not possible unless restrictions are imposed since there can be more than one set of different values of A_0 and A_1 through A_p resulting from observationally equivalent reduced form methods. There are two kinds of restrictions that one can impose- short run restrictions and long run restrictions. Sims

(1980) proposed the following identification strategy, based on the Cholesky decomposition of matrices (recursive identification strategy):

$$A_0^{-1}B = \begin{pmatrix} a_{0,11} & 0 & 0 & 0 & 0 \\ a_{0,21} & a_{0,22} & 0 & 0 & 0 \\ a_{0,31} & a_{0,32} & a_{0,33} & 0 & 0 \\ a_{0,41} & a_{0,42} & a_{0,43} & a_{0,44} & 0 \end{pmatrix} \quad (3-6)$$

In this identification strategy, the identification of structural shocks depends on the ordering of variables, with the most endogenous variable ordered last. The Cholesky decomposition implies that There always exists a lower triangular matrix P that ensures that $S = PP^T$, if S is semi definite positive. In other words, We can always find a lower triangular matrix A_0^{-1} so that $\Omega = A_0^{-1}(A_0^{-1})^T$. The Cholesky decomposition allows us to and the values in A_0 recursively, without estimation.

In addition to the individual country studies, the paper also focuses on estimation of a Panel VAR in order to understand the response of the inequality variables to a shock in monetary policy for a panel of emerging economies. The basis Panel VAR is very similar to that of standard VAR model, with a country specific dimension to it. Canova and Ciccarelli (2013) [2] point out that Panel VARs are much more powerful tool in order to address policy related questions, particularly questions related to transmission of shocks across borders. Panel VARs have been used to address a variety of issues in applied macroeconomics literature and among policymakers. It has been used in business cycle analysis. The main purpose of Panel VARs is to analyze the transmission of transmission of idiosyncratic shocks among different variables at a particular time period. Panel VARs are also useful in analyzing the importance of interdependencies and in checking whether the results obtained in the individual country case can be generalized or if it only holds true for a one country case. They also enable us to understand the extent to which there is dynamic heterogeneity and also to characterize the similarities and differences among the countries in the panel for the question under study.

This study uses the system GMM approach to study the Panel VAR among the countries. The system GMM estimates are a more reliable and efficient fixed effect since they allow us to solve problems of serial correlation, heteroskedasticity, and endogeneity of variables. The approach is however recommended for larger sample size, with the time period significantly large and the number of countries in the panel is also significantly large. However, it is also practiced among small panel countries, in order to compare results with those obtained by literature. Other kinds of Panel VAR include the Fixed Effects and Random Effects Panel VAR, in which case the estimation of IRFs is not possible.

The data for the variables have been obtained on quarterly basis for all the five countries. The analysis consists of 5 individual country analysis and 2 panel analysis. India, China and

South Africa form one panel and Brazil and Russia are analysed using another panel. The first panel is a balanced panel with quarterly data ranging from 1991-2015. The second panel is an unbalanced panel since both Russia and Brazil have faced episodes of hyper-inflation in recent years. This study would focus only on the post hyper-inflation episode in the two countries. Russia's data ranges from 2000-2015, using quarterly data and Brazil's data ranges from 1996-2015, using quarterly data. Hyper-inflation in Russia lasted from 1996-2000 and in Brazil it lasted from 1985-1995. The reason why the paper choses to avoid studying the hyper-inflation episode is because the inclusion of the hyper-inflation years tend to distort the results of the SVAR estimation in both the individual country case and the panel VAR.

Chapter 4

Cross-Country Analysis : Results and Findings

In this section, the results of the SVAR and Panel VAR methodology are discussed to address the research questions specified in Chapter 2. The results are divided into three parts. The first part discusses the results of the individual country analysis, for all the five countries. For the cross country analysis, both SVAR results are reported. Two sets of results for each country have been estimated- one for income inequality and the second for consumption inequality. Both inequality measures are measured using gini coefficient. The SVAR is estimated for a set of five variables, namely, Inflation, Real Exchange Rate, Real GDP Growth Rate, Monetary Policy Instrument and Inequality Measure. All the data for the five countries have been used on quarterly basis. Inequality measures have been obtained from GCIP database as annual data and have been interpolated to quarterly data. As mentioned earlier, this interpolation is done to ensure there is enough data points to estimate the panel analysis and also for the individual country analysis. For India, China and South Africa, the data ranges from 1991Q1-2015Q4, for Brazil it ranges from 1996Q1-2015Q4 and for Russia; the data ranges from 2000Q1-2015Q4. The primary question centering this paper is ‘Do shocks in monetary policy significantly affect income and consumption inequalities among the major emerging economies- Brazil, China, India, Russia and South Africa?’. The first part of the results focus on this question individually for each country. The second part discusses the result from the panel VAR analysis and the third part discusses the results based on its sensitivity.

Literature points out different estimation methods in SVAR. Some of the papers have estimated the model after differencing the variables to account for stationarity. The objective of the analysis plays a major role in choosing if the model has to be estimated after stationarising the variables. This approach is recommended when there is a need to make inferences based on the significance of the coefficients. However, this approach comes with a problem if there is cointegration among variables. When variables are cointegrated, differencing of variables in the model can cause serious misspecifications. When the objective of the model is to understand the relationship between the variables in the long run, it is better to avoid differencing of variables, in case of which certain valuable information, leading to a bias in estimation of the results. In this paper, the focus remains to be to understand

the relationship between the variables and hence estimation with differences in the presence of cointegration can lead to misspecification of results. Thus, to avoid this problem, the estimation for all the countries is estimated at levels. The problem is illustrated for the case of India, where the impulse responses for the country has been estimated for both levels and in differences to understand how the results are distorted in case cointegration exists. For the other four countries, the model estimation is done using level variables alone. The SVAR results obtained for all the countries and the Panel VAR results are not reported in this thesis and are available upon request.

4.1 Monetary Policy Shocks and its Effect Inequalities in the Indian Economy

Income and consumption inequality in India have been on the raise in the last few decades. India's monetary policy has been different to suit different circumstances. The time period covered in this dataset begins exactly after the Balance of Payments crisis that India faced in 1991 followed by the opening up of the economy. 1991 year marked the beginning of a new era in the history of Indian Economy. Monetary policy after 1991 has been in response to the aftermath of the crisis. After 1991 crisis, the period until 1997 mainly focused on macro-stabilization and bringing inflation under control which was seen to be quite high, along with rectifying the balance of payments situation. The main focus of monetary policy remained inflation control, by adopting tight monetary policy. Financial reforms had given Central Bank greater autonomy. The period from 1992 until 1997 was seen by an acceleration of economic activity. With the opening up of the economy and with privatization of many public sector units, there has been an increase in the level of economic activity taking place in the country. It was in 1995, that the economy was beginning to experience inflationary pressures. Monetary policy measures were tightened foreseeing the rise in inflation. After inflation was brought under control, it continued to remain moderate thereafter. However, the growth in the period remained lesser than 7%, below the projected or the expected level of growth, until 2000. The monetary policy measures in the period from 1991-2000, were successful in containing inflationary pressures and the building up of foreign exchange reserves. In the late 1990's, the Central Bank had introduced a new instrument- the repo rate and began operating with it as their main tool of policy. It was also the period when the inflationary pressures eased out and the focus of the Central Bank in the early 2000s was to address the volatility in the foreign exchange market by strengthening the reserves. The repo rate became the signaling instrument from 2001 onwards. Monetary policy instrument, in this paper for the Indian case is taken to be as interest rate from 1991-2000 and from 2001 onwards, the monetary policy instrument taken to be as repo rate.

4.1.1 Monetary Policy Shocks and its Effect on Income Inequality

For the Indian economy, the effect of monetary policy on income inequality has been estimated based on the SVAR approach with all the variables at levels. This is done to ensure

that the effect is accurately captured, even in the presence of cointegration among variables. The Structural IRFs obtained from the SVAR analysis is seen in figure 4-1

Inflation's response to real exchange rate depreciation is seen to decline after about three quarters and is unresponsive until then. Real exchange rate depreciation is expected to bring in more inflation with imports becoming costlier. But in the case of India, it is seen to decline after three quarters indicating that there are lesser imports in the economy following depreciation of the currency. Inflation's response to real GDP shock is seen to be positive until the fourth quarter and declines thereafter. In the first three quarters, the effect is positive indicating that the result is in line with the Phillips curve relationship. As real GDP growth rate increases, inflation does increase. However, after three quarters, it declines owing that inflation is sensitive to price rigidity and regulation. Inflation's response to contractionary monetary policy begins to decline after three quarters. The responses look reasonable and demonstrate the presence of interest rate channel of monetary policy transmission at work: policy interest rate contraction affects market interest rate decreases investment levels in the economy, which in turn negatively affects output levels in the economy thereby reducing inflation. Income inequality on the other hand has a positive effect on inflation instantly and continues to increase thereon. Widening gaps between the incomes of rich and poor increases the demand from the side of high income group, affecting inflation positively.

Real exchange rate's response to a positive shock in inflation is seen to increase gradually until the long run. Increase in inflation brings depreciation in the currency eventually. Higher price levels of products reduce the demand for Indian goods in the international market and depreciation of currency helps in boosting exports in the economy. On the other hand, increase in the real GDP growth rate, the real exchange rate appreciates. Monetary policy contraction also depreciates the real exchange rate, but after four quarters, as in the case of a positive inflationary shock. This is seen to be different from the exchange rate channel of transmission. By theory, contractionary monetary policy is expected to appreciate real exchange rate through the exchange rate channel. Income inequality has no visible effect on real exchange rate during the entire period.

Real GDP is seen to show positive response to increase in inflation levels in the economy. Inflation boosts growth rate in the economy by driving production levels. It increases gradually from the instant quarter following the shock until the second quarter and declines, but continuing to remain positive throughout. Depreciation of currency on the other hand declines real GDP growth. Contractionary monetary policy has a negative effect on real GDP growth after four quarters. Until then, the response is seen to be nil. In response to an increase in income inequality, real GDP is seen to show marginal increase in the long run and remain unresponsive in the short run.

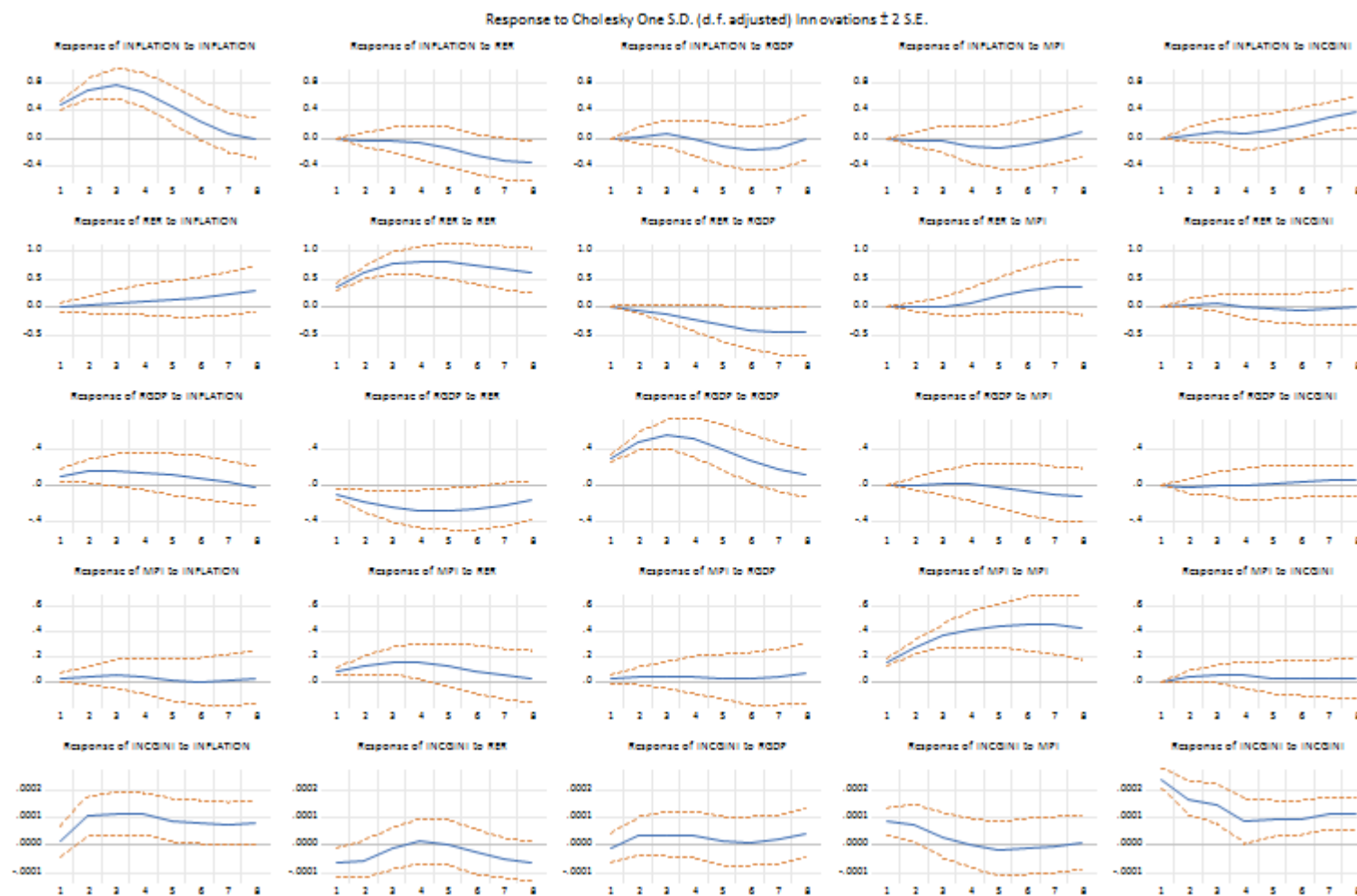


Figure 4-1: SVAR-Impulse Response Functions for Indian Economy, Income Inequality Model

Monetary policy is seen to be more responsive to shock in real exchange rate over inflation in the economy. Positive shock in inflation and real exchange rate both bring about a contractionary monetary policy. Increase in real GDP also brings about a marginal contractionary monetary policy throughout the period following the shock.

Income inequality's response is seen to be most significant and positive to a shock in inflation. Positive inflation shock brings increase in income inequality throughout the period. In emerging economies such as India, the rich or the high income group mainly consist of producers or manufacturers, for whom inflation causes an increase in price levels, thereby increasing the income levels of them, while leaving the income of the low income working group unchanged. This increases the gap between the incomes of rich and the poor. Real exchange rate's effect on income inequality is seen to be negative instantly but continues to increase until the third quarter and then begins to decline until the long run. In the short run, depreciation of exchange rate brings about an increase in income inequality owing to an increase in incomes of the skilled labor and leaving the incomes of unskilled labors unchanged. Depreciation of the local currency lowers the relative cost of capital, and thereby, supports foreign direct investments. This will be to be benefit of high skilled laborers and not the unskilled laborers, there by worsening income inequality in the economy. The opening up of the Indian Economy and with the New Economic Policy of 1991, there has been significant increase in the employment levels and incomes in the high skill sector but the unskilled sector continues to remain untouched. Studies such as Bahmani-Oskooee (2010) [1] and Muhammad et al (2011) [11] have shown it to be similar. Income inequality is seen to increase with a positive shock in real GDP growth. Contractionary monetary policy brings about an increase in income inequality in the short run and declines marginally after five quarters and remains unresponsive in the long run. Since contractionary monetary policy brings about an increase in income inequality for a significant time period, the effect is seen to be in line with earnings heterogeneity channel and savings redistribution channel. As an emerging economy, inequality is more driven by unemployment levels. If unemployment falls disproportionately on low-income households due to a contractionary monetary policy shock, this shock induces an increase in income inequality.

In order to illustrate the problem of bias in results with the presence of cointegration, the SVAR model has been estimated after stationarising the variables. The ADF test has been used to check for stationarity and the results obtained have shown that all the five variables are stationary at the first difference. To understand if there is cointegration between the variables, the responses in level has been extracted from the difference response through accumulated impulse response functions. In the absence of cointegration, the level response extracted through accumulated response is expected to be similar to the actual level responses. The accumulated responses extracted from the difference responses are seen in figure 4-2.

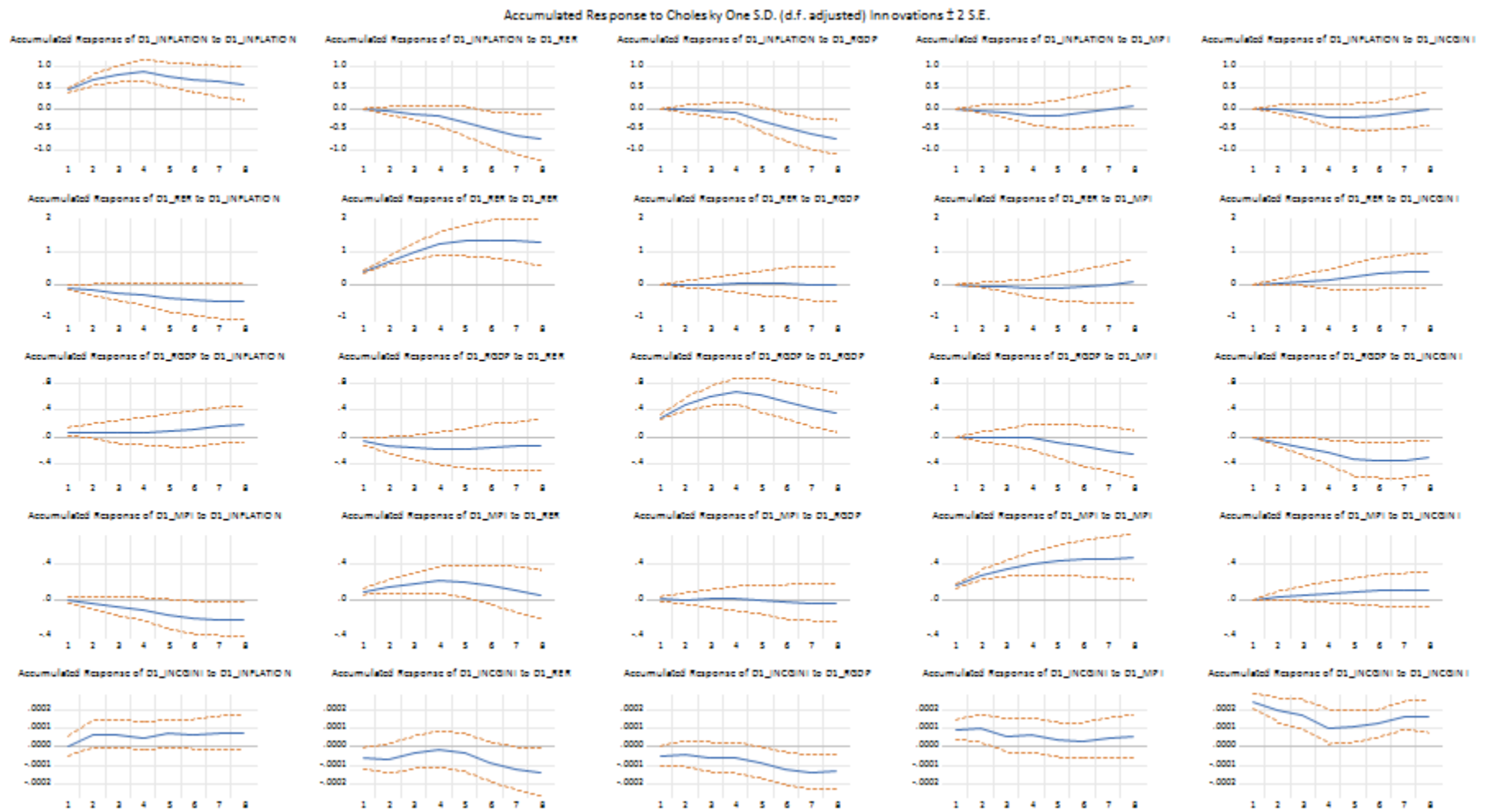


Figure 4-2: Accumulated impulse responses- SVAR income inequality model

The accumulated responses are seen to be different from the level responses to a significant extent, indicating that there can be a possibility of a cointegration. It can be seen that the biggest bias is for RER responses. The response of RER to inflation and MPI is completely different, also response of RER to MPI. Thus, it can be said the variables can be involved in a cointegration relationship. Interest rate and exchange rate might be linked via Uncovered Interest rate Parity condition but can be concretely said only after conducting appropriate tests. The fact that estimating the model in differences can lead to this problem indicates that the choice to have estimated the variables in levels is indeed the right one as the presence of cointegration is bound to distort the actual results and justifies the decision to do so for the rest of the countries as well. Estimating the results in levels is robust to estimating the model accounting for cointegration.

4.1.2 Monetary Policy Shocks and its Effect on Consumption Inequality

The structural impulse responses obtained for the consumption inequality model has been depicted in **4-3**. The model has been estimated at levels.

The responses of the other variables are similar in terms of income inequality model. The response of other variables to shock in consumption inequality is seen to be minimal and positive. Consumption inequality is seen to have most significant effect on real GDP growth. Real exchange rate is seen to show negligible response. Consumption inequality is seen to increase in response to positive shock in inflation and real exchange rate and decrease to a positive shock in real GDP. Real GDP growth increases production levels in the economy and eventually increases consumption in the economy. Monetary policy contraction brings a reduction in consumption inequality in the economy. Monetary policy's effect on consumption inequality can be traced through three channels (financial segmentation channel, portfolio channel and savings redistribution channel) as highlighted by literature. The studies focussing on consumption inequality thus far have highlighted the transmission through three significant channels. In the income inequality model, the response of income inequality to contractionary monetary policy shock brings increase in income inequality for a significant period. From this, we can expect the channel of transmission to be earnings heterogeneity and savings redistribution channel. If this channel was indeed the channel of transmission, the consumption inequality is expected to increase in response to a contractionary monetary policy following the savings redistribution channel. However, the response of consumption inequality to contractionary monetary policy is seen to be negative throughout the period indicating that the channel of transmission cannot be concretely identified in the case of consumption inequality. This unexpected response of consumption inequality needs to be explained since the channel of transmission of monetary policy effects to both inequality cannot be different, particularly when there is significant positive response of income inequality to contractionary monetary policy. Lambrecht (2015) points out the the presence of financial frictions in the economy and the level of frictions have significant influence over deciding whether consumption inequality increases or decreases to increase in interest rate.

Lambrecht (2015) also points out that there exists a financial development threshold beyond which contractionary monetary policy increases consumption inequality. The negative response of consumption inequality to contractionary monetary policy despite the increase in income inequality to contractionary monetary policy significantly states that the economy has not reached the financial development threshold, beyond which consumption inequality increases. The empirical evidence to this regard for the case of India is beyond the scope of this thesis. Thus, by the response of income inequality to contractionary monetary policy it can be said that there is a presence of savings redistribution or earnings heterogeneity channel in the economy, however the response of consumption inequality is not in line with this channel, indicating that there is an existence of financial development threshold.

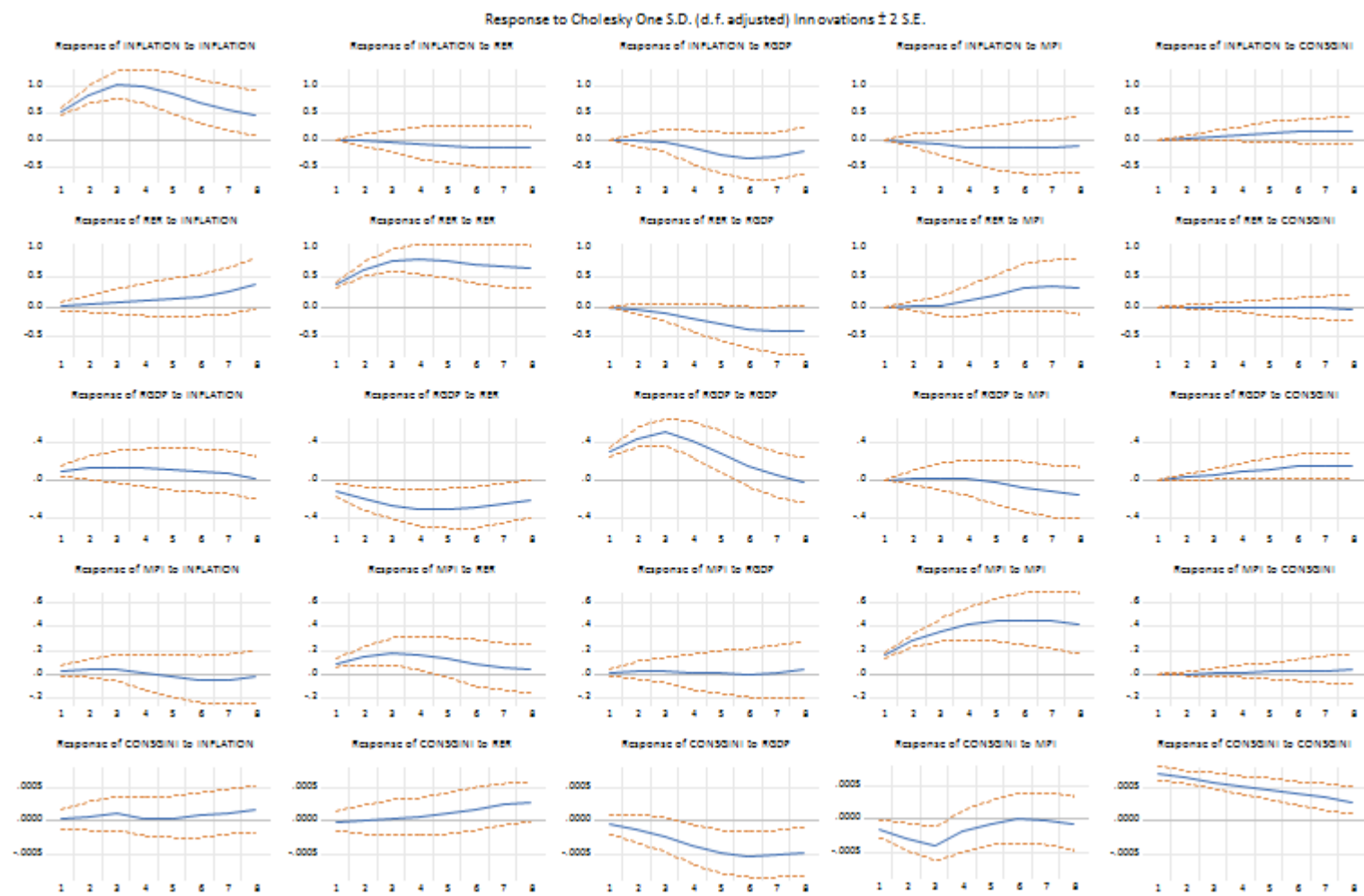


Figure 4-3: SVAR-Impulse Response Functions for Indian Economy, Consumption Inequality Model

4.2 Monetary Policy Shocks and its Effect Inequalities in the Chinese Economy

Monetary policy in the period of study began with addressing of raising inflation in 1994. China's story of economic growth began with the introduction of a series of growth oriented reforms that began in 1979. In the eighties, these reforms had begun to show results, putting China as one of the fastest growing economies in the world. It continued to be so in the nineties as well. The growth in the eighties had reflected in inflation levels in the early nineties. From 1992, China witnessed high inflation levels for a period of 5 years peaking at 1994 with 24%. In order to control this, contractionary monetary policy was adopted, which was successful in bringing inflation back in single digits, without hampering growth levels to a large extent. In 1997, the onset of the Asian financial crisis did leave an impact on the Chinese economy. China follows a fixed exchange rate system and the Asian financial crisis had been followed by the depreciation of the currencies of a lot of Asian economies. China continued to maintain its exchange rate pegged against the dollar. As a result of the crisis, the Chinese economy witnessed deflation in 1998 and 1999, with inflation levels remaining close to 0 until 2002. In order to meet with this problem, an expansionary monetary policy was adopted, with interest rates reduced. In addition to this, the government started to tax interest on deposits and adjusted money supply through central bank open-market operations. Growth rates were seen to increase steadily until 2007. Inflation increased, still remaining below the threshold level. In 2008, with the onset of the Great Recession, there was a sudden fall in the growth rate. China's GDP growth, which was over 10% after 2003 and peaked at 13% in 2007, reduced to 9% and 8.7% in 2008 and 2009, the lowest level since 2000. Inflation levels continued to remain high in 2008 until the next year, which saw a marginal deflation in the economy. Interest rates were lowered immediately in 2008 by two percent. The effect of the financial crisis of 2008 did have an effect on Chinese economy but was reduced to a large extent immediately with appropriate monetary policy measures that were taken in the right time. In 2010, the Chinese economy had fallen back in track with a GDP growth of 10%, as per the projections. Monetary policy in China has always been directed towards maintaining stable growth and keeping inflation under control. It has been successful to a large extent. The major instruments of monetary policy used to achieve these objective has been interest rates, cash reserve ratio and monetary base targets. This analysis has been done taking interest rate to be monetary policy instrument throughout the period. Various studies have used monetary base M2 growth rate as the monetary policy instrument for China. However, this study uses interest rate as the measure of monetary policy and later part of the section studies the sensitivity to the results obtained for M2 growth rate as monetary policy indicator.

4.2.1 Monetary Policy Shocks and its Effect on Income Inequalities

For the Chinese economy, the effect of monetary policy on income inequality has been estimated based on the SVAR approach with all the variables at levels. This is done to ensure that the effect is accurately captured, even in the presence of cointegration among variables.

The Structural IRFs obtained from the SVAR analysis is seen in figure 4-4.

Inflation's response to depreciation in currency and real GDP growth is seen to be positive throughout the period following the shock. Depreciation in currency increases import prices causing import driven inflation. Real GDP growth also drives inflation after two quarters, affirming the Phillips curve relationship. Inflation's response to contractionary monetary policy is also seen to be positive indicating the 'prize puzzle' in the estimation. The price puzzle is very commonly observed in the case of a SVAR estimation indicating that a contractionary monetary policy leads to an increase in price levels in the economy. In response to an increase in income inequality, inflation is seen to reduce marginally until the fourth quarter and shows a positive response after four quarters.

Real exchange rate's response to inflation, monetary policy and income inequality shocks is seen to be positive. Increased inflation rates cause Chinese goods to be costlier in the international market, which reduces the demand for Chinese goods. Being one of the most open economies in the world that is dependent on exports for growth, the primary concern of the Chinese economy is to ensure that there is no hindrance to exports due to inflation. Hence, there has to be a depreciation to ensure that Chinese goods continue to have the demand in the international market. Monetary policy contraction leads to depreciation in currency. Income inequality increase also brings about depreciation in currency. Real GDP growth leads to a minor depreciation until the fourth quarter and remains unresponsive thereafter.

Real GDP is seen to increase significantly with depreciation in exchange rate. Depreciation in exchange rate boosts exports and in the case of Chinese economy exports constitute a major part of the GDP growth in the economy. Inflation is seen to have a minor positive response on real GDP growth in the economy after the second quarter and remains unresponsive in the following periods. Contractionary monetary policy brings about a decrease in real GDP growth after five quarters. It remains unresponsive to income inequality shock.

Monetary policy's response to positive shock in inflation is seen to contract throughout the period following the shock. Depreciation in real exchange rate brings about an expansionary monetary policy initially and continues to expand until the fifth quarter and then is seen to contract there onwards. Real exchange rate depreciation causes inflation due to increase in import prices and hence monetary policy contracts. Growth rate of real GDP is seen to cause contractionary monetary policy. An increase in real GDP growth causes inflation levels in the economy, which is countered with contractionary monetary policy.

Income inequality's response to shock in inflation, real exchange rate and real GDP is seen to decrease throughout the period. Inflation boosts production in the economy, which in turn increases employment levels and income levels. Income inequality also reduces to depreciation in exchange rate. As an economy that is dependent on manufacturing to a large extent, the increase in real exchange rate will not bring about much disparity in the income levels of skilled and unskilled laborers with majority of them remaining skilled in manufacturing sector, as opposed to the case of India. Hence, income inequality is seen to

decrease. The response of income inequality to monetary policy shock is seen to be mixed. In the short run, until the fourth quarter, it is seen to be positive and then shows a negative response thereafter until the end of the period. Thus it is ambiguous to say whether there is a positive or a negative effect on income inequality and what is the channel of transmission since both negative and positive response are seen to be for a significant period of time. Although the response in the short run until the fourth quarter is seen to be positive, the over all trend in the response is negative. However, the channel of transmission cannot be concretely identified.

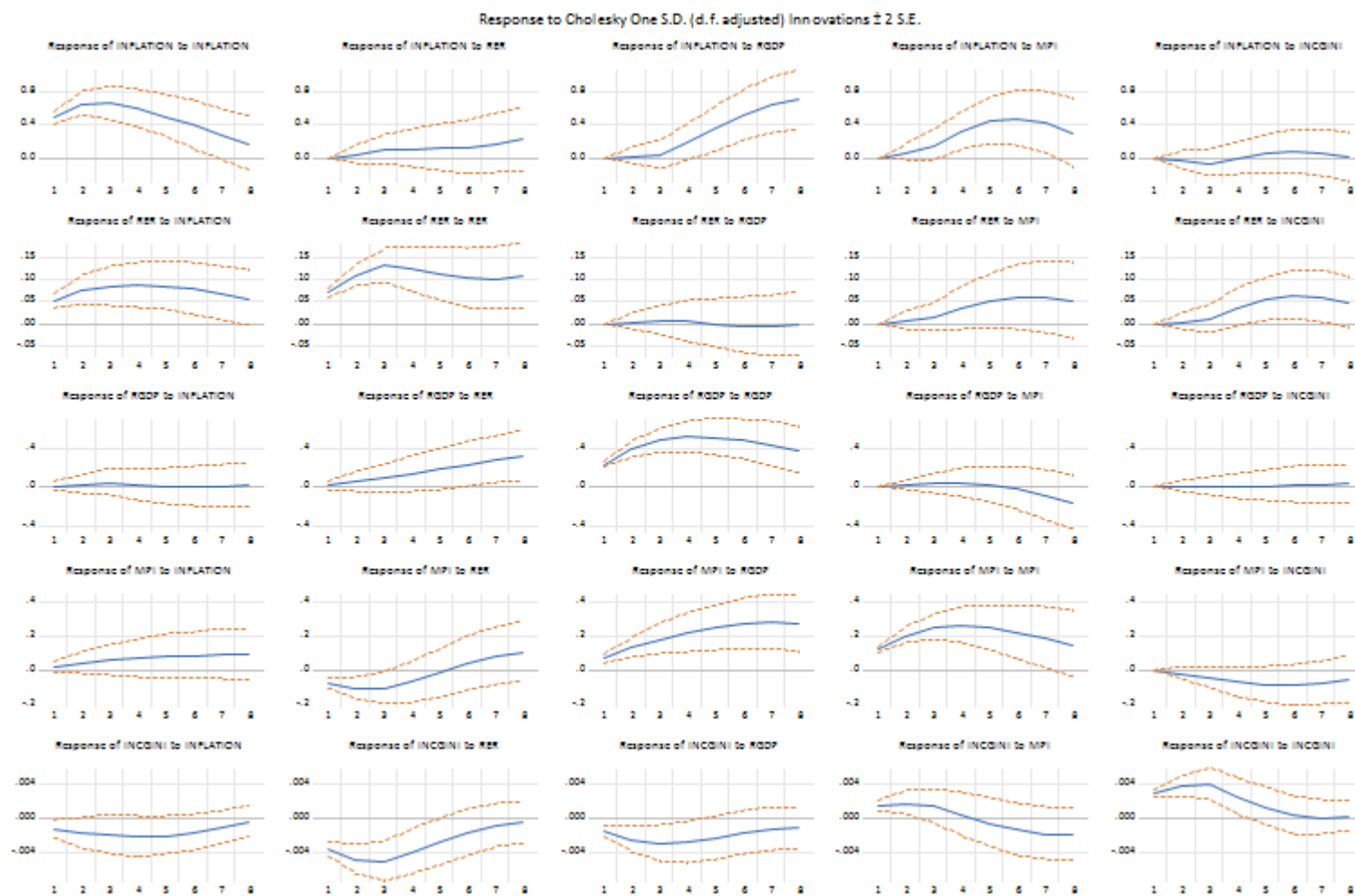


Figure 4-4: SVAR-Impulse Response Functions for China Economy, Income Inequality Model

4.2.2 Monetary policy and its Effect on Consumption Inequality

The structural impulse responses obtained for the consumption inequality model has been depicted in figure 4-5. The model has been estimated at levels. The responses of the other variables are similar in terms of income inequality model. Consumption inequality has a positive effect on inflation, real exchange rate and real GDP growth. Increase in consumption inequality brings more inflation in the economy after three quarters. Increased consumption inequality brings more demand for goods and drives inflation eventually. Real exchange rate also depreciates to a positive shock in consumption inequality. Increased consumption from high consumption group increases demand and imports in the economy. As an economy that is dependent on exports for growth, the increase in demand for goods does leave an effect on exports which eventually has to be addressed by depreciation of currency.

Consumption inequality is seen to reduce to a positive shock in inflation indicating that the burden of inflation falls on the high consumption group relatively more. Increase in inflation levels make it more difficult for the high consumption individuals to afford their original basket and are forced to reduce their consumption. Consumption inequality also reduces until the fifth quarter to depreciation in real exchange rate. Depreciation brings more exports indicating that producers find it more profitable to sell goods in international market rather than in the domestic market. Lesser amount of goods available for consumption in the economy reduces consumption inequality in the economy. After five quarters, it increases to show a positive response. Real GDP growth also reduces consumption inequality throughout the period. Increased real GDP comes with increased employment and production which reduces consumption inequality. Contractionary monetary policy also has a negative effect on consumption inequality in the economy similar to the case of India. In the case of China, the response of income inequality is seen to be positive for one year after contractionary monetary policy shock and then shows significant negative response, making it unclear to understand the channel of transmission. If indeed the effect of monetary policy contraction on income inequality is positive, the channel is more in line with earnings heterogeneity and savings redistribution channel. The expected effect of contractionary monetary policy on consumption inequality is positive. If the effect is negative, then the channel of transmission of monetary policy shock is more in line with the income composition channel, financial segmentation channel and portfolio channel. From the results, it can be observed that the response of consumption inequality is indeed negative throughout the period following the shock. However, since the effect on income inequality is seen to be ambiguous, the channel of transmission cannot be concretely identified. It would be flawed to assume that the channel of transmission is in line with income composition, financial segmentation and portfolio channel based on the response of consumption inequality since it can also be possible that the country still has not reached the financial development threshold level beyond which consumption inequality increases. Besides, the positive response is seen to be for over a year following the shock which indicates that there is increase in income inequality for a significant amount of time following a contractionary shock in monetary policy. The correct channel of transmission can be identified only after understanding the country specific dynamics such as financial development threshold, inflation threshold etc.

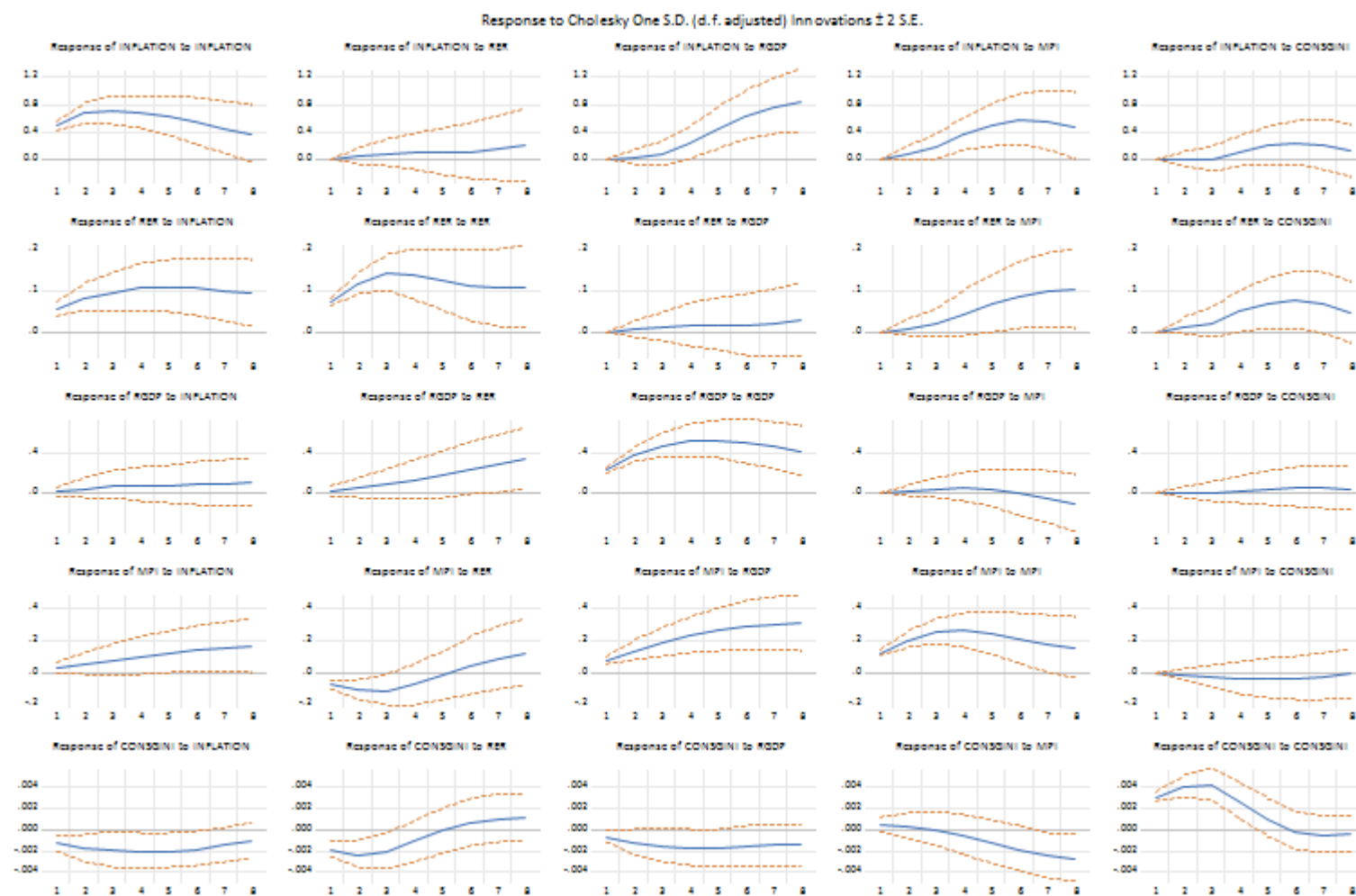


Figure 4-5: SVAR-Impulse Response Functions for China Economy, Consumption Inequality Model

4.3 Monetary Policy Shocks and its Effect Inequalities in the South African Economy

South Africa's monetary policy from the period of 1991-2015 has seen major reforms. In the beginning of 1991, inflation rates were seen to be very high, with around 16%. Although it began to decrease thereafter, it continued to remain high. In 2000, there was a change in the monetary policy regime in South Africa. Prior to 2000, the Reserve bank followed the classical cash reserve system based on the recommendations of the De Kock Commission. Bank rate or the rate at which the central bank provided accommodation to the banks was used as the policy instrument. In 2000, the Central Bank of South Africa formally adopted the inflation targeting in the economy. It was also a time when many of the economies around the world were beginning to adopt inflation targeting. With the formal adoption of inflation targeting regime in the country, the Central Bank decided introduce repo rates as the policy variable. These repo rates are market determined in daily tender of liquidity through repurchase transactions. As far as exchange rate is concerned, the dual tier exchange rate system was put to an end in 1995 for certain capital account transactions. With the onset of inflation targeting regime in 2000, the economy experienced deflationary pressure. In addition to this, the currency had also depreciated to a large extent in 2001, which posed as a threat to progressively reduce inflation in the economy. Real GDP growth rate averaged over 3.5% per annum in the late nineties. In 2003, a slowdown in the growth rates was observed. After 2003, the mid 2000's had seen a favorable external environment coupled with a strong domestic demand that put the growth rate back on track. Growth rate averaged to 5% from 2005-2007. Again in 2008, the onset of the financial crisis had brought about a change over the economic outlook. Monetary policy was eased out in the beginning of 2008. Interest rates were reduced until mid-2009, however inflation continued to remain higher than projections.

4.3.1 Monetary Policy Shocks and its Effect on Income Inequalities

For the South African economy, the effect of monetary policy on income inequality has been estimated based on the SVAR approach with all the variables at levels. This is done to ensure that the effect is accurately captured, even in the presence of cointegration among variables. The Structural IRFs obtained from the SVAR analysis is seen in figure 4-6. Real exchange rate is seen to bring about import inflation in the economy. South Africa is a small open economy and hence it can be expected that imports play an important role in the economy to aid consumption. Real exchange rate depreciation makes imports costly, driving inflation in the economy. Response of inflation to real GDP is contrary to the Phillips curve relation, indicating that as output grows, the inflation levels in the economy reduces marginally. Contractionary monetary policy has little effect in controlling inflation, indicating that the interest rate channel is operational only to a small extent. Increase in interest rates brings down a marginal reduction in the economy, indicating there is no presence of price puzzle. Income inequality increases inflation gradually until the third quarter and then declines to

return to stable position in the long run. Increase in income levels creates more demand in the economy driving inflation.

Real exchange rate has a positive response to shocks in inflation and negative response to shocks in real GDP, monetary policy and income inequality. Monetary policy and real GDP growth is seen to have little effect on real exchange rate. Inflation is seen to bring depreciation in currency. Costlier goods tend to have lesser demand in the international market. As inflation increases, goods become costlier and reduce demand in the international market, reducing exports. This is countered with depreciation of currency. Real GDP growth, monetary policy contraction and income inequality increase appreciates real exchange rate in the long run. Contractionary monetary policy brings about an appreciation in real exchange rate indicating that the exchange rate channel is operational.

Real GDP response to inflation increase and real exchange rate depreciation is seen to be negative. Inflation is seen to bring marginal increase in real GDP growth rate in the quarters immediately following the shock. After the second quarter, it is seen to decline to show a negative response. Inflation is seen to not have significant effect on increasing growth rate in this economy. This is seen also in the paper of D. Hodge (2006)[10], titled 'Inflation and Economic Growth in South Africa' which points out that inflation does pull down economic growth significantly in the long run. Real exchange rate depreciation also brings reduction in economic growth. This means that boosting exports via real exchange rate depreciation does not contribute much towards real GDP.

Monetary policy is seen to contract to a positive shock in inflation only in the long run. Contractionary monetary policy is seen to be adapted to a positive real GDP shock and real exchange rate depreciation. Real exchange rate depreciation is seen to increase exports but bring in import inflation in the economy. This is seen to bring in contractionary monetary policy. Monetary policy is most responsive to shock in inflation and real GDP. Although monetary policy regime in the economy is inflation targeting, the response of monetary policy to inflation is seen only in the long run.

Income inequality is seen to increase to a positive inflation shock in the long run and remains unresponsive in the short run. Contractionary monetary policy is seen to bring positive effect on income inequality in the South African economy, indicating that there is a presence of earnings heterogeneity and savings redistribution channel. South African economy is seen to have a higher level of unemployment level when compared to other emerging economies. Thus, a contractionary monetary policy can increase income inequality through earnings heterogeneity channel through disproportionately transmitting the burden of unemployment on low income group. There is a possibility of the existence savings redistribution channel as contractionary monetary policy can also increase income inequality through savings redistribution channel as well. The presence of these two channels in the economy can be affirmed after looking at the response of consumption inequality. In line with these two channels, the response of consumption inequality to contractionary monetary policy is expected to increase. In response to real GDP growth, income inequality is seen to show an increase until the fourth quarter and then declines thereafter.

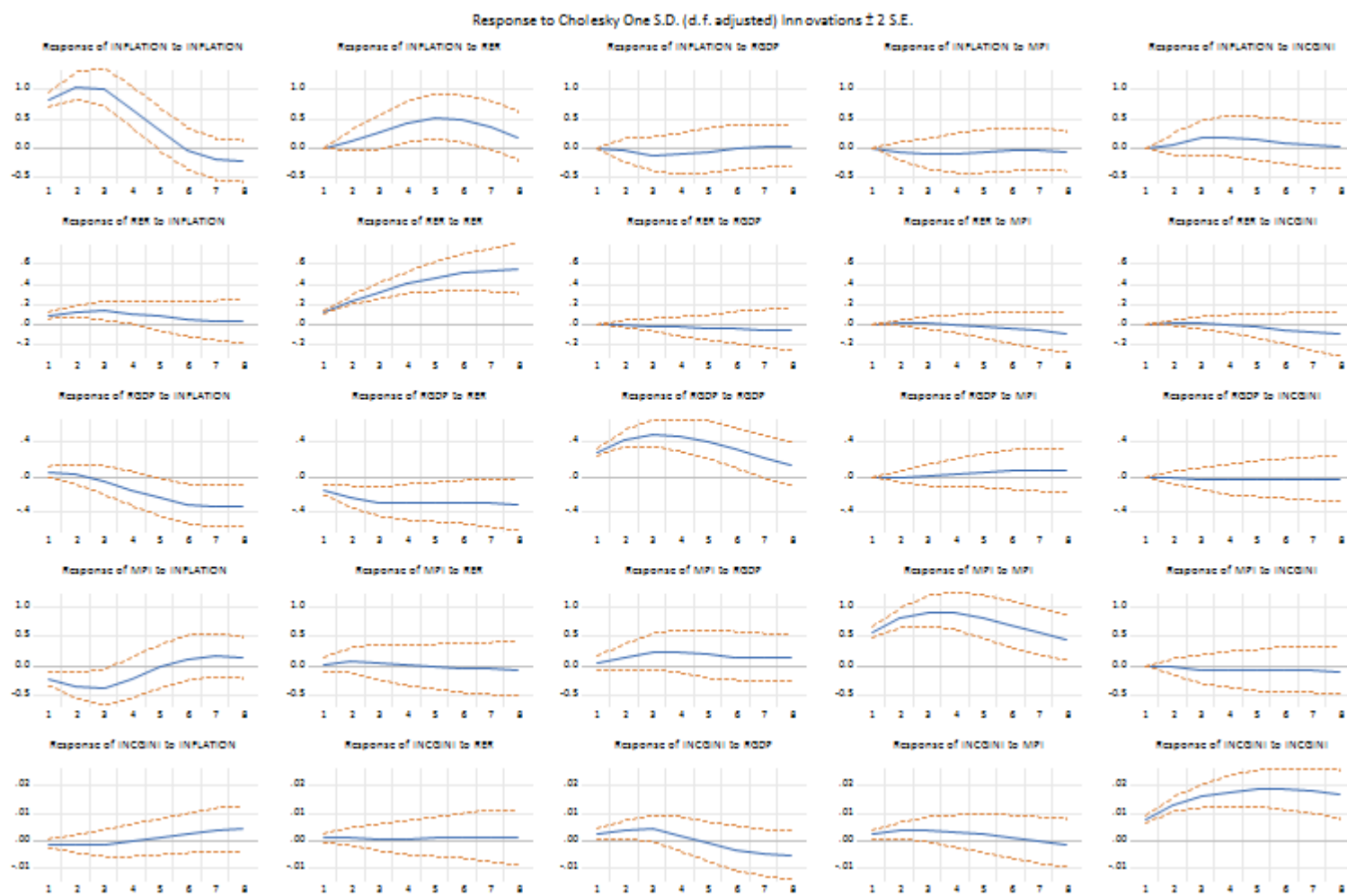


Figure 4-6: SVAR-Impulse Response Functions for South Africa Economy, Income Inequality Model

4.3.2 Monetary Policy Shocks and its Effect on Consumption Inequalities

The structural impulse responses obtained for the consumption inequality model has been depicted in figure 4-7. The model has been estimated at levels. The responses of the other variables are similar in terms of income inequality model. Consumption inequality is seen to have positive effects on inflation and real GDP growth while it has a negative effect on monetary policy. Increase in consumption inequality has a positive effect on inflation throughout the period. Increase in consumption basket of the high consuming group creates demand led inflation in the economy. Real exchange rate depreciation has very little response to shock in consumption inequality.

Consumption inequality is seen to increase with a positive shock in inflation levels in the economy. Consumption inequality can increase either through increase in consumption levels of the high consumption group or through reduction in the consumption levels of the low consumption groups. Inflation increases consumption inequality by burdening the consumers, who are unable to afford the same consumption basket due to increase in price levels. Burden of inflation falls relatively more on low income group, for whom the real income is further reduced to be able to afford consumption. As real income decreases, low income group reduce their consumption. Real exchange rate depreciation and real GDP growth is seen to bring decline in consumption inequality. Depreciation of currency tends to boost exports and restrict imports thereby reducing the amount of goods in the economy available for consumption. High consumption group, who are high income members in the economy, are left with lesser goods to consume, eventually reducing the consumption inequality. When real GDP increases, the income levels of the population are also increase, enabling the low consumption group also to consume more. Monetary policy is seen to have minor effect on consumption inequality. Contractionary monetary policy brings a marginal increase in consumption inequality and remains unresponsive in the long run. The effect of contractionary monetary policy on income inequality is seen to be positive throughout the period indicating that the channel of transmission is through savings redistribution and earnings heterogeneity channel. Although the response of consumption inequality is seen to be minor there is positive response for a significant period of time. The response of contractionary monetary policy is seen to be positive affirming the presence of savings redistribution channel and earnings heterogeneity channel.

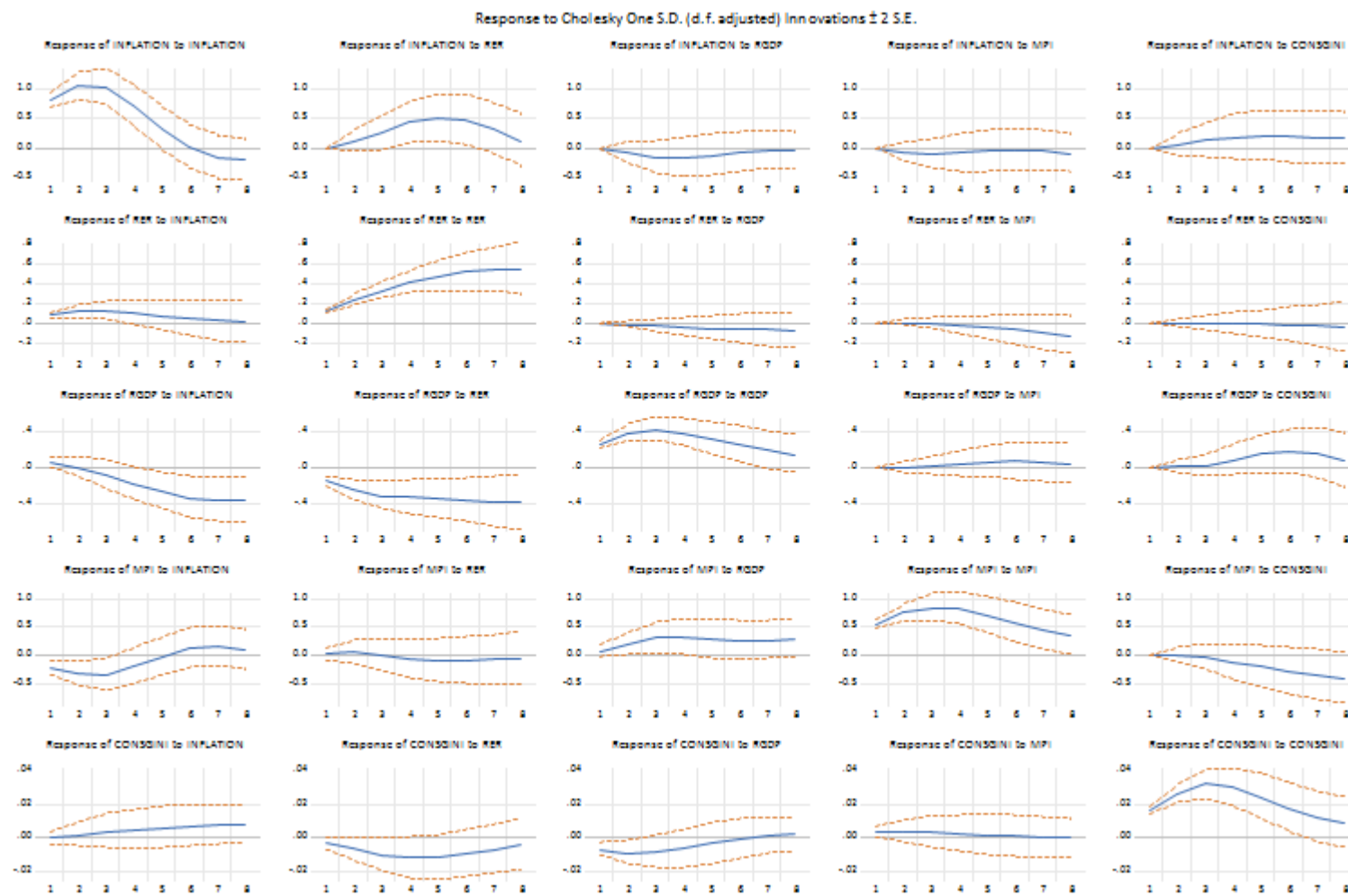


Figure 4-7: SVAR-Impulse Response Functions for South Africa Economy, Consumption Inequality Model

4.4 Monetary Policy and its Effect on Inequalities in Brazil

Brazil has faced a period of hyperinflation and this paper focuses on the post hyperinflation episode in the economy. During the hyperinflation period, monetary policy was characterized by passive monetary policy. The post hyperinflation period from 1995-2015 was seen with successfully controlling inflation but unfortunately failed to improve economic growth. The entire period after the hyperinflation episode was characterized with moderate growth period with better stability. Inflation targeting was adopted as the monetary policy regime in 1999. The real GDP growth rate in the entire period averaged up to 3 percent. The low inflation levels again brought about a new challenge in terms of a banking crisis. Fall in inflation led to the fall in seigniorage-like revenues that were partially captured by the banks (Ayres et al., 2019) [13]. The decrease in revenues hurt the banks performance and contributed to the banking crisis. The Asian financial crisis of 1997 and the 1998 Russian financial crisis also had an effect on the Brazilian economy. In 1998, post the Russian financial crisis, there was a fall in the international reserves in Brazil. Floating exchange rate was adopted in 1999. From 2004-2008 had been the best period of the Brazilian economy in the period of focus. Growth rates began to improve; external environment was better which led to expansion of international trade, which led to increase in international reserves. Again with the onset of the global financial crisis of 2008, the central bank adopted a countercyclical monetary policy in order to prevent the country to going into a recessionary period. The effect was seen to be fruitful until 2010 where the GDP growth was seen to be at around 6.2 percent and did not last longer from thereafter. In 2012, the real GDP growth again fell to less than 2 percent. In Brazil, the role of fiscal policy is seen to be sounder and sought after to address economic issues rather than monetary policy. At various instances during the economic slow-down, immediate fiscal measures were taken into action. Particularly in addressing matters of poverty and inequality, the fiscal measures are seen to be of greater success. In 1999, the government implemented large conditional cash transfer programs, such as the social welfare program Bolsa Familia, which led to big improvements in income inequality in the fight against poverty. The monetary policy variable has been the SELIC interest rate which is the short term interest rate of the Central Bank of Brazil.

4.4.1 Monetary Policy Shocks and its Effect on Income Inequality

For the Brazilian economy, the effect of monetary policy on income inequality has been estimated based on the SVAR approach with all the variables at levels. This is done to ensure that the effect is accurately captured, even in the presence of cointegration among variables. The Structural IRFs obtained from the SVAR analysis is seen in figure 4-8.

Inflation's response to real exchange rate depreciation is seen to be negative indicating that there is no import related inflation in the economy. This can mean that there inflation in the economy is not driven by demand and the demand for goods in the economy is weak. Real GDP growth has a negative effect on inflation indicating that Phillips curve

relationship does not hold in this country. This can indicate the existence of price rigidity in the economy. Monetary policy contraction is seen to bring about increase in inflation levels in the existence confirming the existence of price puzzle. Income inequality does not significantly affect the inflation levels in the economy throughout the period following the shock.

Real exchange rate is seen to appreciate to a positive shock in inflation and contractionary monetary policy and depreciates to shock in real GDP growth rate. Contractionary monetary policy appreciating real exchange rate indicates that the exchange rate channel is significant in Brazil. Real GDP growth rate comes with increase in production levels, incomes of the individual, which may push demand in the economy, causing more import demand. This can cause increase in imports over exports. Depreciation tends to reduce imports and boosts exports. Income inequality has negligible effects on real exchange rate throughout the period following the shock.

Real GDP is seen to show negative response to inflation increase. Inflation is expected to bring a positive effect on real GDP in the short run and negative in the long run. In the case of Brazil, inflation does not show any positive effect on real GDP growth throughout the period. This could be possibly because of the fact that the country has faced episodes of hyperinflation and inflation is seen to be hindrance to economic growth even after this episode also. Real exchange rate depreciation brings about growth in real GDP throughout the period. Contractionary monetary policy decreases real GDP growth after three quarters. Income inequality has no significant effect on real GDP growth in the economy throughout the period.

Inflation increase is countered with monetary policy contraction. Real exchange rate depreciation brings about expansionary monetary policy, in order to boost inflow of foreign investment. Real GDP growth rate leads to loosening of monetary policy since growth rate of real GDP is not seen to bring inflationary pressures.

Income inequality is seen to increase to positive shock in inflation, real GDP growth and contractionary monetary policy. Contractionary monetary policy is seen to bring positive impact on income inequality in the long run indicating that the channel of transmission is savings redistribution and the earnings heterogeneity channel. Inflation has positive effect on income inequality. Ferreira and Litchfield (2001)[6] for Brazil, find that higher inflation leads to a lower share of income held by the poorest share of the population. The paper also mentions the contribution of Neri (1995), who looking at Brazil, discusses the channels through which inflation can lead to higher income inequality. Economies of scale and barriers to entry in financial services can reduce the access of the poor to inflation hedges relative to the rich; the relatively competitive labor market for unskilled labor in developing countries reduces the bargaining power of poor workers. Real GDP is seen to increase income inequality in the long run. Initially, the response is seen to be negative. As real GDP increases, the amount of investments increases in the economy, which in turn increases output. As the output increases, the amount of income increases disproportionately. The incomes of producers increase, while the income of the workers does not increase, widening the gap in incomes.

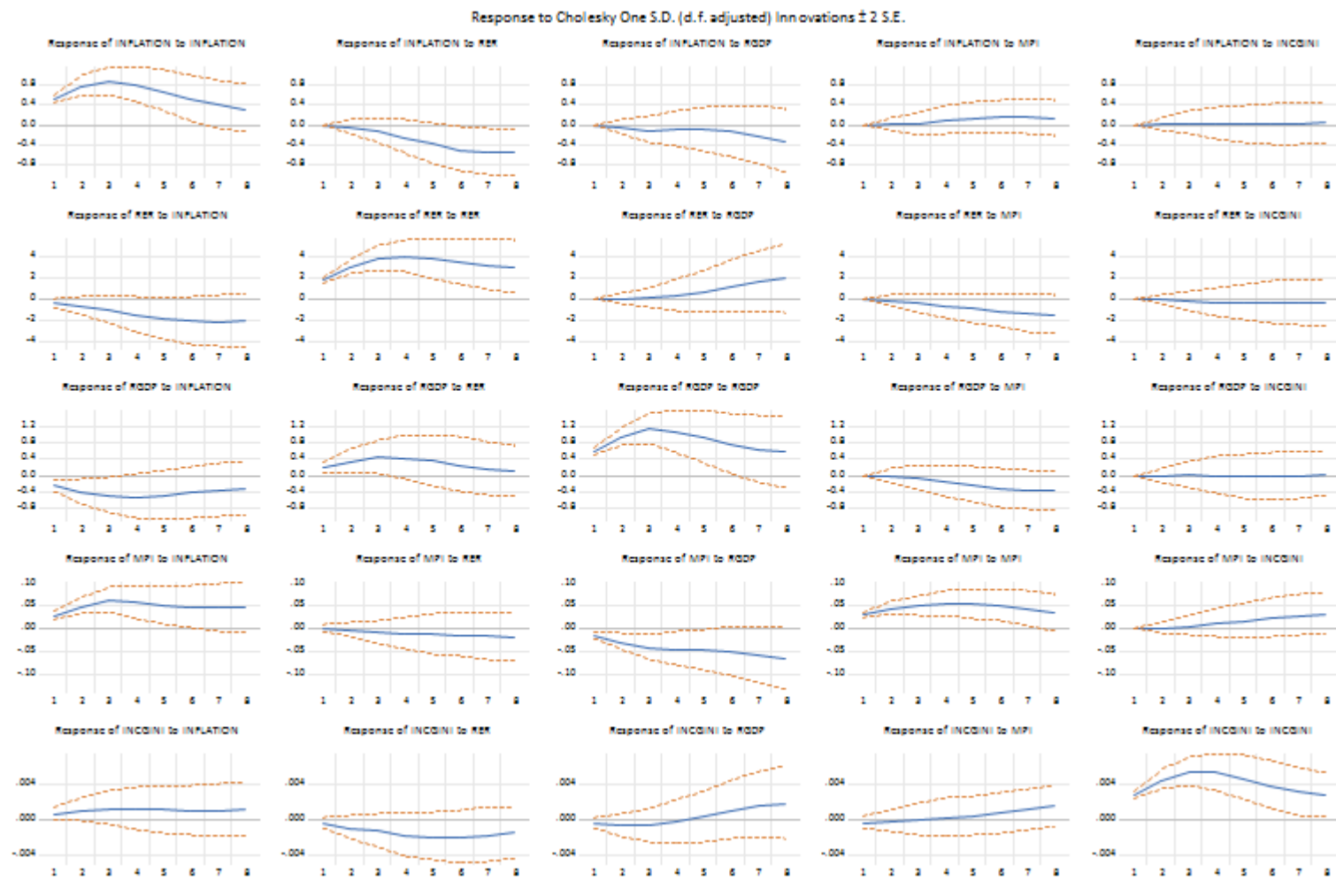


Figure 4-8: SVAR-Impulse Response Functions for Brazil Economy, Income Inequality Model

4.4.2 Monetary Policy and its Effect on Consumption inequality

The structural impulse responses obtained for the consumption inequality model has been depicted in figure 4-9. The model has been estimated at levels. The responses of the other variables are similar in terms of income inequality model. Consumption inequality is seen to show significant effect on all the variables. Inflation is seen to increase in response to a positive shock in consumption inequality after three quarters. Increase in consumption levels in the high consumption basket consumers is seen to push demand in the economy, which increases inflation levels eventually. Consumption inequality shock is seen to bring a real exchange rate appreciation. As demand for goods increase in the economy there is excess consumption, leading to lesser amount of goods for export. This reduces the supply of goods in the international market, appreciating the exchange rate. Real GDP is seen to decline marginally following a positive consumption inequality shock in the economy.

Consumption inequality is seen to increase to shocks in inflation, real exchange rate and contractionary monetary policy and decline in response to real GDP growth. Consumption inequality's decline to positive shock in real GDP indicates that the high consumption basket consumers are the low income group. Positive shock in real GDP increases the income levels of the individuals which lead to increase in investments in the economy. This increases incentive to save more and reduces consumption among the low income group reducing inequality. Real exchange rate depreciation brings more increase in consumption inequality. Inflation causes a marginal increase in consumption inequality. Contractionary monetary policy increases consumption inequality, affirming the presence of savings redistribution channel and earnings heterogeneity channel. Contractionary monetary policy brings about an increase in both income and consumption inequality. The effect on income inequality also indicates that the channel of transmission can either be savings redistribution or through earnings heterogeneity channel. The response of consumption inequality is seen to be stronger than that of income inequality.

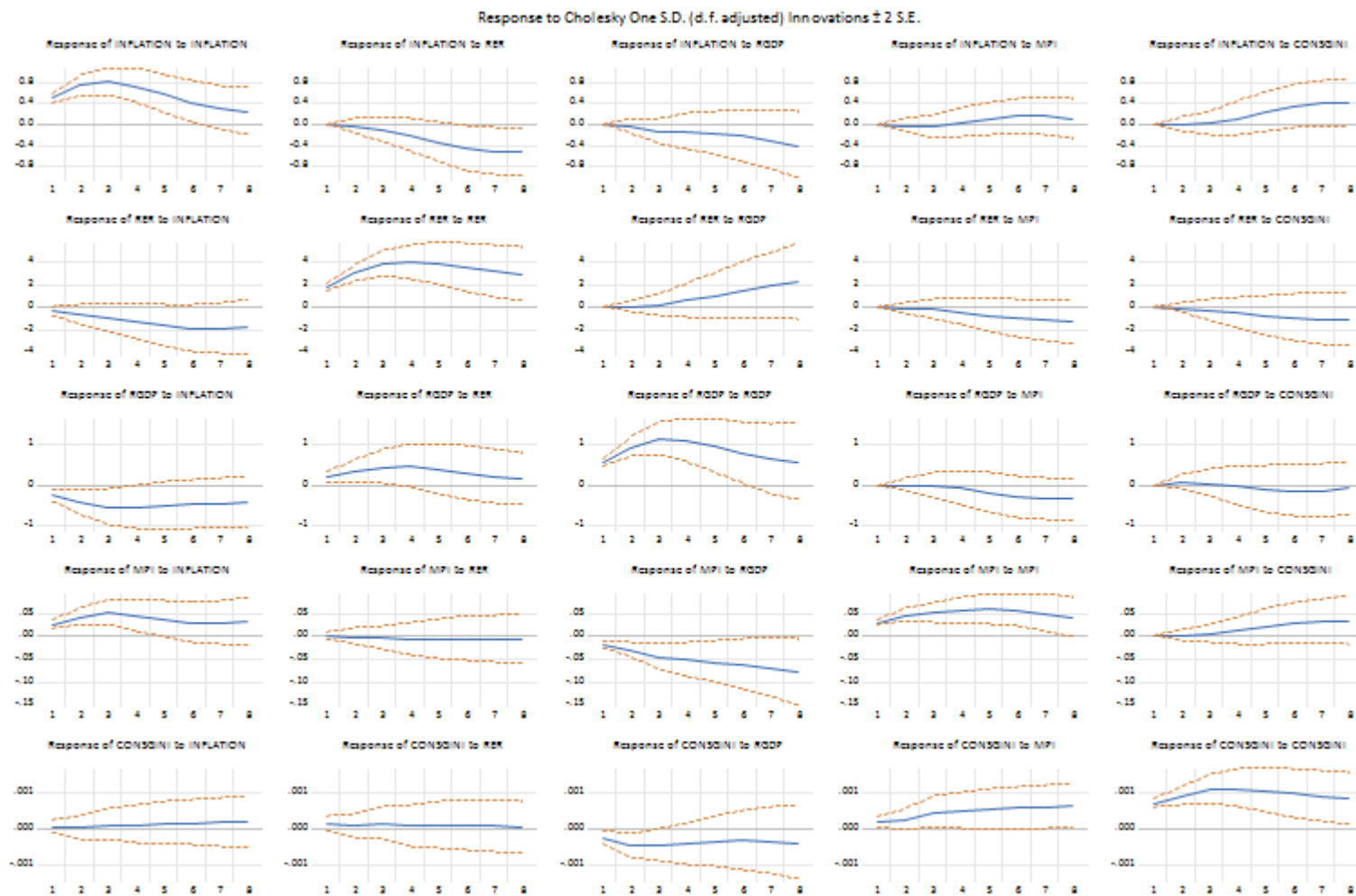


Figure 4-9: SVAR-Impulse Response Functions for Brazil Economy, Consumption Inequality Model

4.5 Monetary Policy and its Effect on Inequality in the Russian Economy

Monetary Policy in Russia is implemented by the Central Bank of Russia, which was established in 1990. Its main objective has been to manage Russia's foreign reserves and foreign exchange, and setting short-term interest rates, which is one of the main instruments of the bank's monetary policy implementation. The paper focuses on the post hyperinflation period from 2000-2015. The episode of hyperinflation came to an end in 1999. The Russian economy was also hit by the Asian crisis which was seen at the end of nineties and was just recovering from the hyperinflation episode. The beginning of 2000 was seen with increase in the reserve rate requirements. In 2001, the external position of Russia was seen to be quite bad. The depreciation in the exchange rate had created a strong effect on the import side. Exports were not seen to increase largely. The Russian economy also experienced a similar exchange rate crisis again in 2008, and the central bank had to devalue its currency in order to maintain exchange rate reserves. The reserves were seen to increase in 2009 as an effect of devaluation. Growth rates during this period were also seen to be negative until late 2009, with the repercussions of the Great Recession coming to an end. It began to improve after 2010. Again in 2014, there was a fall in the oil process, which severely affected the exports of Russia, with oil being one of the main exporting commodities, the fall in its price has been one of the main reasons for the fluctuating reserves in the Russian economy. This was followed by a weakening of the currency again. In addition to this, the economy began to experience increasing inflation rates, which was countered with a contractionary monetary by lowering the key rates. In 2015, the key rate of interest was reduced gradually.

4.5.1 Monetary Policy Shocks and its Effect on Income inequality

Inflation in the Russian economy is driven by depreciation and real GDP growth. The analysis for the Russian economy shows the existence of a price puzzle, as inflation is seen to increase to a positive shock in interest rates. Income inequality is seen to significantly reduce inflation levels in the economy in the long run and remains unresponsive in the short run. Expensive imports due to depreciation of real exchange rate do cause significant inflation implying that the economy does consume a lot from imports. Real GDP growth brings in more inflation in the economy, affirming the presence of the Phillips curve relationship.

Real exchange rate is seen to depreciate to positive shocks in inflation, real GDP growth and contractionary monetary policy. The real exchange rate channel requires that a contractionary monetary policy should bring about appreciation in real exchange rate. However, the response in the case of Russia is seen to be the opposite of what is expected. Income inequality increase is seen to appreciate the currency. Increase in income levels can lead to shift in demand from tradable goods to non-tradable goods which in turn lead to increase in the price of non-tradable goods eventually leading to an appreciation of exchange rate. Inflation of tradable goods tends to cause lesser demand in the international market which leads to depreciation in the economy.

Real GDP is seen to respond negatively to increase in inflation levels in the economy, similar to the case of Brazil. Inflation in the Russian economy has been continuing to show inflationary pressures even after the hyperinflation episode. Thus, inflation in an economy that has recently moved out of hyperinflation causes lesser positive effect on real GDP growth foreseeing hyperinflation again. Hence inflation increase is seen to be detrimental to real GDP growth. Real exchange rate depreciation causes real GDP growth in the long run while it is seen to have negative effect initially. Contractionary monetary policy brings deterioration in economic growth after four quarters and remains unresponsive until then. Income inequality increase is seen to show negative effect on real GDP growth after three quarters. After two years following the shock, the effect is seen to be positive marginally. For majority of the period, income inequality is seen to harm real GDP growth.

Inflationary shock is seen to have negligible effect on monetary policy throughout the period. This can be due to the existence of a price puzzle in the data. Real exchange rate depreciation has a contractionary effect on monetary policy after two quarters. Real exchange rate depreciation is seen to bring import inflation in the economy which is countered using contractionary policy. Monetary policy has negligible response to a positive shock in real GDP growth in the long run and a minor positive response in the short run. Real GDP growth also boosts inflation in the economy and is countered using contraction of monetary policy.

Inflation and contractionary monetary policy are expected to bring increase in income inequality. Inflation deteriorates economic growth, which increases unemployment levels in the economy. This worsens the gap between the rich and the poor. Real exchange rate depreciation brings down income inequality and real GDP growth has negligible effects on income inequality reduction. Contractionary monetary policy is seen to most significantly increase income inequality when compared to other variables. This implies that the effect is seen to be in line with earnings heterogeneity channel and savings redistribution channel. As an emerging economy that is still battling to control inflation and the existence of Phillips curve relationship, unemployment is seen to be a key driving force in the economy. The earnings heterogeneity channel points out that the burden of unemployment falls on the low income group and not on the high income group, affirming the presence of earnings heterogeneity channel.

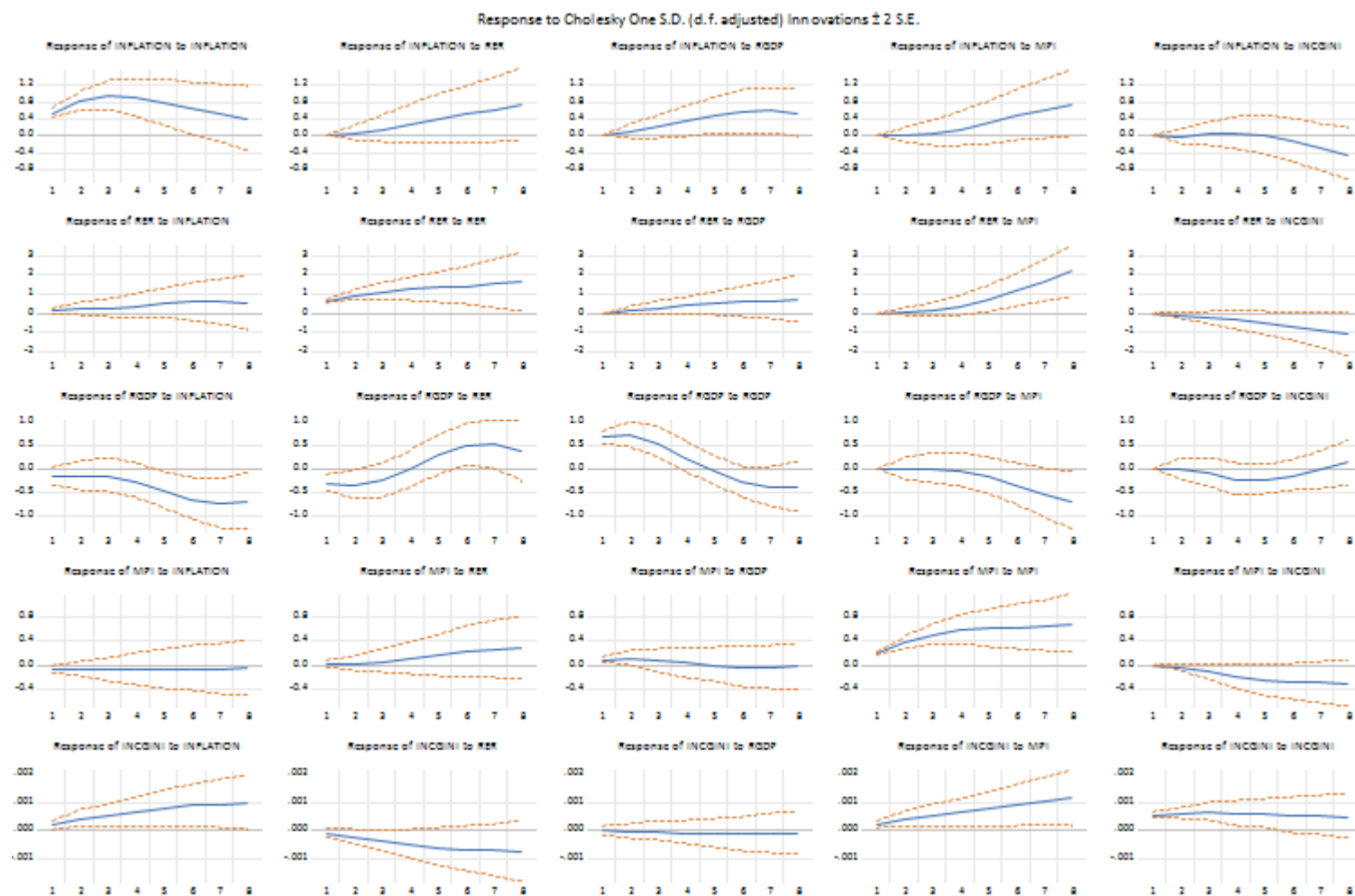


Figure 4-10: SVAR-Impulse Response Functions for Russian Economy, Income Inequality Model

4.5.2 Consumption Inequality and Monetary Policy

The structural impulse responses obtained for the consumption inequality model has been depicted in figure 4-11. The model has been estimated at levels. The responses of the other variables are similar in terms of income inequality model. Consumption inequality shock is seen to have positive effect on real GDP growth and depreciates real exchange rate. Inflation is seen to reduce in response to a positive shock in consumption inequality initially and in the long run is seen to increase. Consumption inequality increase here is seen to be due to a decrease in the low consumption basket consumers. Positive shock in consumption inequality is seen to depreciate. As consumption of the high consumption basket consumers' increase, there is excess demand for imported goods which can cause an imbalance in trade. To facilitate exports, real exchange rate is seen to depreciate. Consumption inequality increase is seen to have positive effect on real GDP growth. Increase in the consumption levels of the high consumption basket consumers tends to increase demand for goods which stimulates production driving growth in the economy.

Consumption inequality is seen to respond negatively to real exchange rate depreciation and inflation shock. Real exchange rate depreciation is seen to bring import inflation in the economy, which makes the high consumption basket consumers difficult to afford consumption from imports. Thus, the consumption levels of the high consumption basket consumers reduce to bring down consumption inequality in the economy. Inflation also is seen to bring down consumption inequality. Inflation burdens low income group, who tend to have higher consumption levels, which reduce their consumption. This brings down consumption inequality. Real GDP growth increases consumption inequality. Real GDP growth tends to increase the income levels of investors, who are high income group and motivates them to increase investments substituting for consumption. Low income group tend to have high consumption levels and high income group tends to have high investment levels. This widens the gap in consumption between the populations. Monetary policy contraction does not have significant effect on consumption inequality throughout the period following the shock. The savings redistribution channel is expected to have positive effect on both consumption and income inequality. The response is seen to be almost nil throughout the period indicating that although income inequality increases after contractionary monetary policy shock, there is no significant effect on consumption inequality. In this case too, there is a possibility that that the country specific characteristics can have significant effect in the transmission of monetary policy effect on inequality.

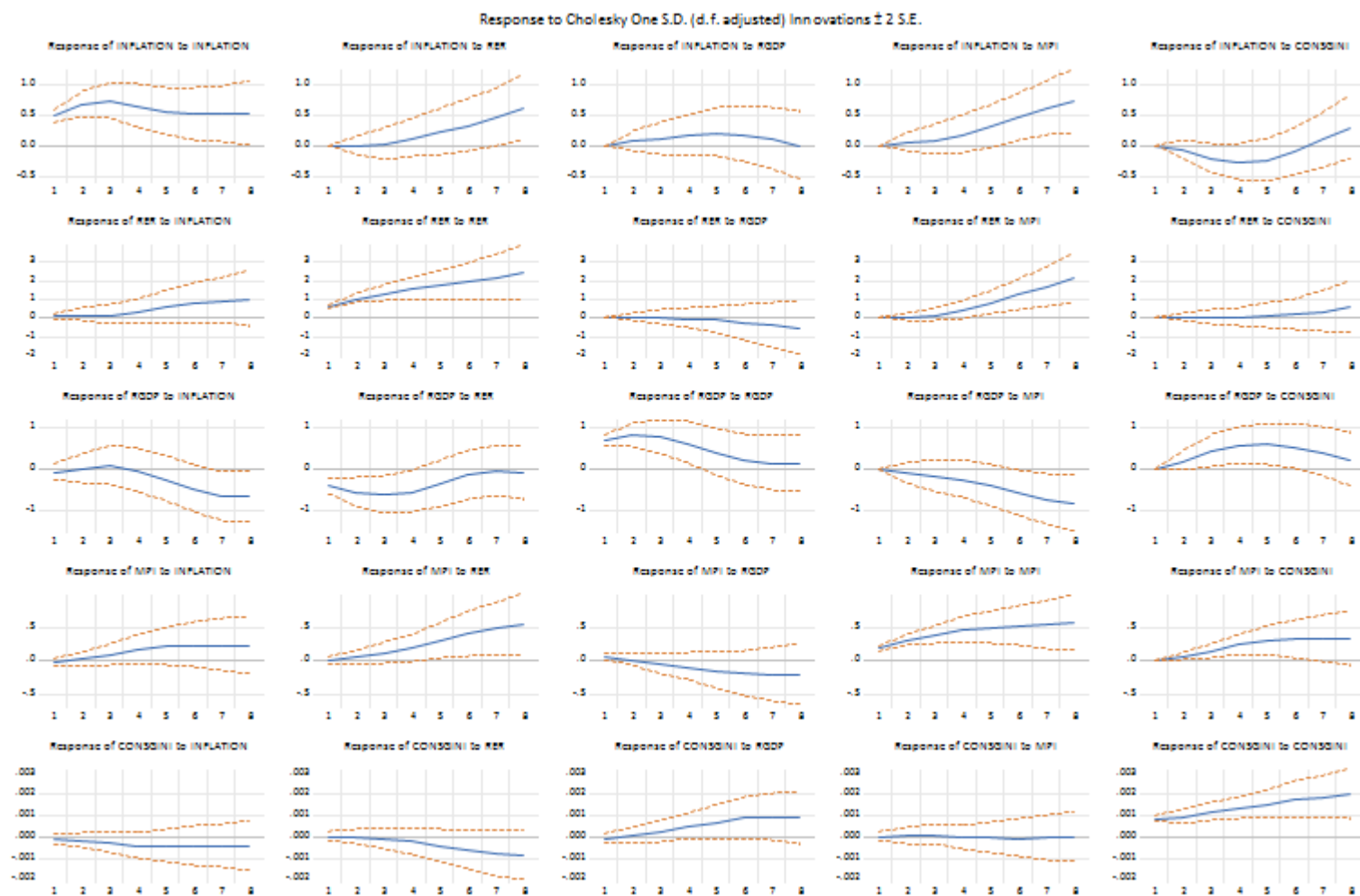


Figure 4-11: SVAR-Impulse Response Functions for Russian Economy, Consumption Inequality Model

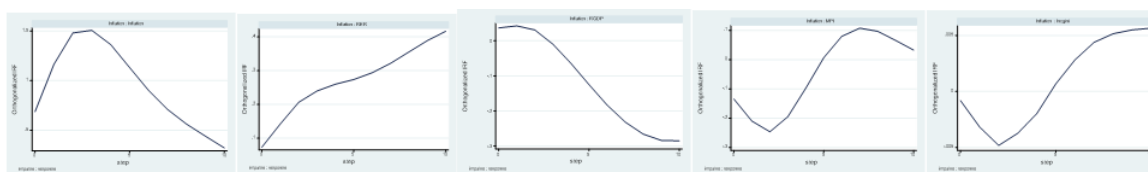
4.6 Balanced Panel VAR Analysis of India, China and South Africa

The Panel VAR analysis has been split into two segments, with the first one understanding the dynamics of monetary policy shocks and its effect on inequalities with a balanced panel, while the second one shows the effect of monetary policy shocks on inequalities among Russia and Brazil with an unbalanced panel VAR. The figure 4-12 and 4-13 shows the impulse responses obtained from the balanced panel VAR analysis. The Panel VAR has been obtained using GMM approach which is recommended for a large panel of countries. Using the GMM is not recommended for a small panel of countries such as three or two countries in the panel. However, this study would like to understand the panel dynamics of the issue and hence the GMM based VAR is estimated. The main aim of the paper is to understand individual country dynamics of the five countries and use a cross country comparison. The panel analysis is undertaken to provide a basic insight into the issue of monetary policy shock on income and consumption inequality. The GMM based panel VAR is one of the approach to estimate panel VAR model. Since this paper only provides an insight into panel VAR and does not concentrate on the approach entirely, the GMM approach is chosen rather than to rely on panel VAR based on Bayesian methods etc. Understanding panel dynamics using an appropriate VAR methodology can be a point to understand for future scope of study.

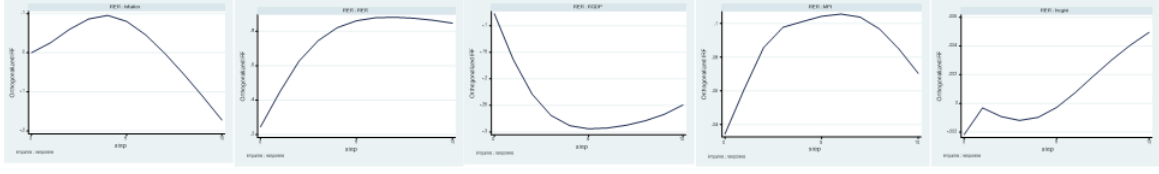
From the panel VAR analysis, it is evident that the effect of shocks in other variables have little effect on both income and consumption inequality. This is observed in the individual country case of SVAR analysis as well. Figure 4-12 shows the impulse responses that have been obtained by the panel VAR methodology for inflation, real exchange rate, real GDP growth rate, monetary policy and income inequality as the variables and figure 4-13 shows the impulse responses that have been obtained by the panel VAR methodology for inflation, real exchange rate, real GDP growth rate, monetary policy and consumption inequality as the variables. Income inequality is seen to be beneficial for growth in the three economies. Higher income inequality in emerging economies means higher concentration of income lies in the hands of producers or investors, which in turn boosts economic growth. An increase in income inequality brings real GDP growth. A positive shock in income inequality brings appreciation in exchange rate throughout the period following the shock. Inflation is seen to reduce in response to a positive shock in income inequality. Contractionary monetary policy is seen to have little effect on income inequality. The effect however is seen to be positive throughout the period following the shock. Similar to the individual country case, contractionary monetary policy is seen to increase income inequality, although the extent of effect is seen to be little. Contractionary monetary policy is seen to have significant effect in controlling inflation and appreciation of real exchange rate. Real GDP growth is seen to have inflationary effects and positive shock in real GDP is seen to contract monetary policy due to this. Growth in real GDP is seen to bring about an appreciation in currency. In the panel of countries, two of them are large open economies and with China being dependent on manufacturing exports, it can be seen that an increase in growth and output levels in the economy has significant effect on exports and real exchange rate levels in the economy. Real exchange rate depreciation has a positive effect on monetary policy in the three economies for

over four quarters and then is seen to decline in the long run. Real exchange rate depreciation is seen to bring import inflation in the countries which is countered using contractionary monetary policy. The contraction of monetary policy is seen to be minimal indicating that expensive imports do not bring in large inflation levels in the economy. Real exchange rate depreciation is seen to bring down inflation in the long run. In the long run, import price increase leads to a reduction in the amount of imports in the economy, which brings down the import related inflation. Depreciation of real exchange rate brings about a decline in real GDP growth which is seen to be contrary to what is expected, in a panel of three emerging economies, of which two are large open economies, the effect of depreciation in real exchange rate is expected to boost exports and contribute to real GDP growth. Depreciation is seen to contract monetary policy and increase income inequality as well following the shock. Positive shock in inflation brings about contractionary monetary policy after four quarters and has an instant and a marginal positive response on real GDP growth for four quarters. In the long run, real GDP growth is seen to deteriorate to increasing levels in inflation. In response to positive inflationary shock, the real exchange rate is seen to depreciate. As India and China are large open economies, the dependence on exports to boost growth is seen to be large. Positive shock in inflation brings about a decrease in demand of the goods in international market and depreciation of exchange rate is necessary to maintain export levels in the economy. Income inequality's response to positive inflationary shock is seen to be negative for four quarters but increases in the long run.

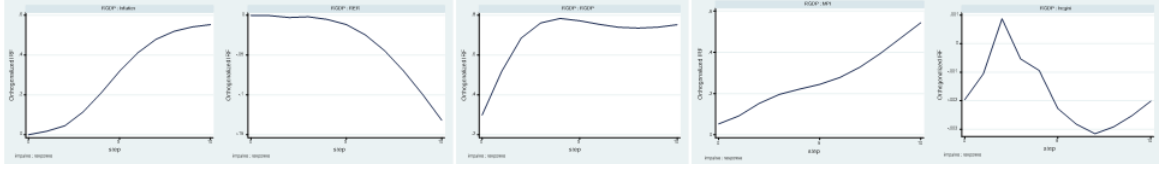
It can be seen from the figure **4-13** that consumption inequality's response to shock in other variables is seen to be minor. Contractionary monetary policy shock is seen to have negative effect on consumption inequality for significant time period although the effect is minor. Similarly, positive shock in inflation and depreciation of real exchange rate is also seen to bring down inflation levels in the economy. Consumption inequality is seen to respond positively to a positive shock in real GDP growth. However, consumption inequality does have significant effect on the other variables. Positive shock in consumption inequality is seen to bring reduction in inflation levels in the economy and has positive response from real GDP growth. Increase in consumption inequality is also seen to bring appreciation of real exchange rate and decrease in inflation levels in the economy. As consumption inequality increases, there is excess demand for goods produced in the economy, and hence lesser amount of goods supplied to the international market. Reduction in supply appreciates the exchange rate of the currency.



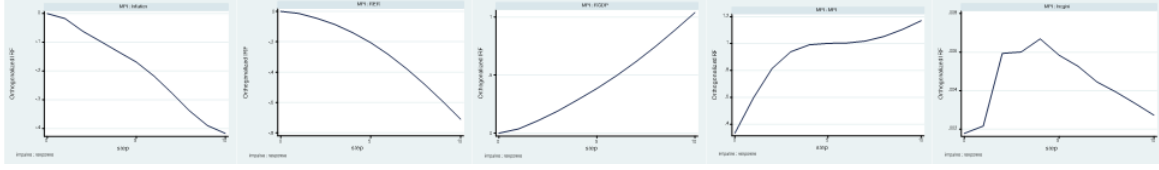
(a) Response of Inflation, RER, RGDP, MPI and Income gini to shock in inflation (left to right)



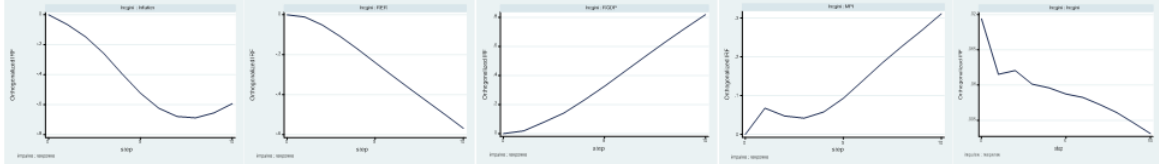
(b) Response of Inflation, RER, RGDP, MPI and Income gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, MPI and Income gini to shock in RGDP (left to right)

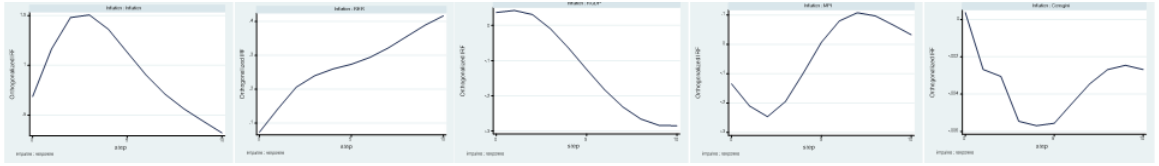


(d) Response of Inflation, RER, RGDP, MPI and Income gini to shock in MPI (left to right)

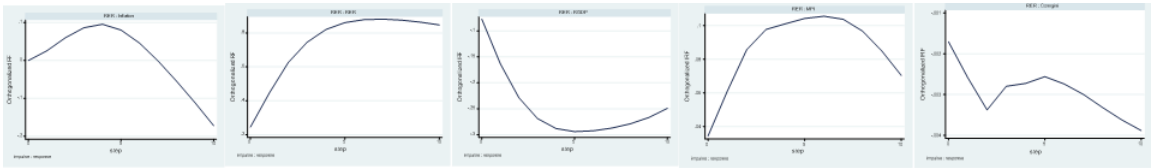


(e) Response of Inflation, RER, RGDP, MPI and Income gini to shock in Income gini (left to right)

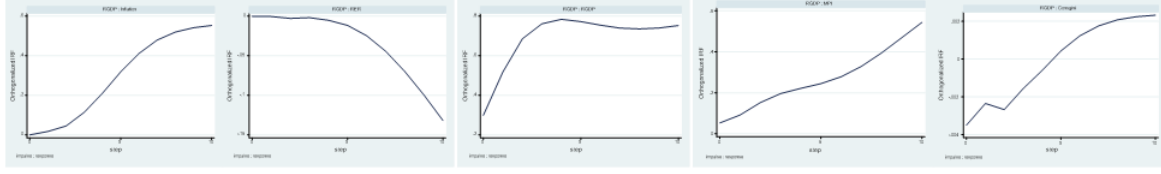
Figure 4-12: VAR-Impulse Response Functions for Balanced Panel, Income Inequality



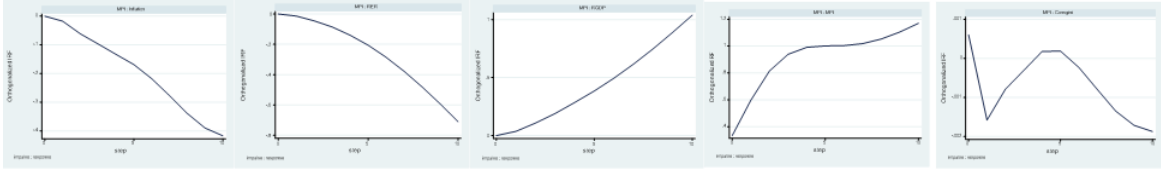
(a) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in inflation (left to right)



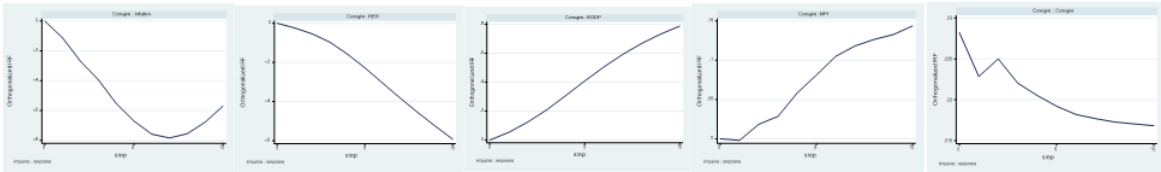
(b) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in RGDP (left to right)



(d) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in MPI (left to right)



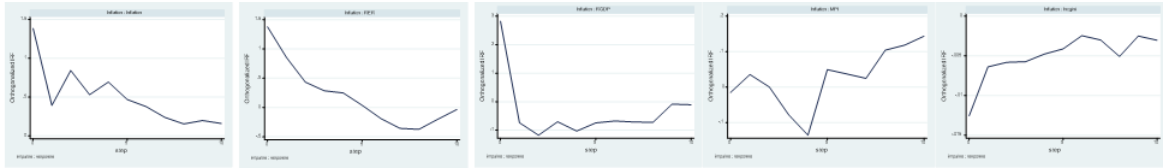
(e) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in Consumption gini (left to right)

Figure 4-13: VAR-Impulse Response Functions for Balanced Panel, Consumption Inequality

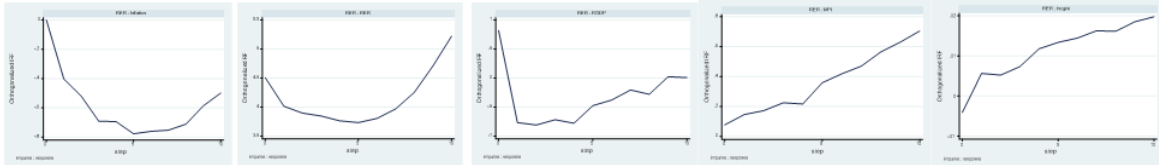
4.7 Unabalanced Panel VAR

Figure 4-14 and 4-15 show the panel VAR analysis of the other two countries- Brazil and Russia. Similar to the case of other countries, the effect of shocks in other variables on both inequalities is seen to be minor. However, the shock in consumption and income inequalities does have significant effect on other variables. Income inequality is seen to bring marginal benefits in growth levels in the economy. Income inequality increase is also seen to appreciate real exchange rate significantly following a shock. Inflation also is seen to reduce in response to a positive income inequality shock throughout the period. Monetary Policy contraction is seen to bring increase in inflation showing an existence of a price puzzle. It is also seen to bring about a depreciation in exchange rate. Real GDP is seen to show a tendency to decline to contractionary shock in monetary policy. The effect of contractionary monetary policy shock is seen to be mixed on income inequality. There is both positive and negative response. In the long run it is positive while in the short run, it shows both positive and negative response which is seen for a significant period of time. Contractionary monetary policy is seen to bring significant depreciation. Contractionary monetary policy has negative effects on foreign investment levels in the country and hence leads to a significant depreciation of currency to maintain foreign investments in the economy. Inflation responds positively to a contractionary monetary policy shock indicating the existence of a price puzzle. In response to contractionary monetary policy, real GDP growth is seen to have volatile response. The over all effect is seen to be negative although there are some periods which show a positive response in the short run. The response of monetary policy to a positive

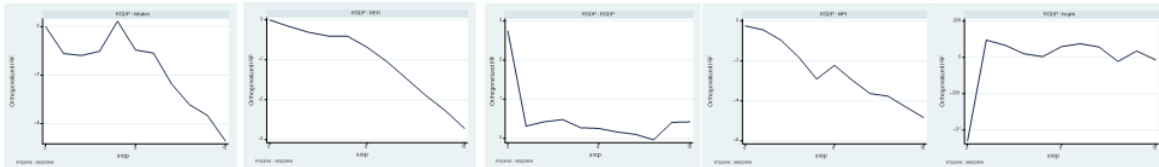
shock in real GDP growth is seen to expand gradually until the long run. Similarly, Real GDP growth is seen to bring real exchange rate appreciation. Real GDP growth is seen to have contradictory effect on inflation. Growth in the real GDP is expected to increase the inflation atleast in the long run. However, the response of inflation to real GDP shock is seen to decrease throughout the period following the shock. The effect of real GDP shock on income inequality is seen to be negative instantly in the period following the shock but immediately increases from the following period onwards to show a positive response until the long run. The negative response is seen only for one quarter. Depreciation is seen to bring positive effect on real GDP growth in the immediate quarter following the shock and then declines in the next quarter onward until the long run. In the last quarter, the effect is seen to be unresponsive. Real exchange rate depreciation is seen to bring down inflation without bringing in import inflation in the economy. Real exchange rate depreciation is seen to increase income inequality throughout the period. The response of real exchange rate depreciation is seen to contract monetary policy. Inflation shock is seen to have significant effects on real GDP growth and real exchange rate depreciation. Real GDP is seen to increase in the short run significantly to a positive shock in inflation but immediately turns negative after two quarters and remains negative after that. Inflation is seen to depreciate real exchange rate in the short run while shows significant appreciation after five quarters. Monetary policy is seen to contract to a positive inflationary shock in the long run. In the short run, there is a contractionary response for two quarters but there is also a negative response that is seen after two quarters for a brief period. After five quarters, the effect is seen to be positive throughout indicating that contractionary monetary policy is adopted. Income inequality is seen to have positive response throughout the period following the inflationary shock.



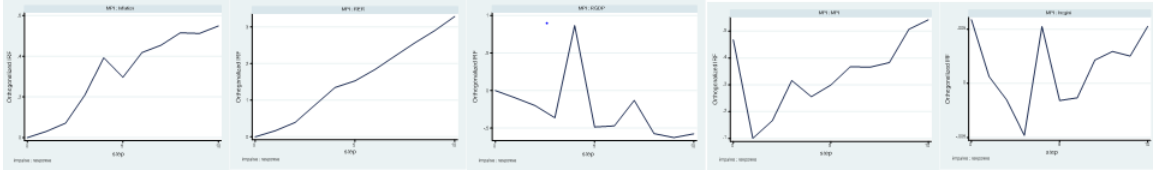
(a) Response of Inflation, RER, RGDP, MPI and Income gini to shock in inflation (left to right)



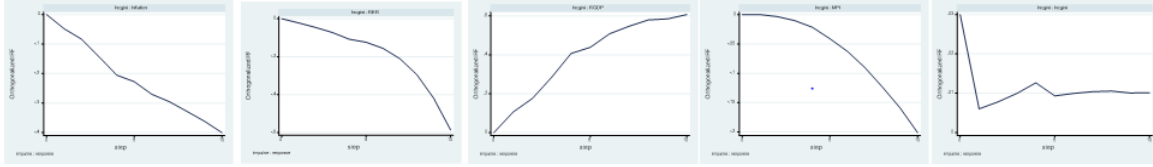
(b) Response of Inflation, RER, RGDP, MPI and Income gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, MPI and Income gini to shock in RGDP (left to right)

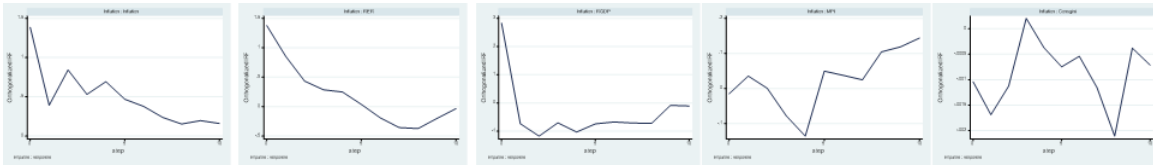


(d) Response of Inflation, RER, RGDP, MPI and Income gini to shock in MPI (left to right)

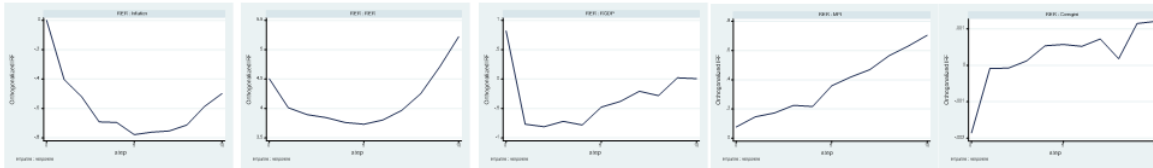


(e) Response of Inflation, RER, RGDP, MPI and Income gini to shock in Income gini (left to right)

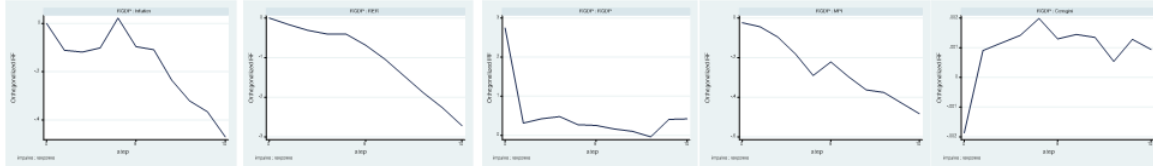
Figure 4-14: VAR-Impulse Response Functions for Un-Balanced Panel, Income Inequality



(a) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in inflation (left to right)



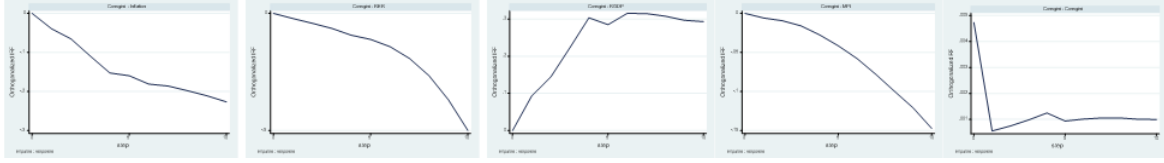
(b) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in RGDP (left to right)



(d) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in MPI (left to right)



(e) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in Consumption gini (left to right)

Figure 4-15: VAR-Impulse Response Functions for Un-Balanced Panel, Consumption Inequality

In the figure 4-15, the consumption inequality model of panel VAR analysis of Brazil and Russia is seen. The response is similar to that of the income inequality model. The response of consumption inequality to shocks in other variables is minor similar to the individual country SVAR analysis. The responses of consumption inequality to shocks in other variables are seen to be similar to that of the income inequality model. The response of other variables to shock in consumption inequality is seen to be positive in the case of real GDP growth but negative for the case of inflation and real exchange rate. Increase in consumption inequality is seen to increase real GDP growth and brings down inflation in the economy. The real exchange rate is also seen to appreciate to an increase in consumption inequality.

As mentioned earlier, the panel analysis is only for the purpose of providing an insight into the panel dynamics of the data. The main aim is to understand individual country characteristics and facilitate cross country analysis. The study does not estimate the panel SVAR methodology due to complexities in estimation. Since the study predominantly focuses on cross country comparison, the panel SVAR analysis is avoided to avoid complexities in estimation. Differences in the results obtained from the cross country analysis can also be due to the fact that in an SVAR analysis, the shocks are identified. Since the panel analysis is only based on VAR, the shocks are not identified and hence can be different from the responses of identified shocks in the SVAR approach.

4.8 Sensitivity Analysis

The last part of the results discusses the sensitivity analysis. This section is divided into three parts. The first part discusses the sensitivity to changes in SVAR ordering. The second part discusses the sensitivity of results to an analysis of subsample. The third part discusses the sensitivity to change in monetary policy variable to M2 broad money.

4.8.1 Sensitivity to changes in SVAR ordering

For the sensitivity analysis based on SVAR reordering, the reordering is based on the granger causality test and the most endogenous variables are ordered last and most exogenous variable is ordered first. For the Indian context the following ordering is used based on granger

causality- Inflation, Monetary Policy Instrument, Income inequality, Real GDP, Real Exchange Rate for the income inequality model and Inflation, Monetary Policy Instrument, Consumption inequality, Real GDP, Real Exchange Rate. The SIRFs obtained are given the figure **4-16** for the income inequality model and figure **4-17** for the consumption inequality model. From the figure 4-16, it can be seen that the results are robust for all the cases except for the case of monetary policy's response to real exchange rate depreciation and for the response of income inequality to real exchange rate. In all the other cases, the responses are qualitatively similar indicating that the results are robust. For the consumption inequality model, it can be seen from the figure **4-17** that the results are robust for the whole model except for the response of monetary policy to real exchange rate.

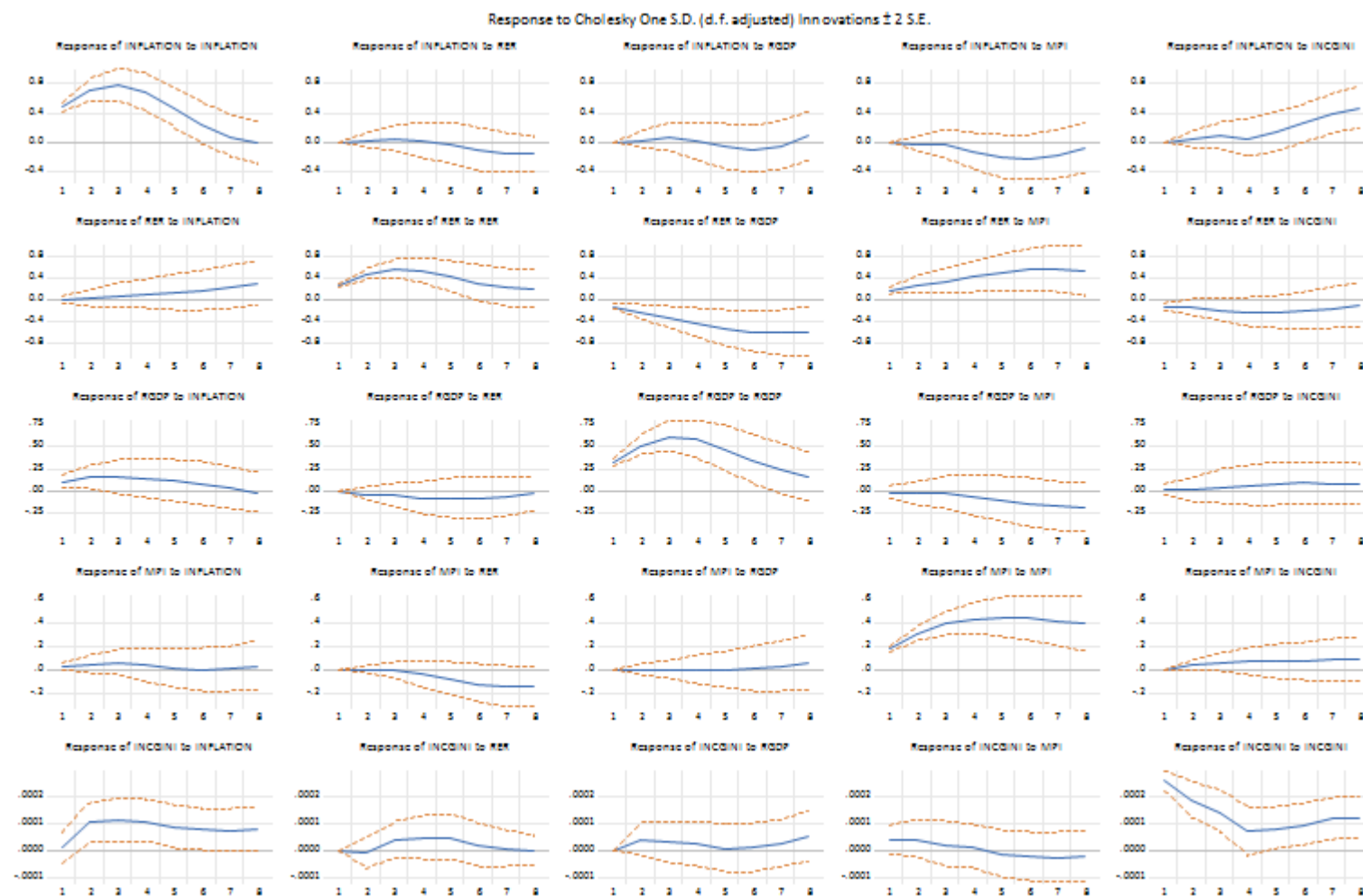


Figure 4-16: SVAR ordering change income inequality model - Indian Economy

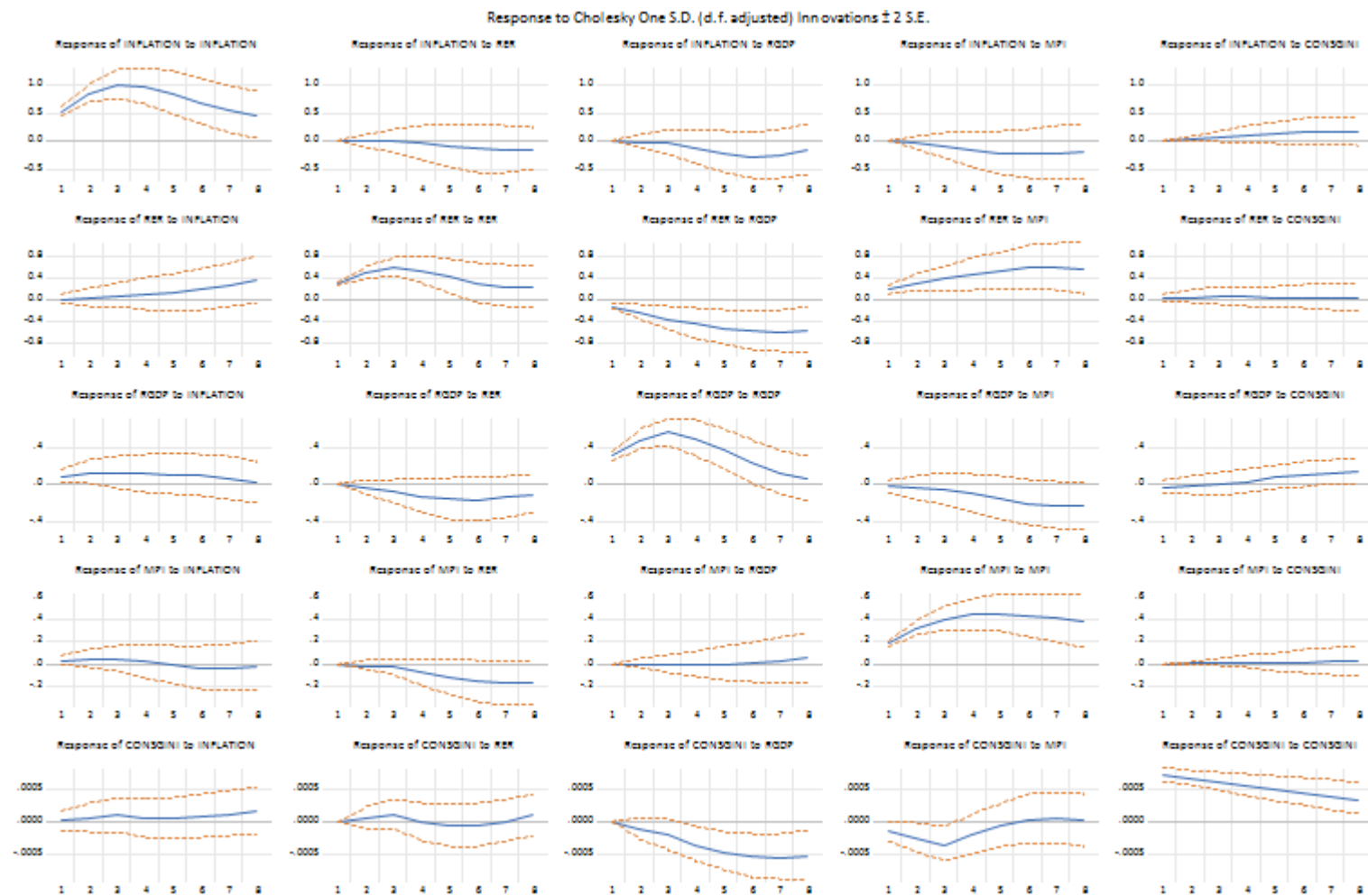


Figure 4-17: SVAR ordering change consumption inequality model - Indian Economy

For China, the ordering that is followed based on the granger causality is- Real GDP, Monetary policy instrument, real exchange rate, income inequality and inflation in the case of income inequality model and real GDP, monetary policy, real exchange rate, consumption inequality and inflation in the case of consumption inequality model. The income inequality model after the change of SVAR ordering is given in figure **4-18** and the consumption inequality model is given in figure **4-19**. From figure **4-18**, it can be observed that the responses of income inequality to shocks in other variables is seen to be robust but there is significant difference in the response of real exchange rate to inflation and monetary policy instrument. The response is entirely different after changing of ordering. Similarly, the response of real GDP to changes in inflation and the response of monetary policy to inflation shock are seen to be sensitive after the changing of ordering. Other responses are qualitatively similar to the main model. From figure **4-19**, it can be observed that the response of consumption inequality is seen to differ for shocks in inflation, real exchange rate and real GDP growth but remains robust for the response to changes in monetary policy.

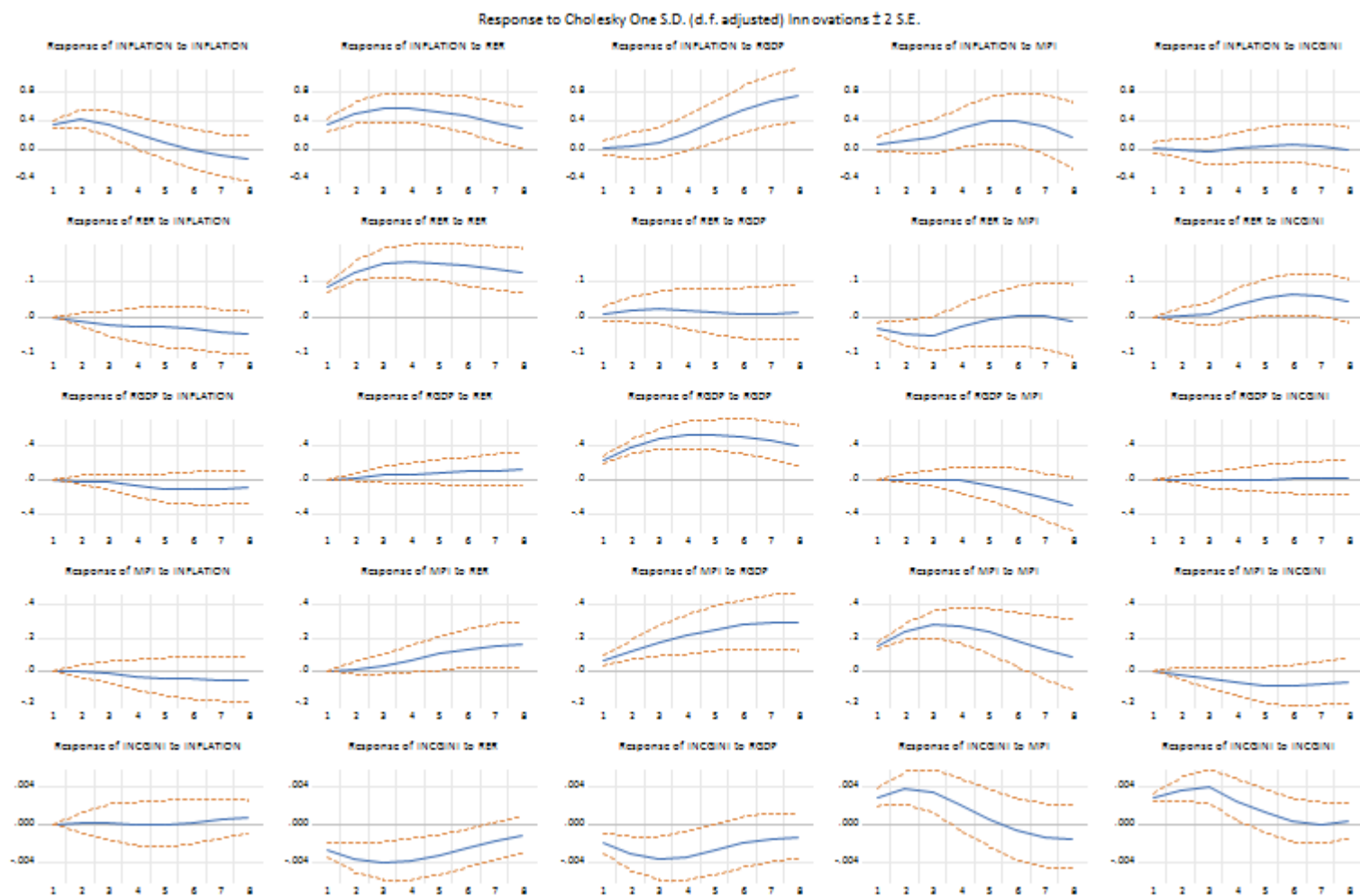


Figure 4-18: SVAR ordering change income inequality model - Chinese Economy

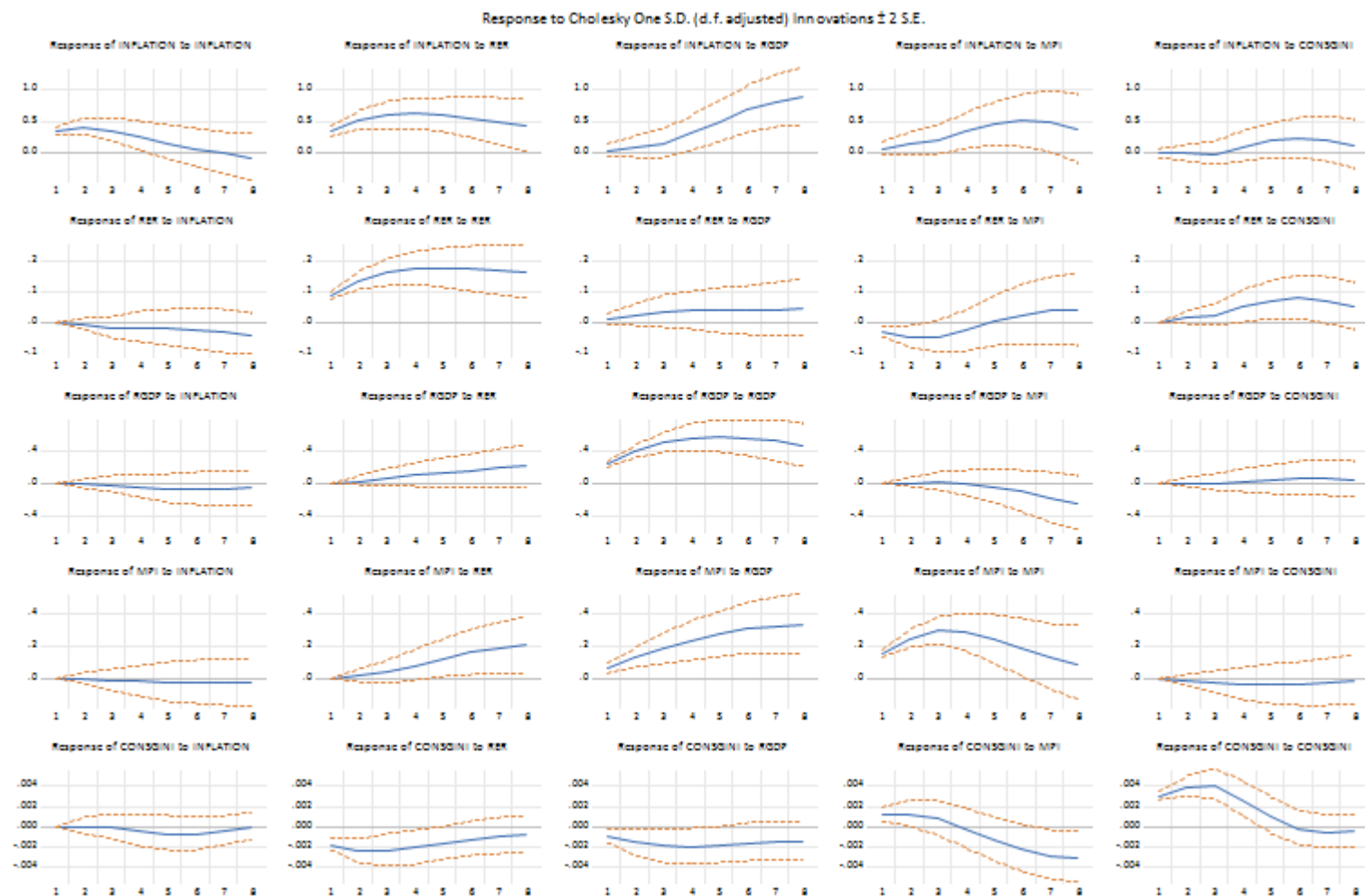


Figure 4-19: SVAR ordering change consumption inequality model - Chinese Economy

For the case of South Africa, the ordering for income inequality based on granger causality is Real GDP, Income inequality, Monetary Policy Instrument, Real Exchange rate and inflation. For the consumption inequality model, the ordering based on granger causality is- Consumption inequality, Real GDP, monetary policy, real exchange rate and inflation. The SIRFs for income inequality and consumption inequality model are seen in figure **4-20** and figure **4-21** respectively. The response of most of the variables is seen to be sensitive in the case of ordering change based on granger causality for the income inequality model and consumption inequality model.

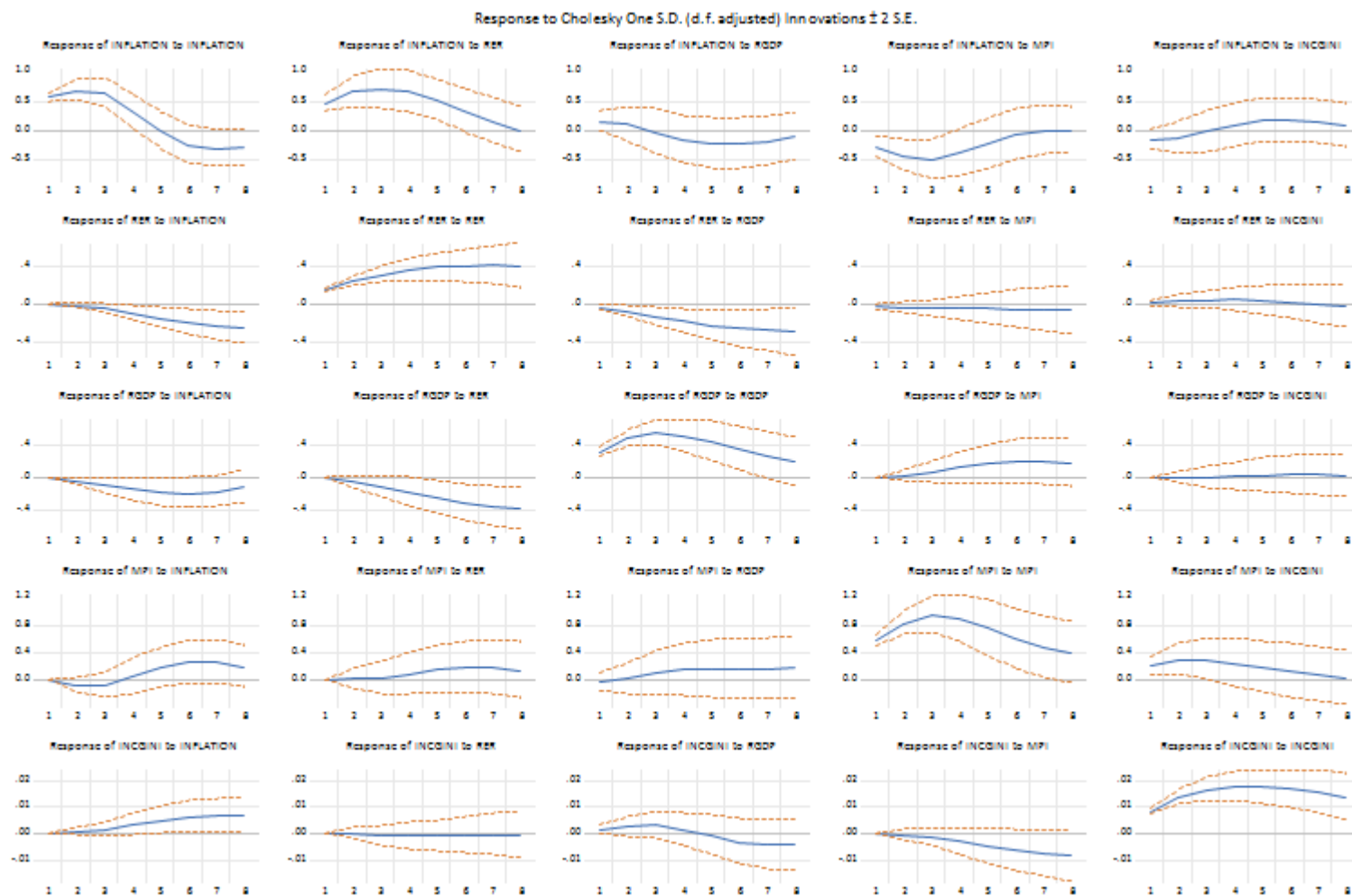


Figure 4-20: SVAR ordering change income inequality model - South African Economy

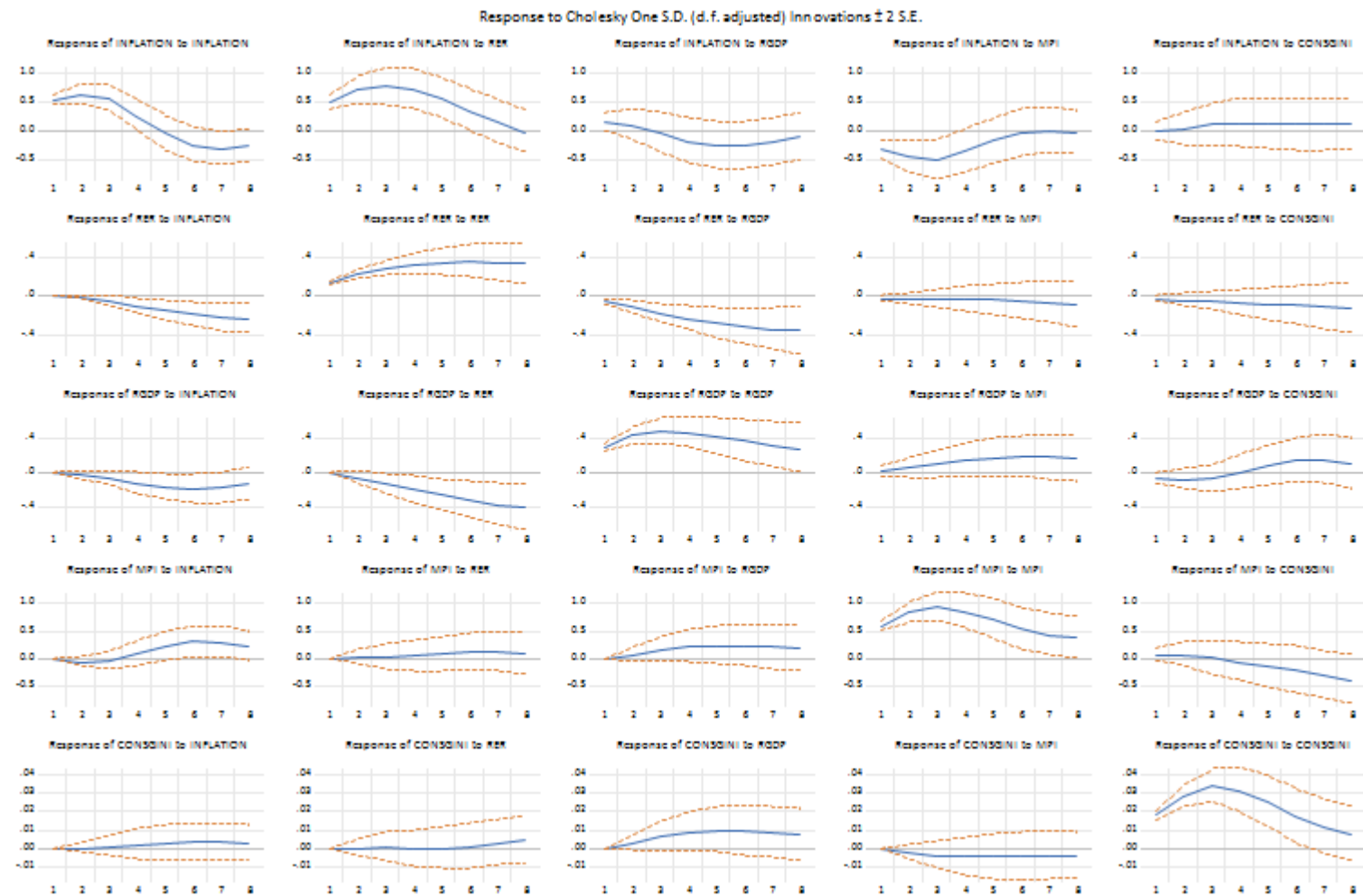


Figure 4-21: SVAR ordering change consumption inequality model - South African Economy

For the case of Brazil, the following ordering is followed for income inequality based on granger causality- income inequality, monetary policy, real GDP, real exchange rate and inflation. For consumption inequality model, the ordering followed is consumption inequality, monetary policy, real GDP, real exchange rate and inflation. The SIRFs for income inequality and consumption inequality model are seen in figure **4-22** and figure **4-23** respectively. In the income inequality model, the response is qualitatively similar in most of the cases. It is significantly different for the response of real GDP to shocks in inflation, real exchange rate and monetary policy instrument. In the case of income inequality response, it is observed to be sensitive to changes in SVAR ordering for the case of inflation. Monetary policy is also different to change in SVAR ordering for shocks in inflation. In the consumption inequality model, the responses of consumption inequality to shocks in other variables are seen to be robust.

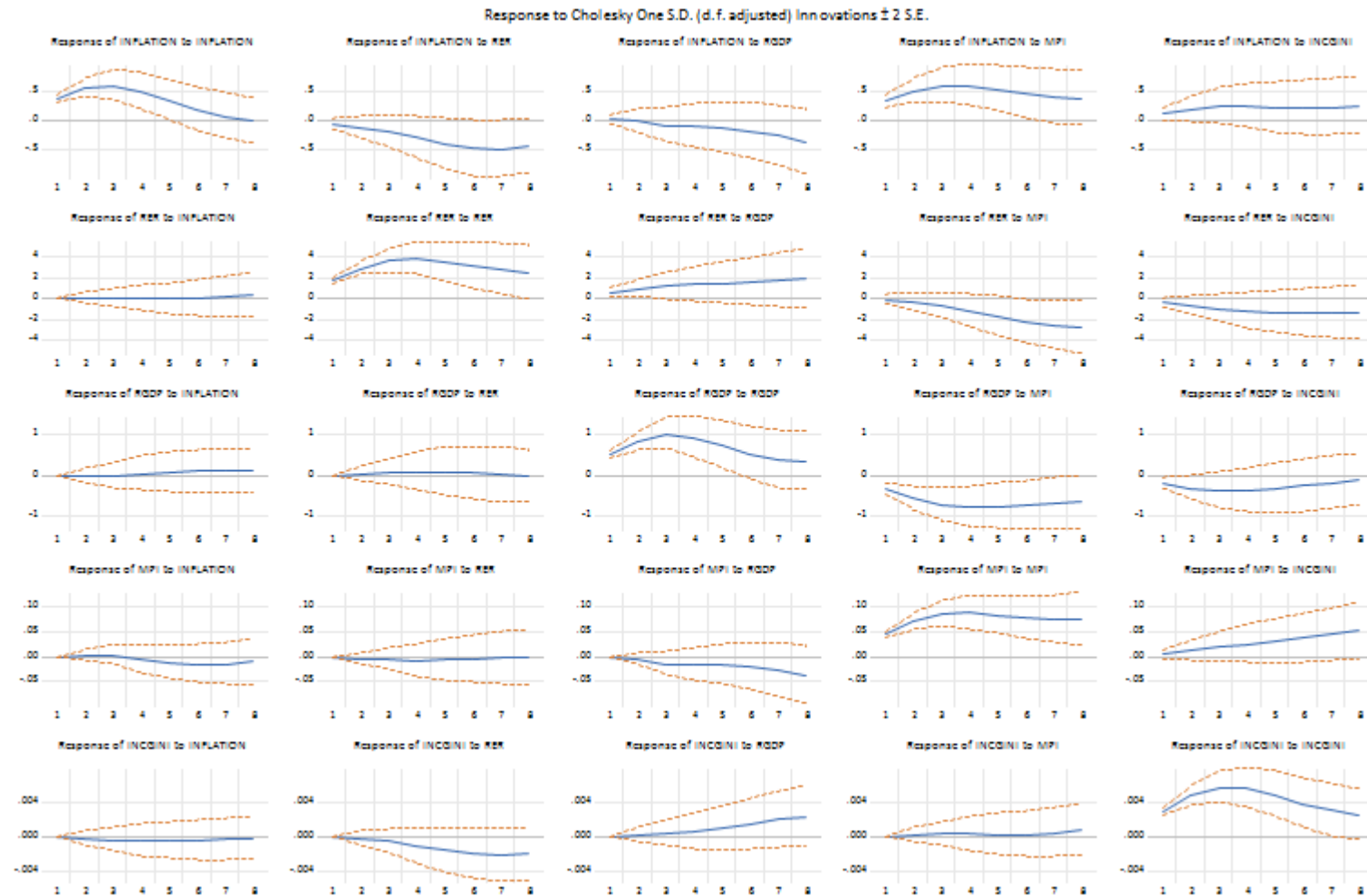


Figure 4-22: SVAR ordering change income inequality model - Brazilian Economy

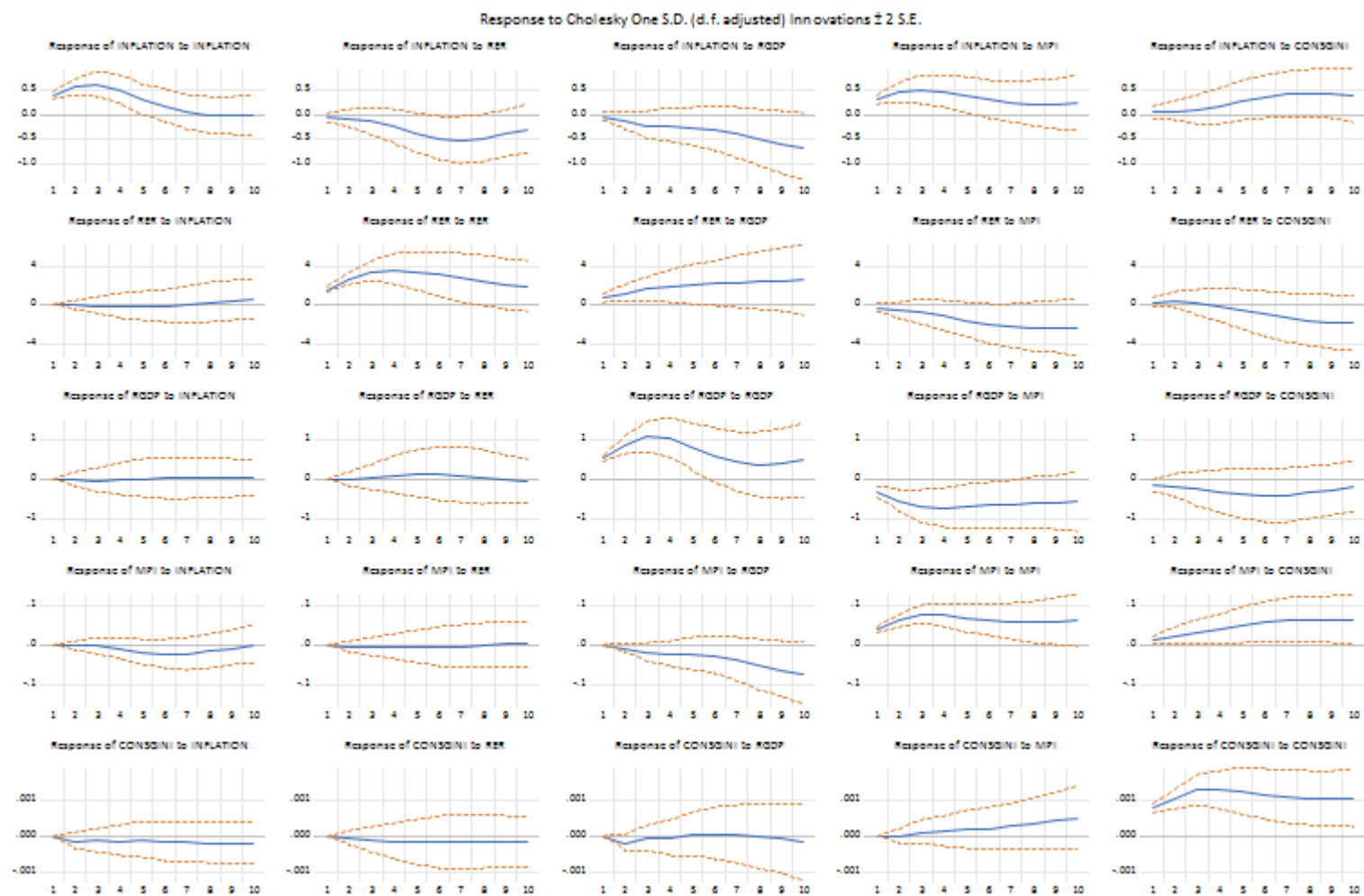


Figure 4-23: SVAR ordering change consumption inequality model - Brazilian Economy

In the case of Russia, the ordering based on granger causality for income inequality is- Income inequality, Real Exchange Rate, Monetary Policy Instrument, Inflation and Real GDP. The consumption inequality model is based on the following ordering Real Exchange rate, Consumption Inequality, Monetary Policy, inflation and RGDP. The SIRFs for income inequality and consumption inequality model are seen in figure **4-24** and figure **4-25** respectively. The results for income inequality model are seen to be robust for the case of Russia among most of the variable. The response of real exchange rate to positive shock in real GDP is seen to be sensitive after reordering of variables. Monetary policy also is seen to have different response to changes in inflation and real GDP growth after change in the ordering. For consumption inequality model, the results are seen to be robust.

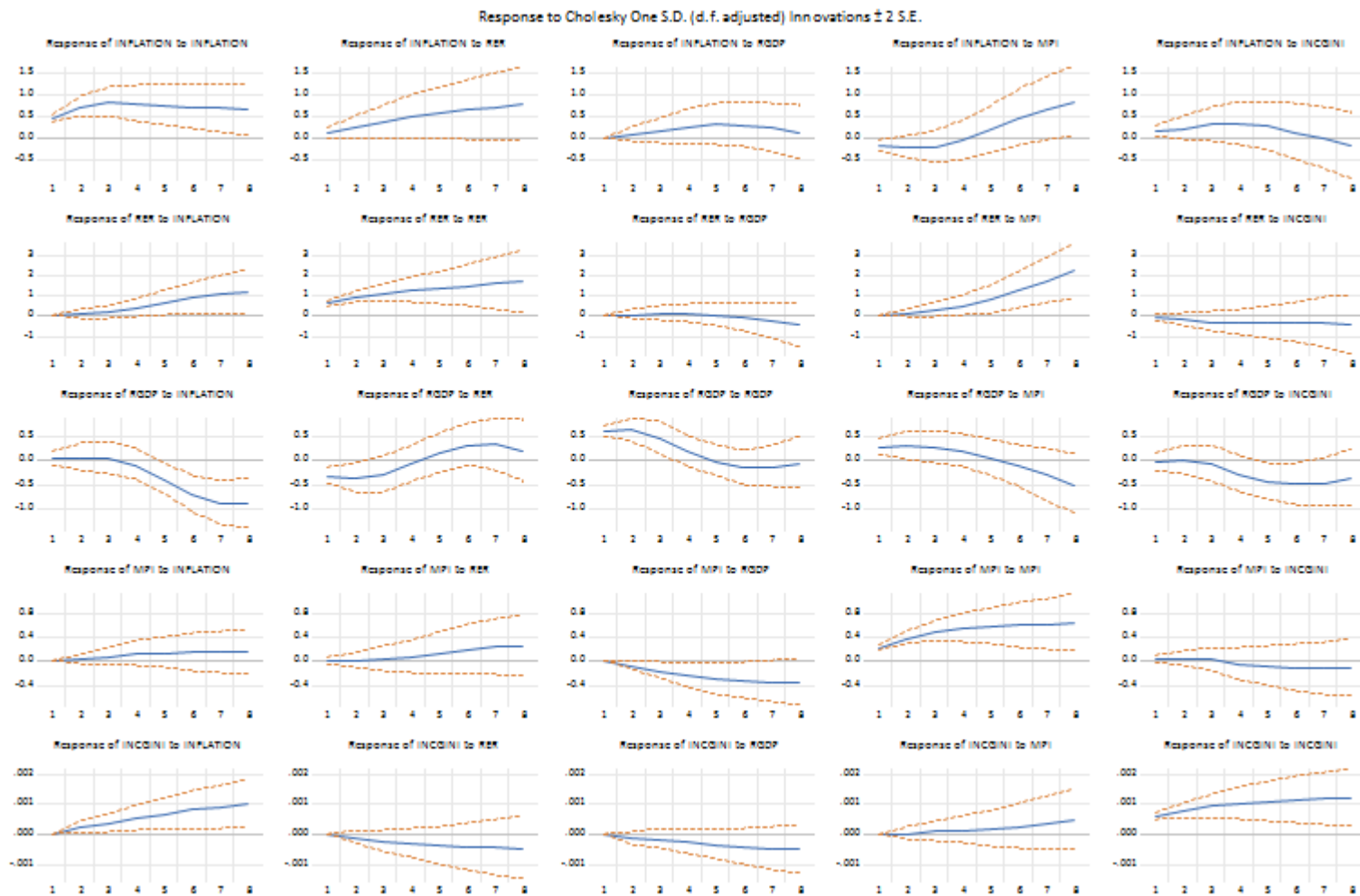


Figure 4-24: SVAR ordering change income inequality model - Russian Economy

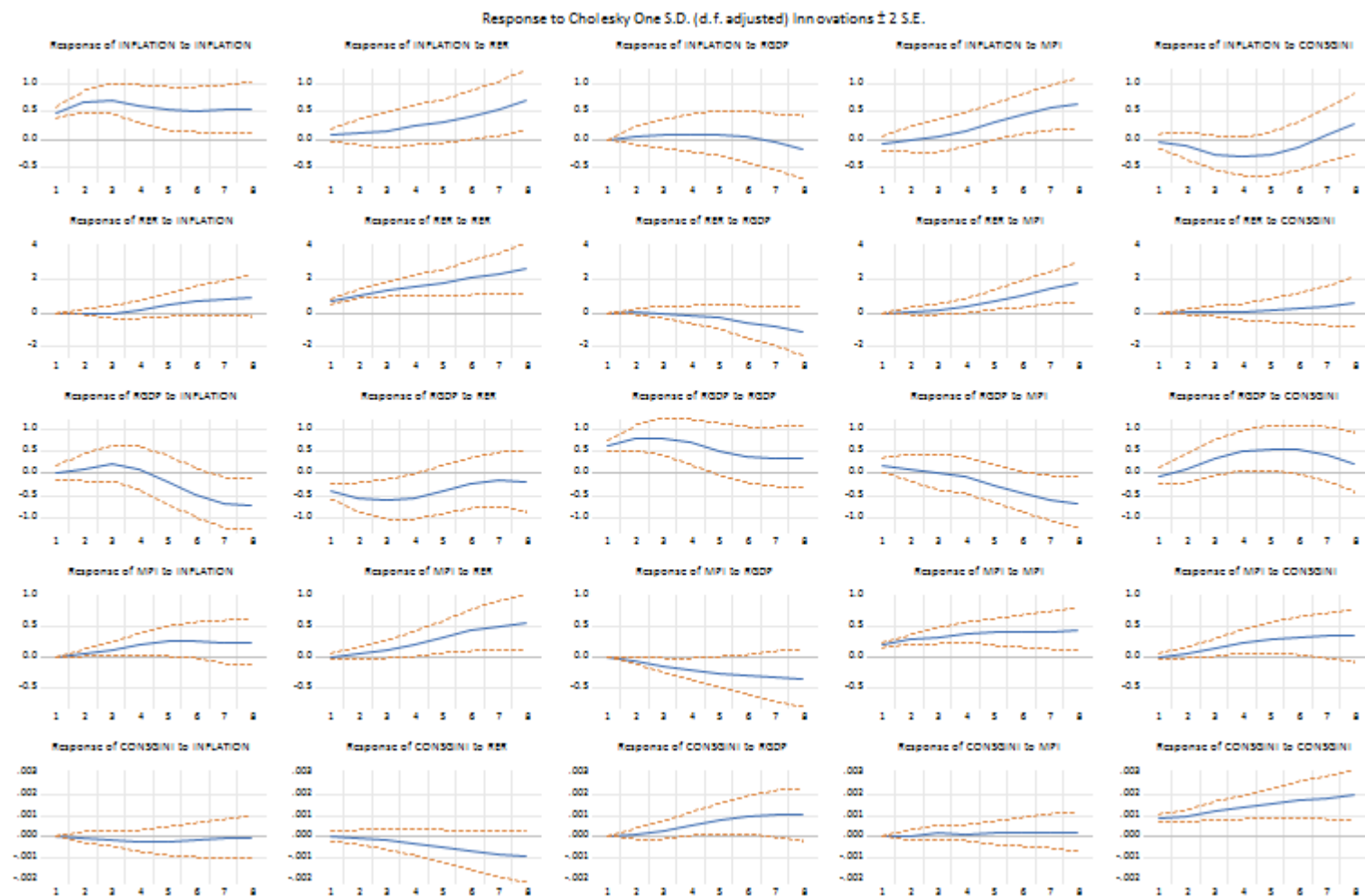


Figure 4-25: SVAR ordering change consumption inequality model - Russian Economy

4.8.2 Sub Sample Sensitivity Analysis

The second part of the sensitivity analysis deals with testing the robustness with for a sub section analysis of the sample. For India, China, South Africa the sample ranges from 1991Q1-2007Q4 and for Brazil from 1996Q1-2007Q4. For Russia, the sample includes 2000Q1-2008Q4. The SIRFs for income inequality and consumption inequality model for India are seen in figure 4-26 and figure 4-27 respectively. For the income inequality model, the responses of some variables including that of income inequality to monetary policy shock is seen to be sensitive. In the original model, the effect of contractionary monetary policy on income inequality is seen to be positive for one year and then declines to show no response in the long run. In the sub sample analysis, the response of income inequality in the instant period following the shock is seen to be positive but remains significantly negative in the subsequent periods, indicating that monetary policy contraction does have significant negative effect on income inequality. This is opposite to the results obtained in the original model. In addition to this, the response of real exchange rate and real GDP to income inequality shock and monetary policy's response to inflation shock, real exchange rate shock, real GDP shock and the response of income inequality to real GDP shock is also seen to be evidently different from the original model indicating that the responses are sensitive to changes in sample. In the case of consumption inequality model, the effect of shocks in other variables on consumption inequality is seen to be robust except in the case of inflation shock and real exchange rate shock. Consumption inequality's effect on monetary policy, inflation, real exchange rate and monetary policy is seen to be evidently different. The rest of the responses are similar to the income inequality model in the sub sample analysis.

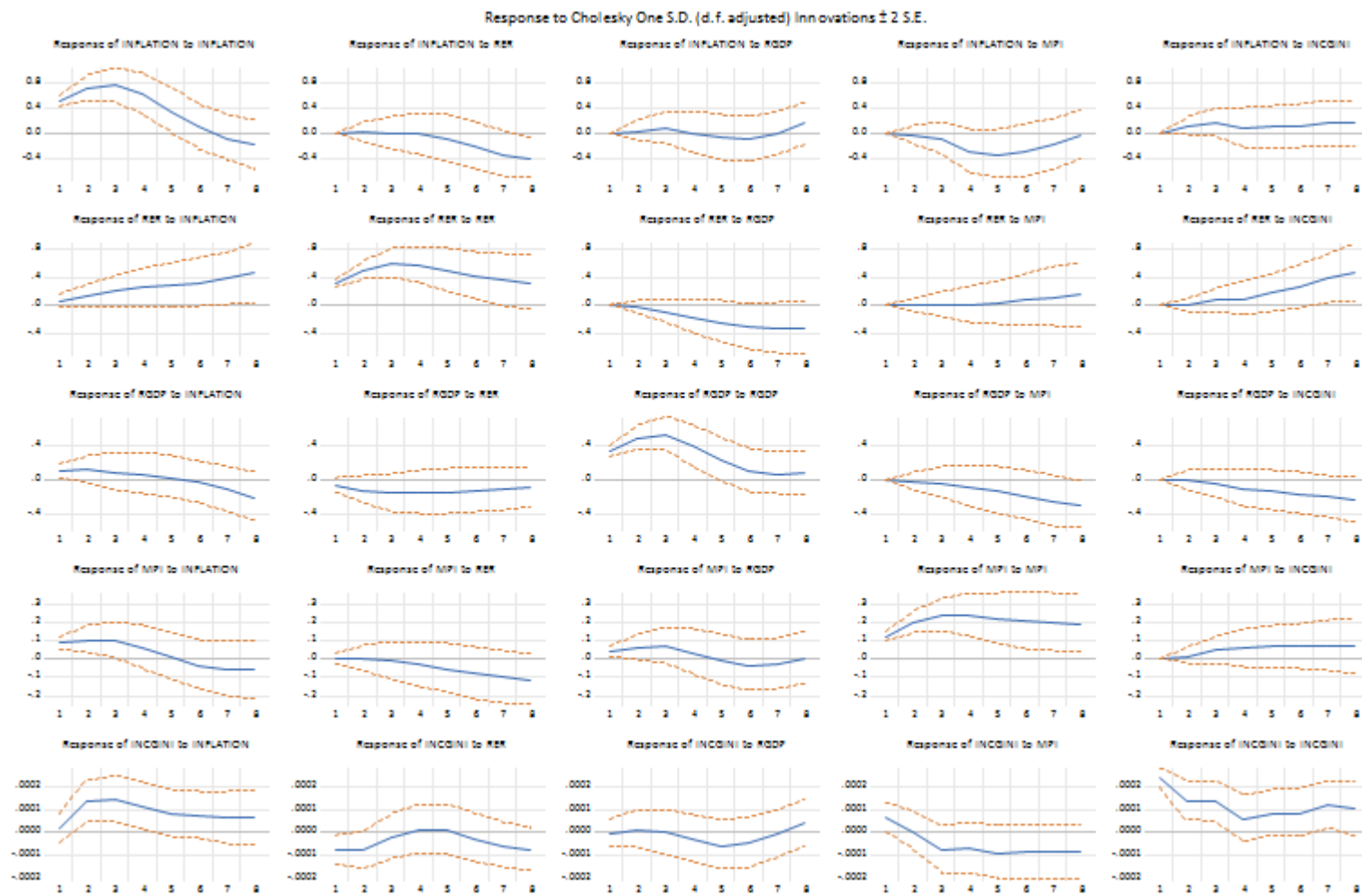


Figure 4-26: Sub Sample Analysis income inequality model - Indian Economy

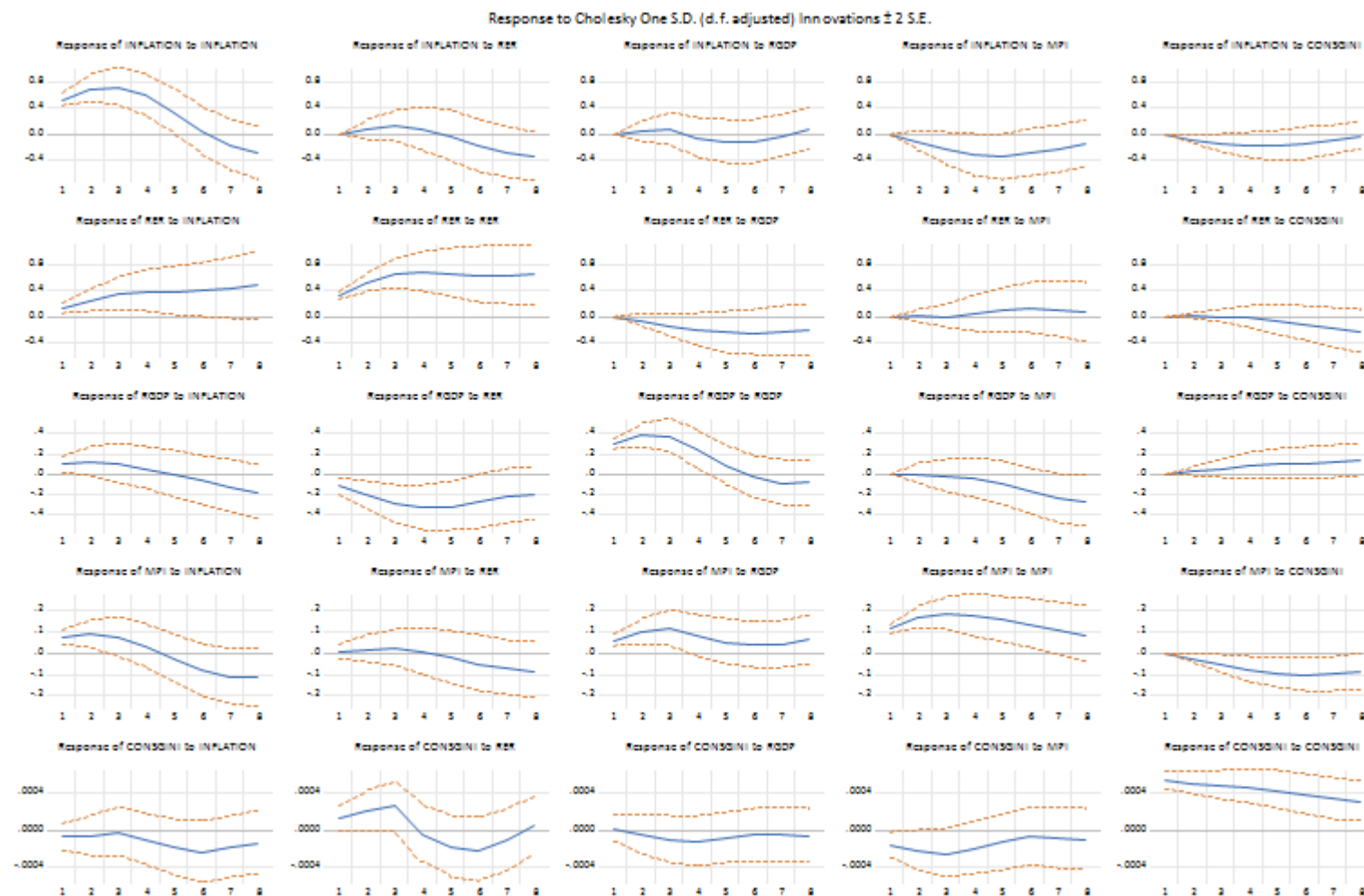


Figure 4-27: Sub Sample Analysis consumption inequality model - Indian Economy

For the Chinese economy, the SIRFs for income inequality and consumption inequality model for sub sample analysis are seen in figure 4-28 and figure 4-29 respectively. The response is seen to be sensitive for many variables in the Chinese economy in the sub sample analysis. The effect of monetary policy shock on income inequality is seen to be positive in the sub-sample analysis with a marginal negative response in the short run. In the original model the effect is seen to be positive in the short run and negative in the long run. The response of income inequality is also seen to be sensitive in the sub sample analysis to shock in inflation and real GDP. Inflation's response to shock in real exchange rate; real exchange rate's response to shock in real GDP growth; real GDP's response to shock in inflation and real exchange rate and monetary policy's response to shock in inflation is also seen to be sensitive in the case of sub sample analysis. For the consumption inequality model, the responses of consumption to shock in other variables are seen to be robust except for shock in monetary policy and real GDP growth. Consumption inequality's effect on other variables is seen to be qualitatively similar in the case of sub sample analysis.

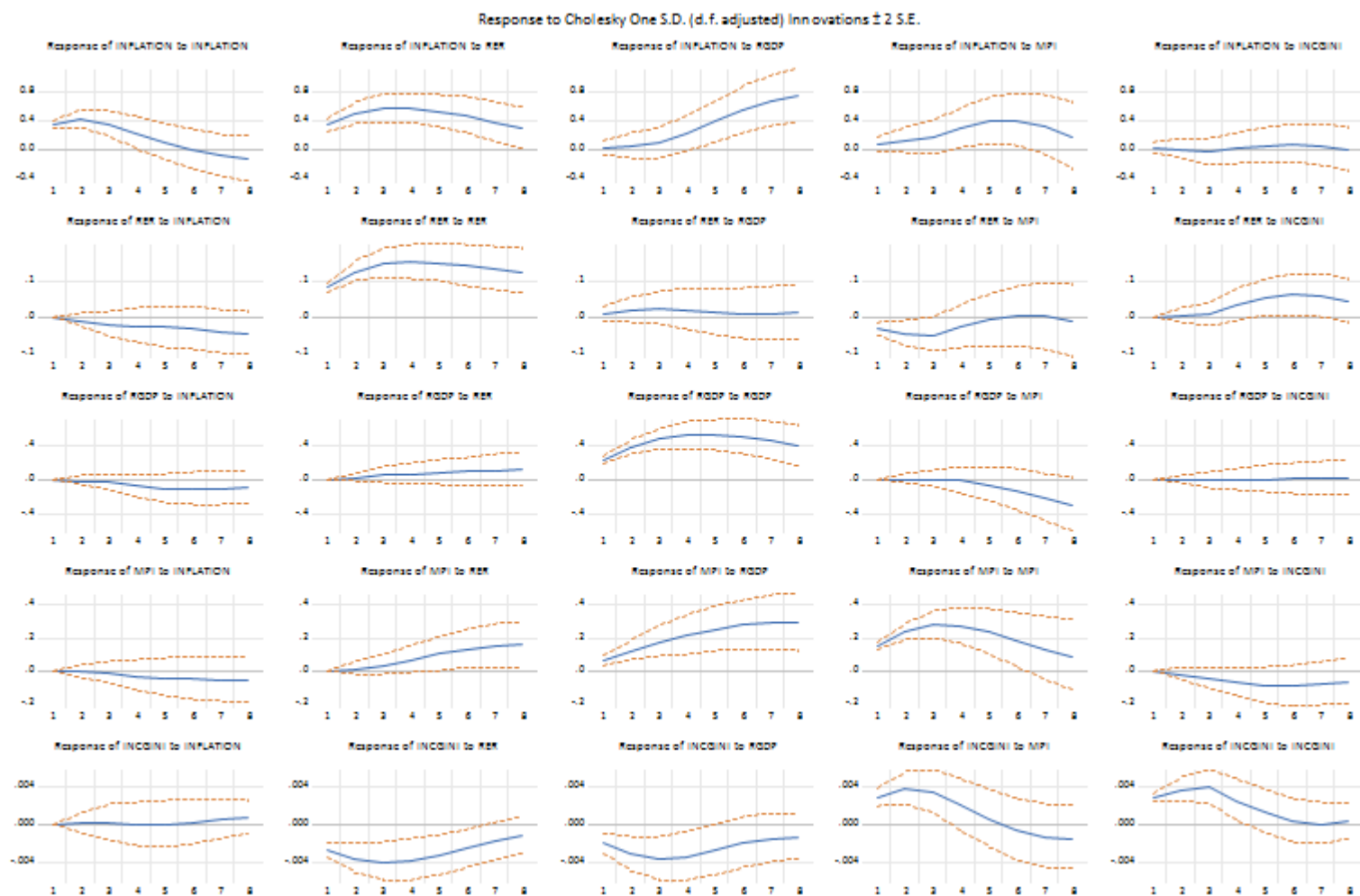


Figure 4-28: Sub Sample Analysis income inequality model - Chinese Economy

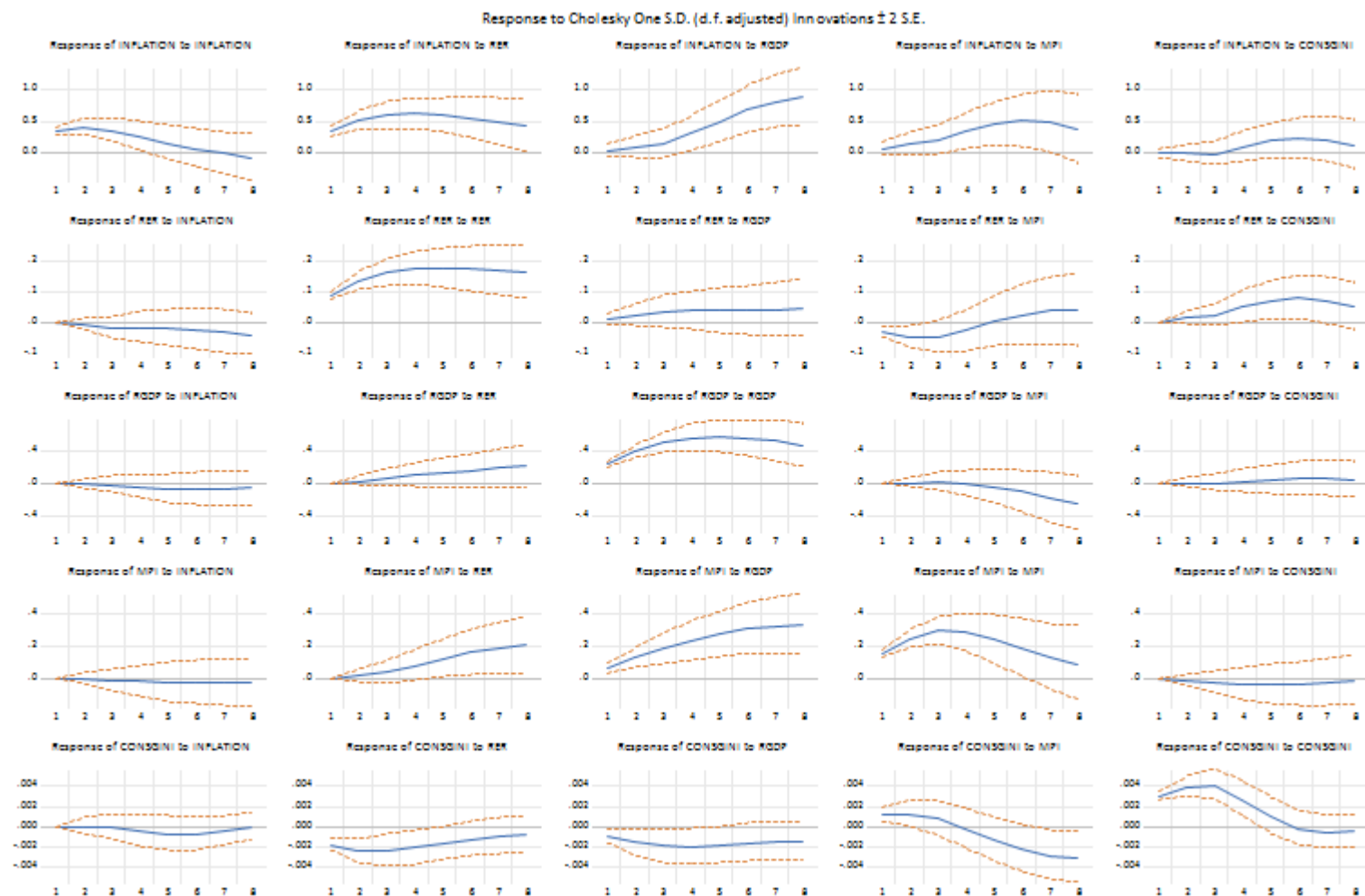


Figure 4-29: Sub Sample Analysis consumption inequality model - Chinese Economy

In the case of South Africa, the SIRFs for income and consumption inequality for the sub sample analysis are seen in figures **4-30** and **4-31** respectively. For the income inequality model, the response of income inequality to contractionary monetary policy shock is seen to be robust but the response of inflation to monetary policy; the response of real exchange rate to monetary policy and income inequality shocks; the response of real GDP to real exchange rate and income inequality shocks and the response of income inequality to shock in real exchange rate are seen to be sensitive. The other responses are seen to be qualitatively similar. In the case of consumption inequality model, the response of consumption inequality to shocks in monetary policy and real GDP growth are seen to be sensitive to change in sample. In the sub sample analysis, the effect of contractionary monetary policy on consumption inequality is seen to be negative and in the original model the response is seen to be unresponsive and positive marginally in the short run. Consumption inequality's effect on real exchange rate is also seen to be different when analyzing the sub sample. The rest of the effects are seen to be similar to the income inequality model.

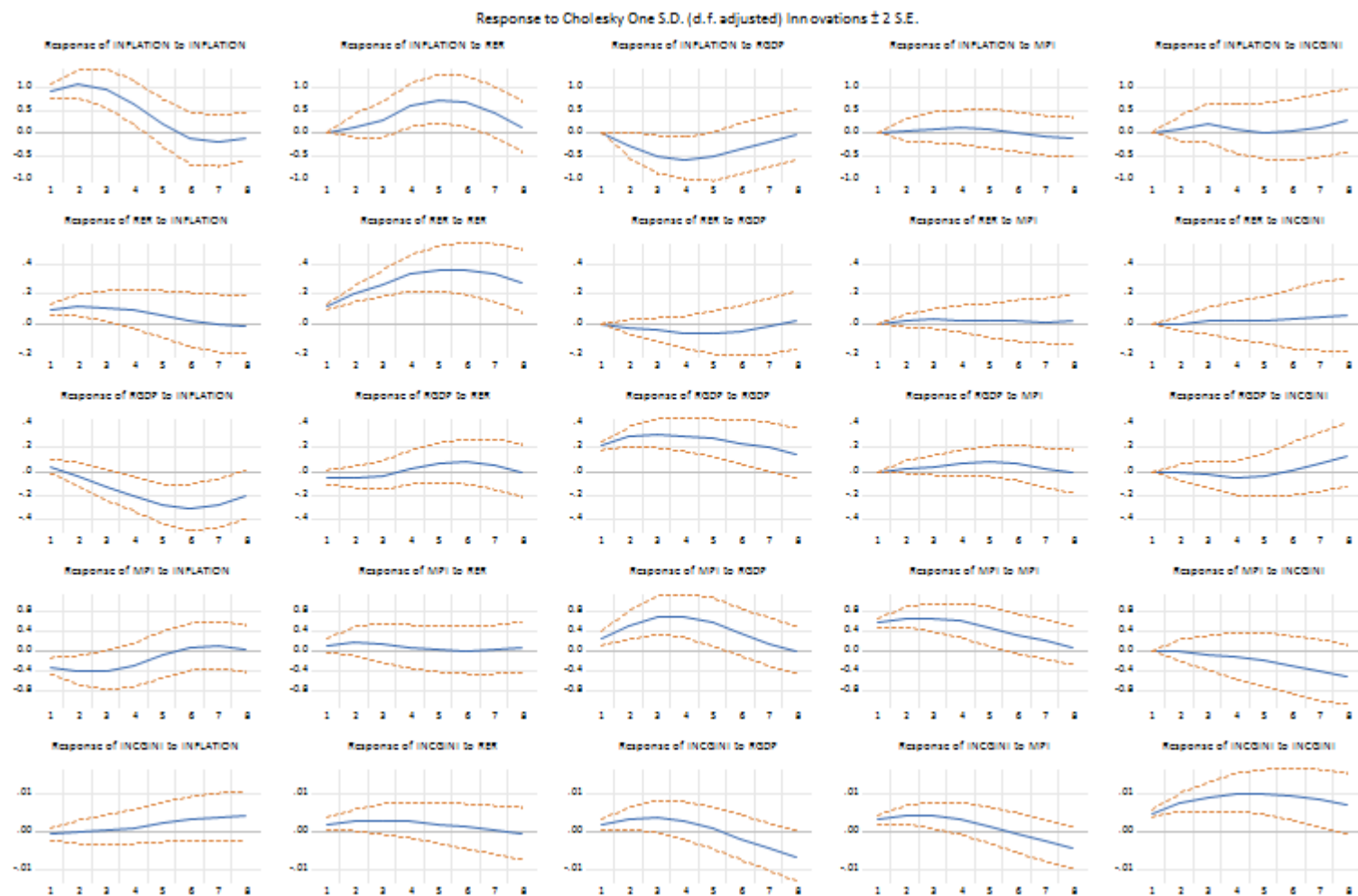


Figure 4-30: Sub Sample Analysis income inequality model - South African Economy

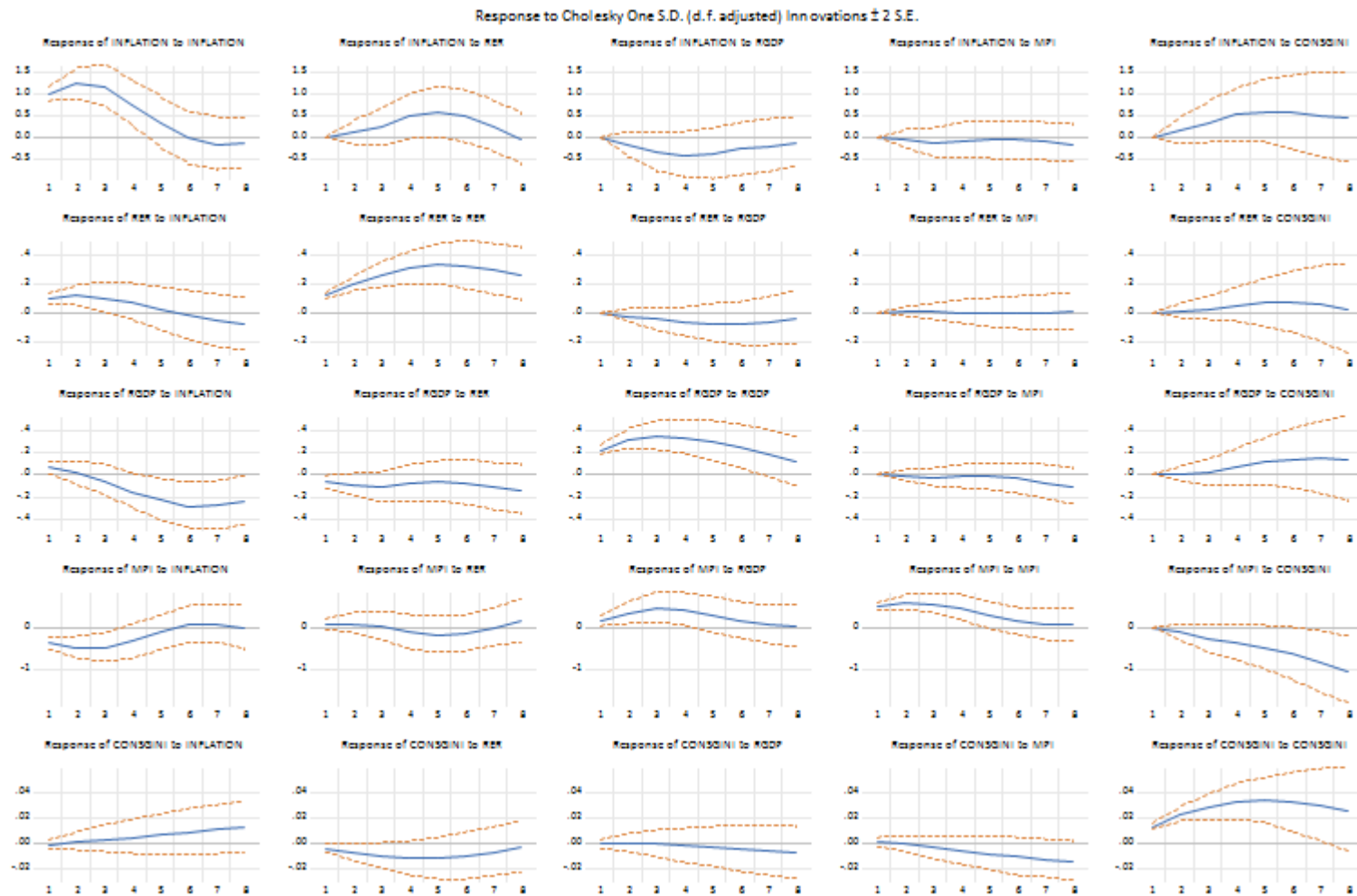


Figure 4-31: Sub Sample Analysis consumption inequality model - South African Economy

In the case of Brazil, the sub sample analysis SIRFs are seen in figure **4-32** and **4-33** for the income and consumption inequality model respectively. For the income inequality model, the sub sample analysis is seen to show sensitivity in results of real GDP's responses and monetary policy's responses to a large extent. The response of income inequality to a contractionary monetary policy shock is also seen to be marginally different. In the original model, the effect is seen to be unresponsive in the short run and positive in the long run. In the sub sample analysis, the effect is seen to be positive but negligible throughout. The response of inflation to real GDP shock and income inequality is also seen to be sensitive in the sub sample analysis. For the consumption inequality model, the response of consumption inequality to contractionary monetary policy is seen to be similar although the extent of response is seen to be different in the original model and the sub sample model. The response of consumption inequality to a positive shock in inflation and real GDP is seen to be sensitive to change in the sub sample model. Similarly, consumption inequality's effect on real exchange rate is seen to be sensitive to change in sample. The remaining responses are similar to that of income inequality model in the sub sample analysis.

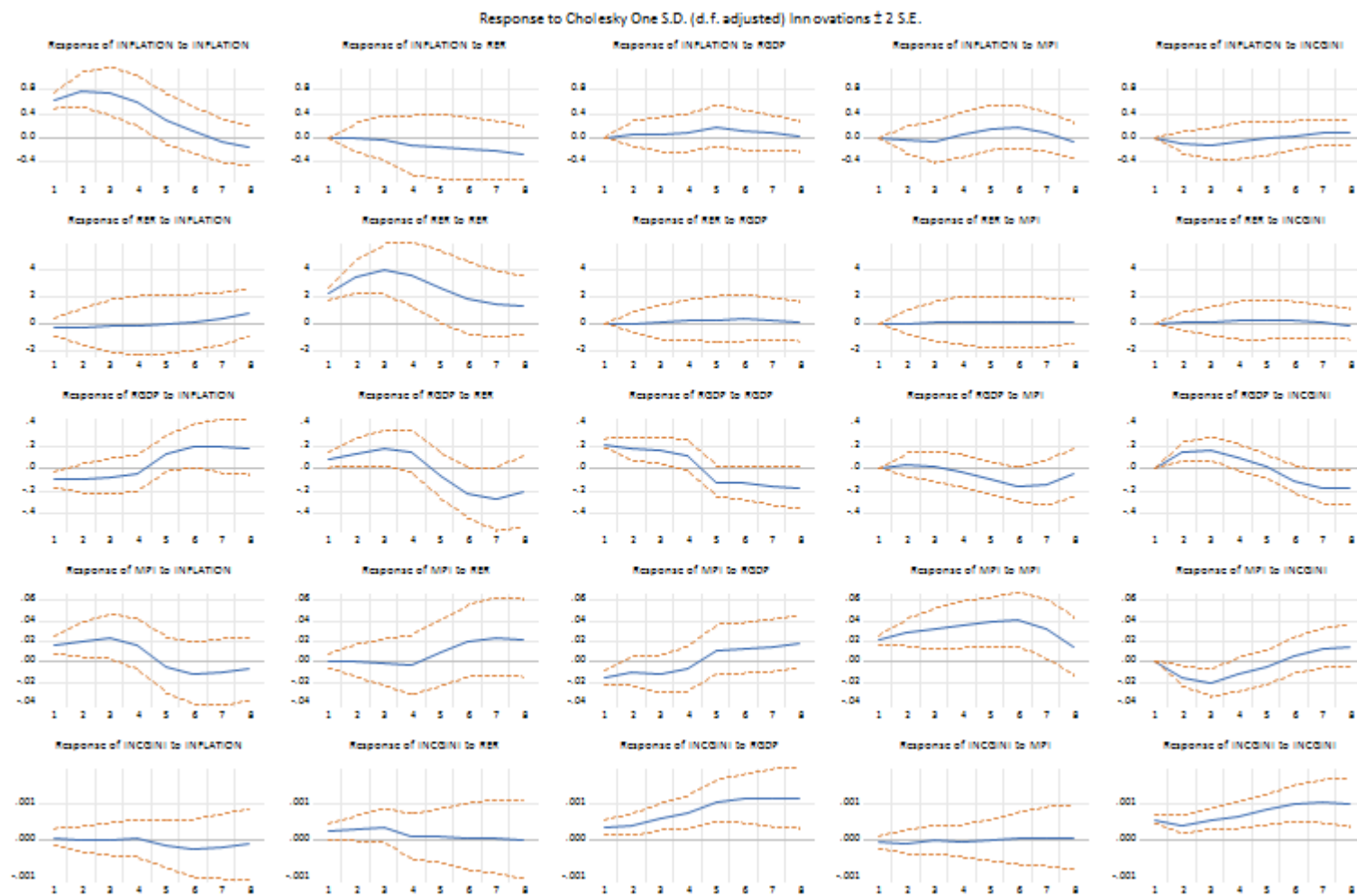


Figure 4-32: Sub Sample Analysis income inequality model - Brazilian Economy

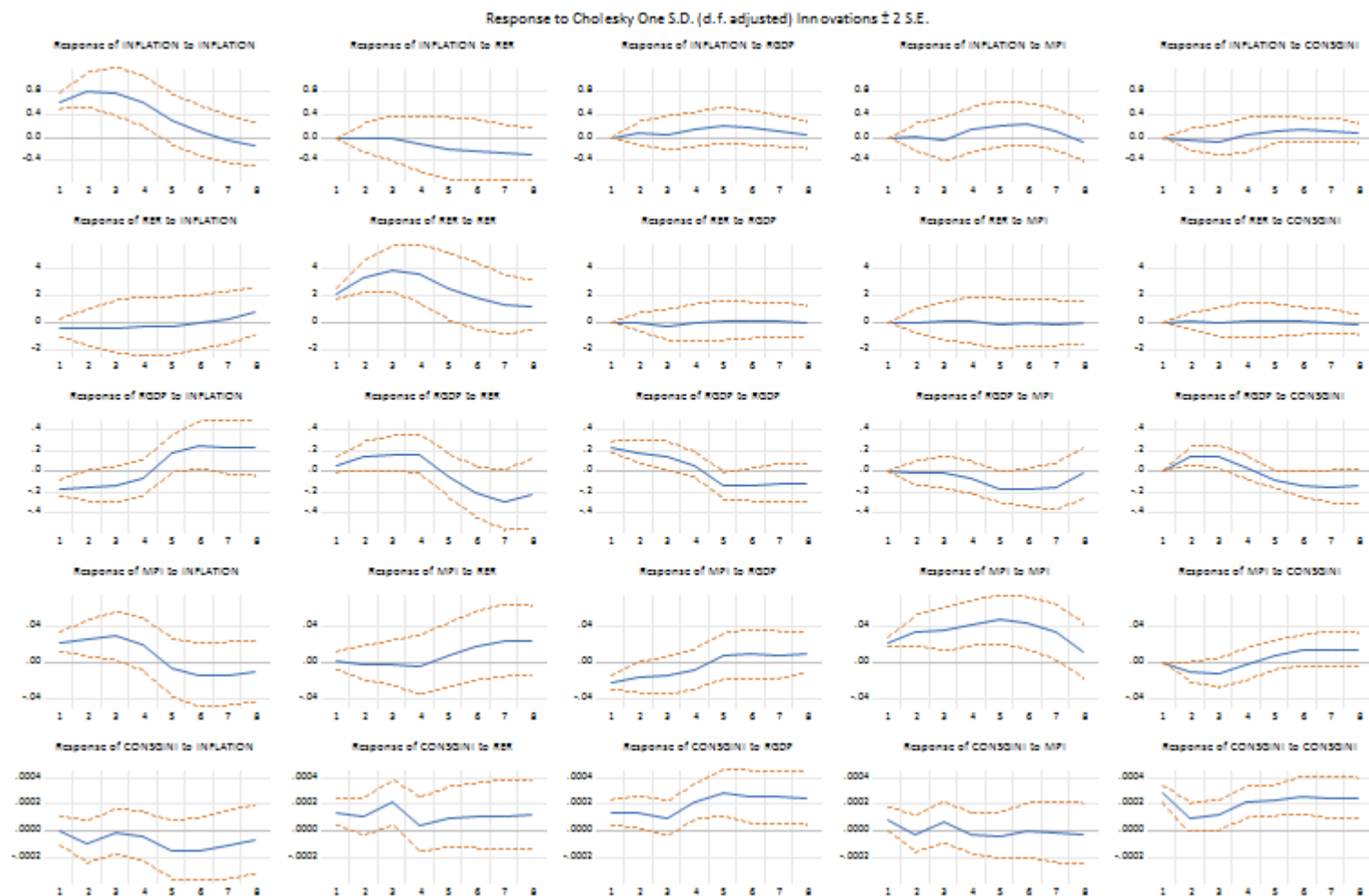


Figure 4-33: Sub Sample Analysis consumption inequality model - Brazilian Economy

For the case of Russia, the SIRFs for the sub sample analysis for income and consumption inequality respectively can be seen in figure **4-34** and **4-35** respectively. For the income inequality model, it can be observed that the response of income inequality to contractionary monetary policy is seen to be positive and robust to the original model. However, the response of income inequality to shock in real GDP is seen to be sensitive in the sub-sample analysis. The response of inflation is also seen to be sensitive to change in sample for shocks in real exchange rate and monetary policy; real exchange rate's response to shocks in real GDP, monetary policy and income inequality is seen to be sensitive to change in sample size. Similarly, the response of real GDP to shock in income inequality and monetary policy response to shock in inflation and real exchange rate are seen to be different. In the consumption inequality model, the response of consumption inequality is seen to be sensitive to change in sample for shocks in all the variables. The effect of consumption inequality to shock on other variables is also sensitive to change in sample size.

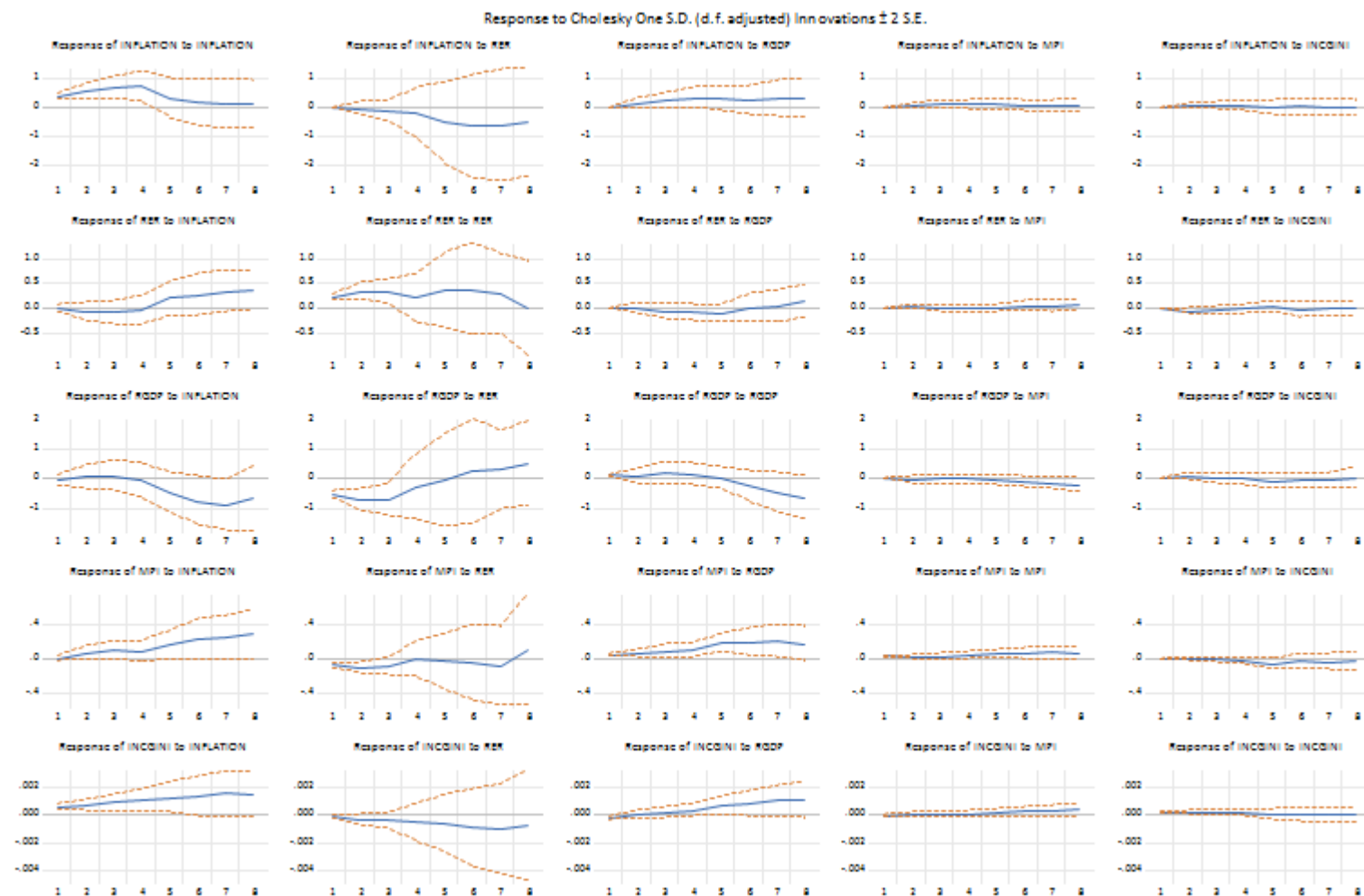


Figure 4-34: Sub Sample Analysis income inequality model - Russian Economy

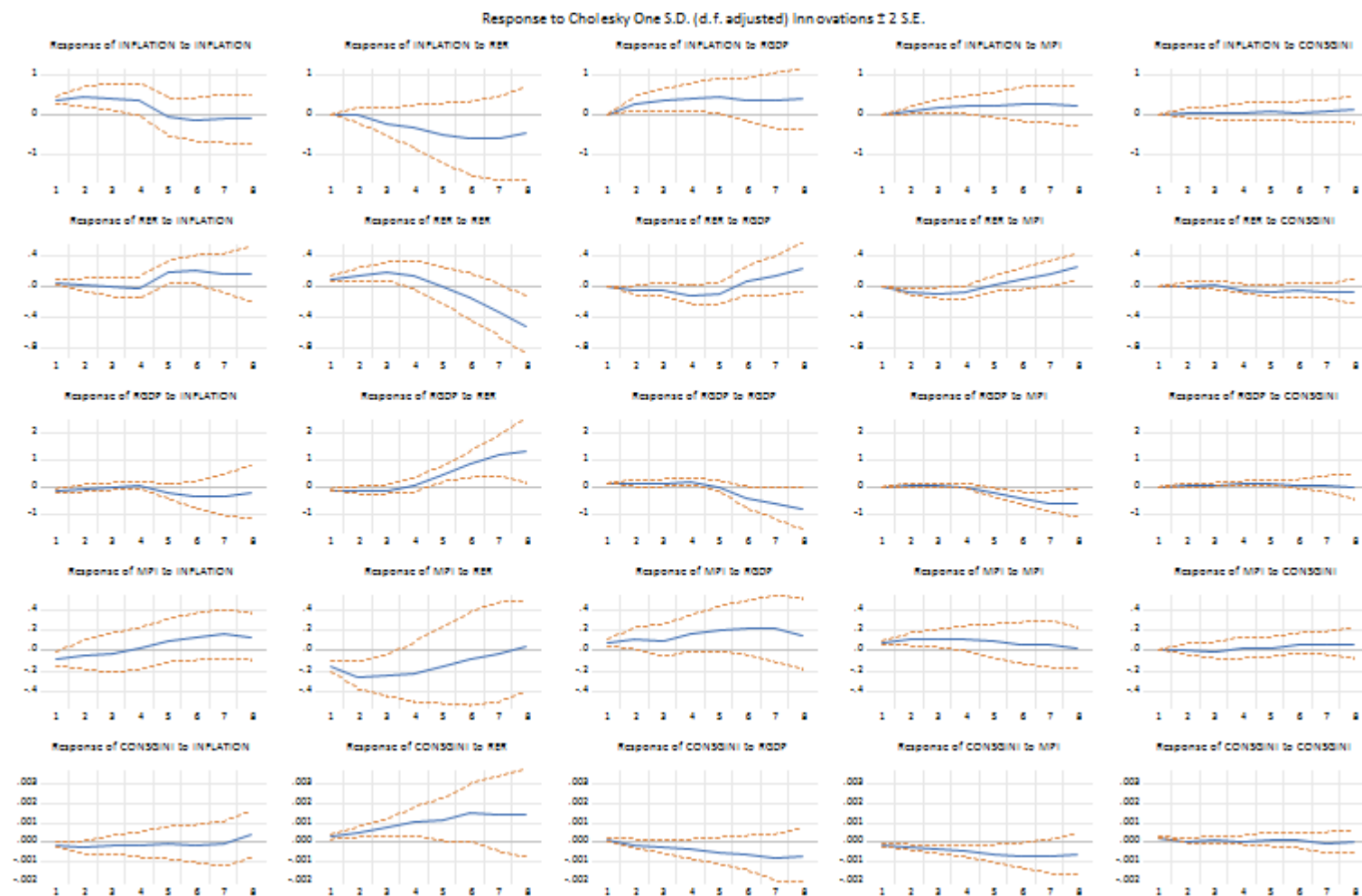
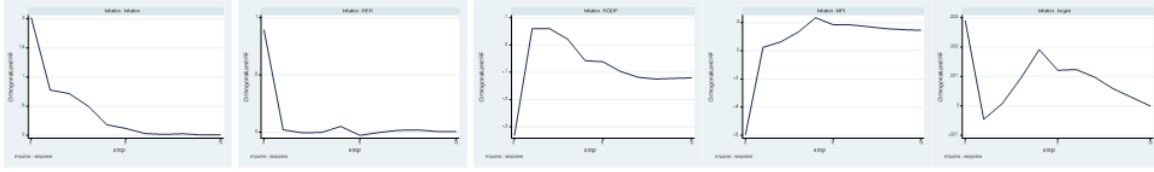


Figure 4-35: Sub Sample Analysis consumption inequality model - Russian Economy

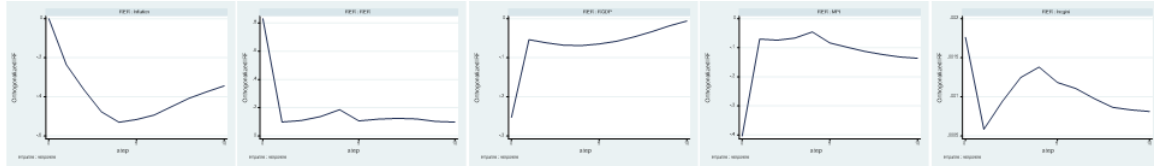
The sub sample analysis for the balanced and unbalanced panel data for income and consumption inequality are seen in figures **4-36**, **4-37**, **4-38** and **4-39** respectively. In the balanced panel analysis, the IRFs from the income inequality model shows that in the sub sample analysis also the response of income inequality to shocks in other variables is minor. Positive shock in inflation has different effect on income inequality in the sub sample analysis. In the sub sample analysis, the response of income inequality is seen to be positive throughout, with a very minor negative response for one quarter and in the long run remains in the stable position. In the original model, the effect was seen to be negative for a significantly longer period of time. The response of real exchange rate is also seen to be different when compared to that of the original model. Although the effect is positive in both the cases, there is a tendency to decline in the sub sample analysis while the original model shows steady increase. Other responses are seen to be qualitatively similar. The response of income inequality to depreciation in real exchange rate is seen to be qualitatively similar by showing positive response in both the sub sample analysis and the original model. To a positive shock in real GDP, the response of income inequality in the sub sample analysis is seen to be similar throughout the period while in the original model, there is a negative response in the long run. Other responses to shock in real GDP are qualitatively similar. The response of income inequality to contractionary monetary policy is also seen to be different in the sub sample analysis. In the sub sample analysis, the response of income inequality is seen to be positive in the short run and declines continuously to show a negative response after about two quarters and remains negative until the end of the period. In the original model, the effect is seen to be significantly positive in both long and short run. The responses of other variables to shock in income inequality is seen to be qualitatively similar for all the variables except real GDP where there is significant difference in the response in the sub sample analysis when compared to the original model. Consumption inequality's effect on other variables is seen to be robust. Contractionary monetary policy's effect on consumption inequality is seen to be sensitive to change in sample size. The effect of real exchange rate and real GDP on consumption inequality are seen to be robust.

For the Unbalanced Panel, the subsample sensitivity analysis is seen in the figure below. The responses of variables to shock in inflation are seen to be qualitatively similar except for the case of income inequality which is seen to show sensitivity to change in sample. Real exchange rate shock is seen to be sensitive for income inequality and monetary policy in the sub sample analysis while the response of other variables remains robust. Responses of shock in real GDP is also seen to be sensitive to change in sample period in all of the variables. Contractionary monetary policy shock brings about a similar response in income inequality in the sub sample analysis also, while for other variables the effect is seen to be sensitive. The responses of other variables to shock in income inequality is seen to be robust even with change in sample size.

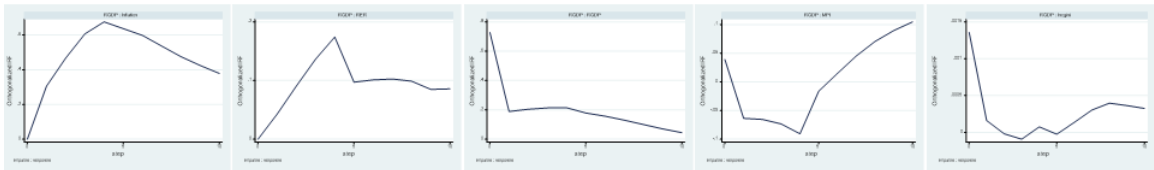
In the consumption inequality model for the unbalanced panel VAR analysis, the response of other variables to shock in consumption inequality is seen to be similar in the case of sub sample analysis also. The response of consumption inequality to a contractionary monetary policy is seen to be qualitatively similar. Similarly the response of consumption inequality to real exchange rate and real GDP shocks are also seen to be robust.



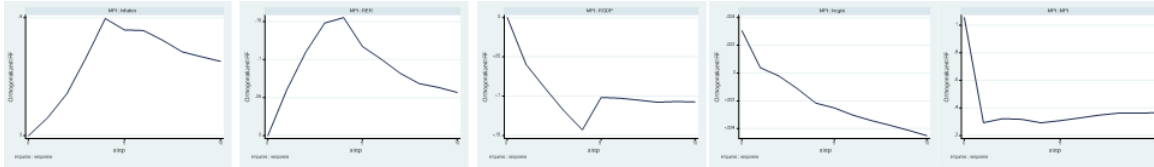
(a) Response of Inflation, RER, RGDP, MPI and Income gini to shock in inflation (left to right)



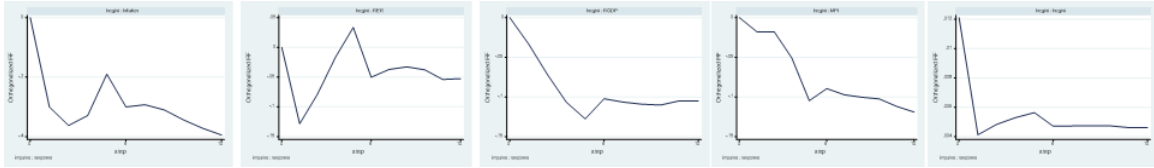
(b) Response of Inflation, RER, RGDP, MPI and Income gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, MPI and Income gini to shock in RGDP (left to right)

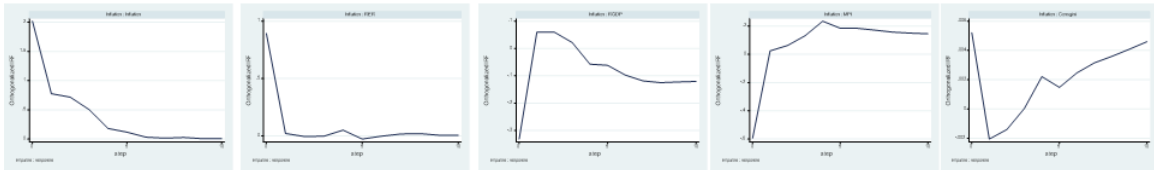


(d) Response of Inflation, RER, RGDP, MPI and Income gini to shock in MPI (left to right)

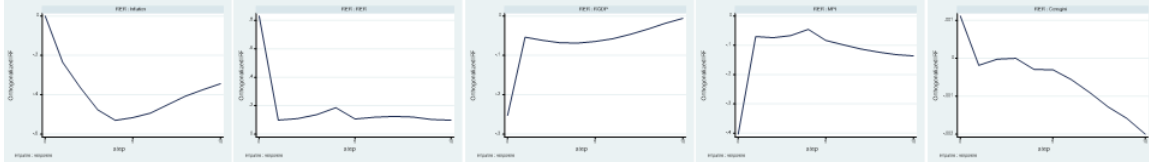


(e) Response of Inflation, RER, RGDP, MPI and Income gini to shock in Income gini (left to right)

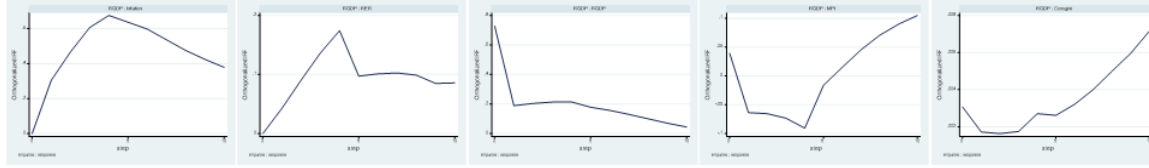
Figure 4-36: Sub Sample Analysis balanced panel VAR - Income inequality model



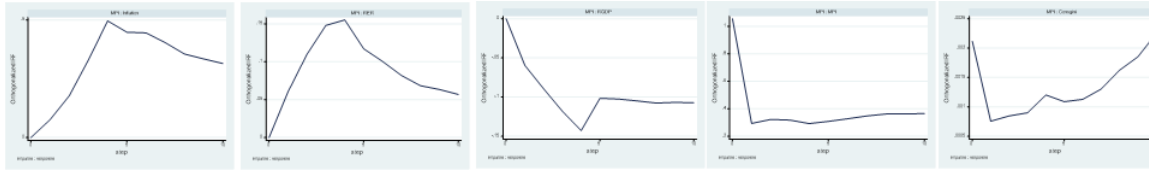
(a) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in inflation (left to right)



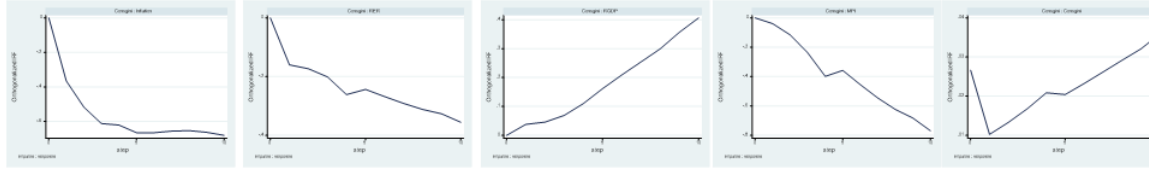
(b) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in RGDP (left to right)

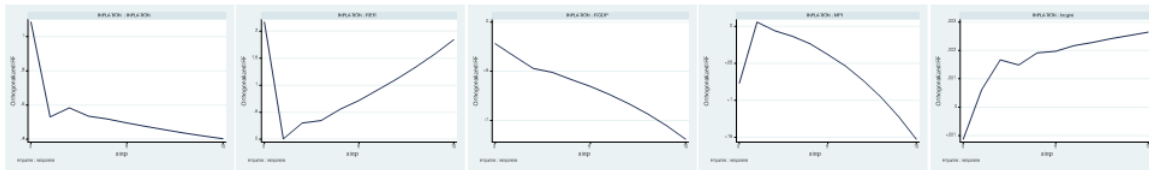


(d) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in MPI (left to right)

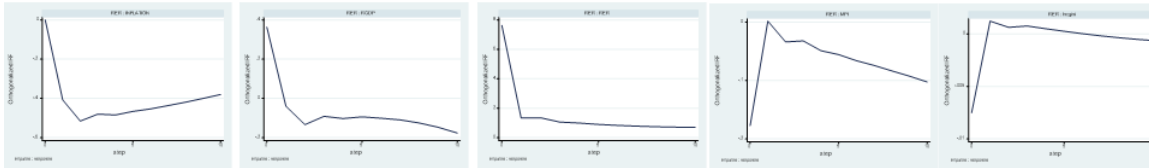


(e) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in Consumption gini (left to right)

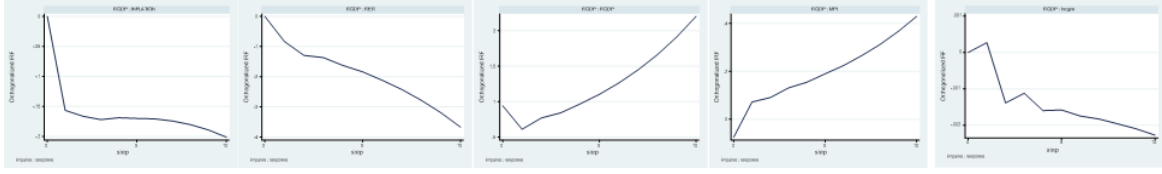
Figure 4-37: Sub Sample Analysis balanced panel VAR - Consumption inequality model



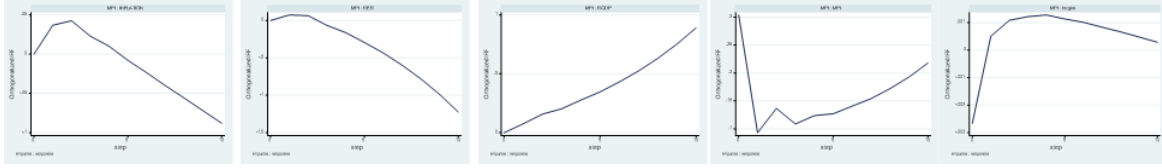
(a) Response of Inflation, RER, RGDP, MPI and Income gini to shock in inflation (left to right)



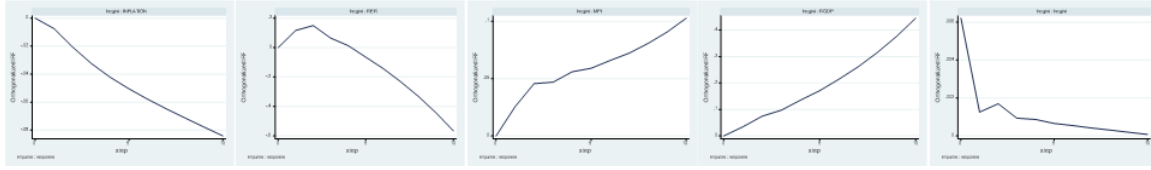
(b) Response of Inflation, RER, RGDP, MPI and Income gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, MPI and Income gini to shock in RGDP (left to right)

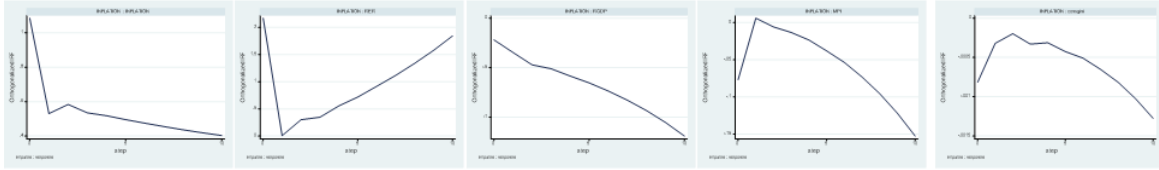


(d) Response of Inflation, RER, RGDP, MPI and Income gini to shock in MPI (left to right)

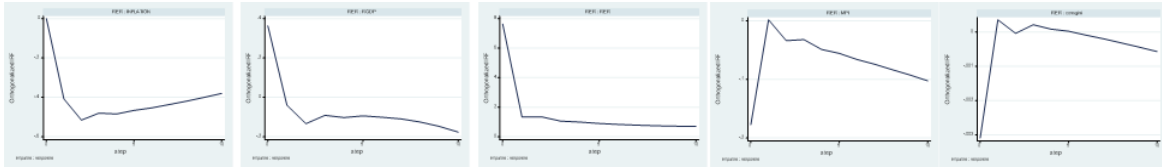


(e) Response of Inflation, RER, RGDP, MPI and Income gini to shock in Income gini (left to right)

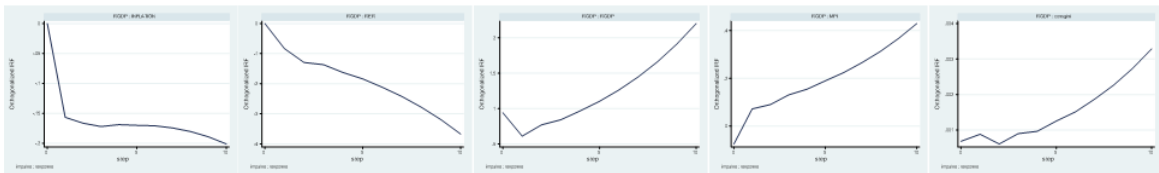
Figure 4-38: Sub Sample Analysis unbalanced panel VAR - Income inequality model



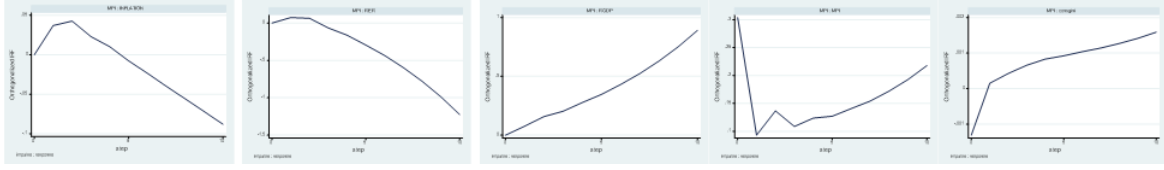
(a) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in inflation (left to right)



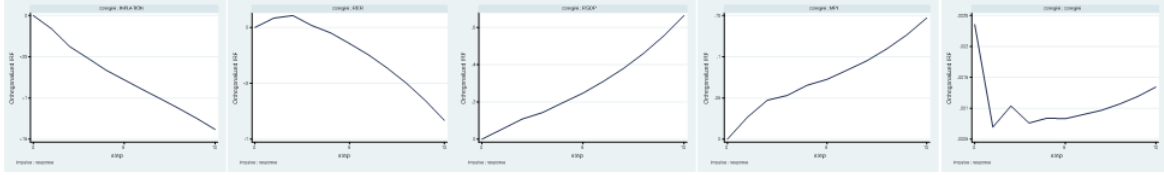
(b) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in RGDP (left to right)



(d) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in MPI (left to right)



(e) Response of Inflation, RER, RGDP, MPI and Consumption gini to shock in Consumption gini (left to right)

Figure 4-39: Sub Sample Analysis unbalanced panel VAR - Consumption inequality model

4.8.3 Sensitivity to change in Monetary Policy Instrument

The third set of sensitivity analysis is done by changing the monetary policy variable to M2 broad money base to see if the results are subject to distortion. Although the primary analysis is based on interest rate as the monetary policy instrument, there are also certain countries like China which do target money supply. South Africa too has adopted the money supply targeting since 1980s to mid-1990. In Russia too, the Central Bank has used money supply as an instrument to control inflation. Thus, the third part of sensitivity analysis focuses on the sensitivity to results to change in monetary policy instrument to M2 broad money. For the case of India, the results of SIRFs for the income and consumption inequality model after change in monetary policy variable is seen in figure 4-40 and 4-41. The responses of both income and consumption inequality measure are seen to be sensitive to change in monetary policy measure. Expansionary monetary policy is seen to bring increase in income inequality and decrease in consumption inequality. The results after change in monetary policy variable are seen to be robust only in the case of real exchange rate only.

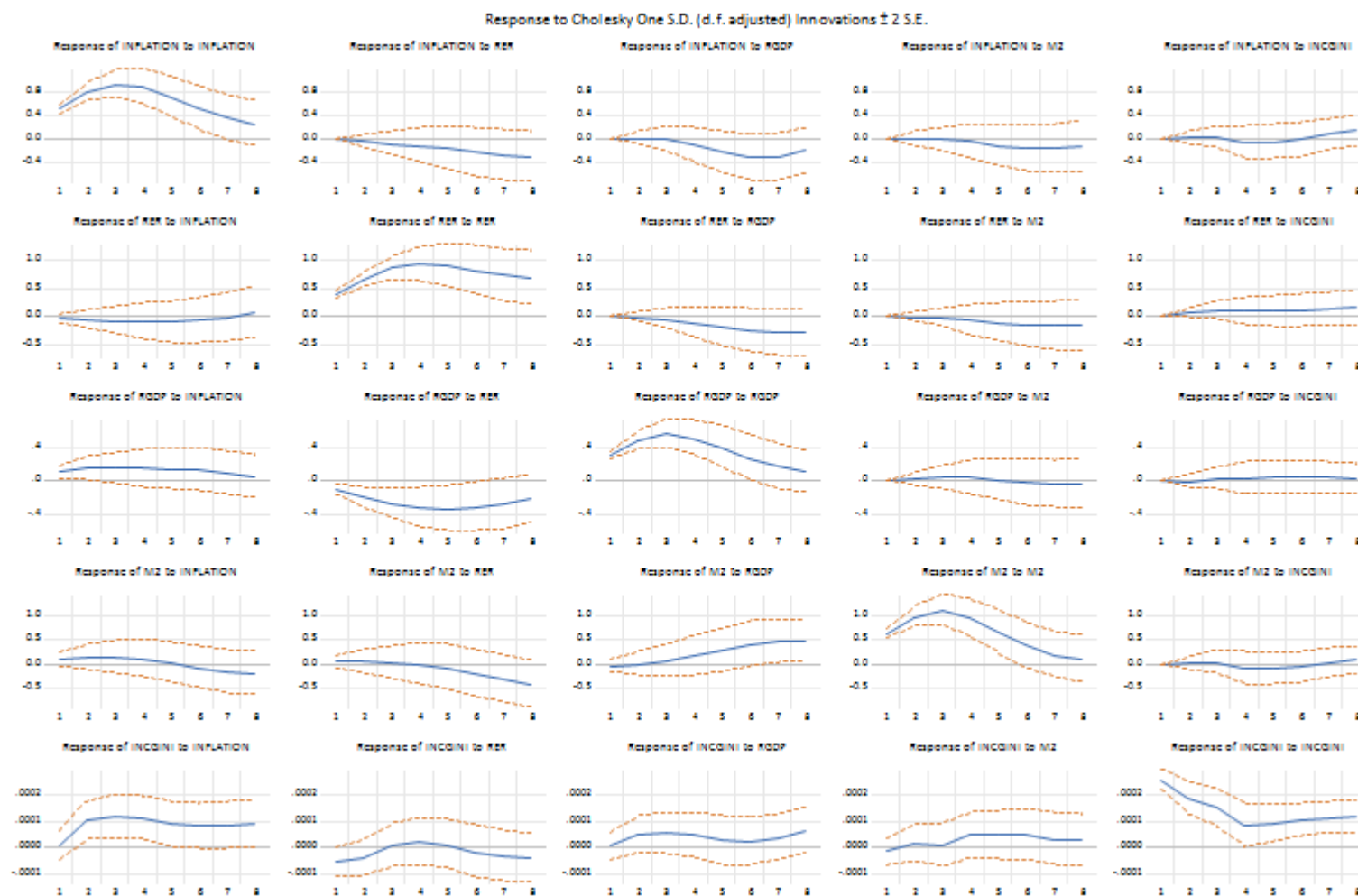


Figure 4-40: Change in MPI - Sensitivity Analysis - Income inequality model - Indian Economy

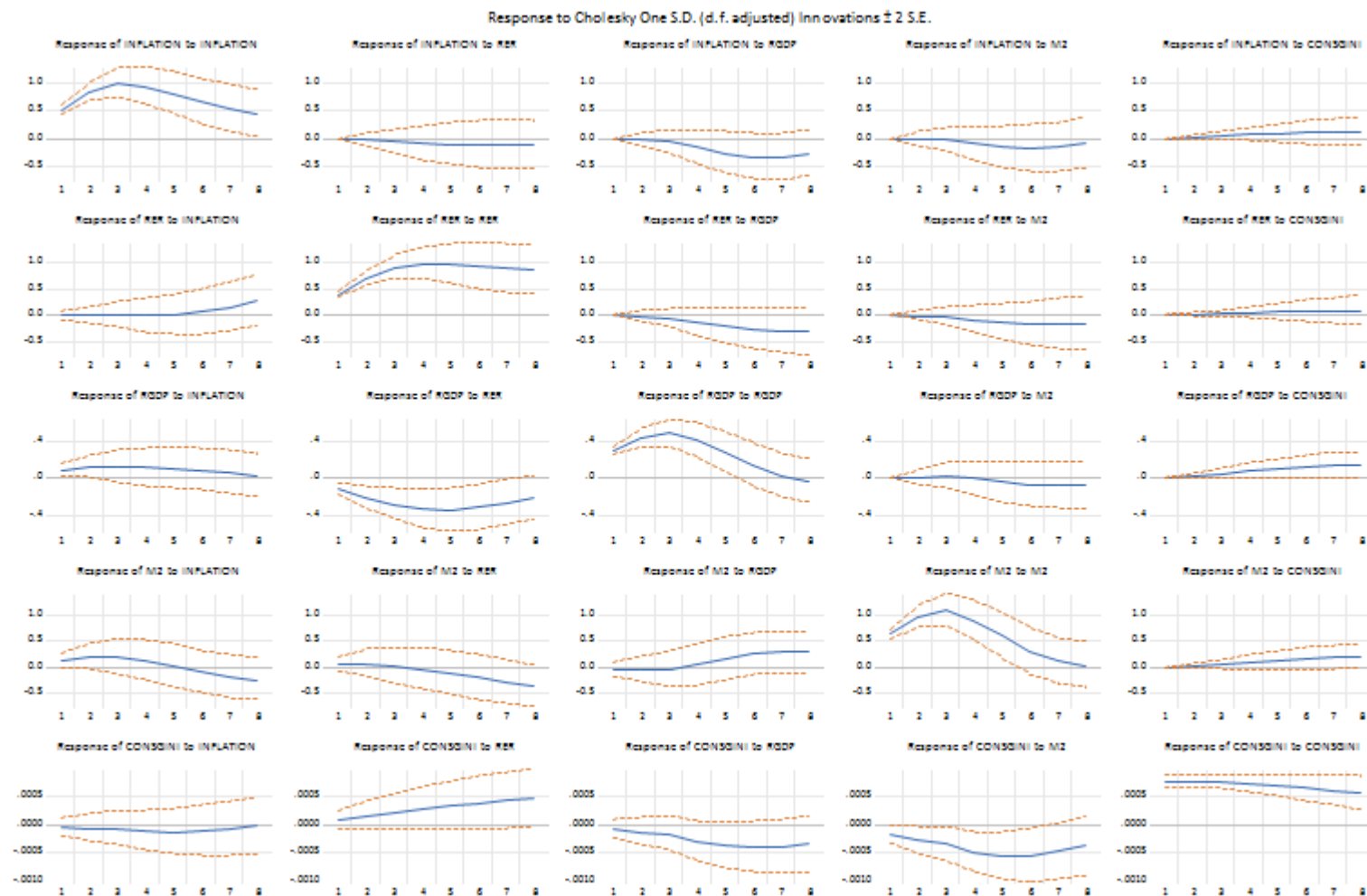


Figure 4-41: Change in MPI - Sensitivity Analysis - Consumption inequality model - Indian Economy

For the case of China, the responses are seen to be similar in both the cases which imply that expansionary and contractionary monetary policy leaves similar effect on income and consumption inequality. Increase in money supply (expansionary monetary policy) increases income inequality in the short run and in the long run declines. This is similar to the effect of increase in interest rate (contractionary monetary policy) in the economy, indicating that the results are sensitive to change in monetary policy instrument. The effect is seen to be sensitive even for the case of consumption inequality model. The results are seen to be robust only for the case of inflation. The SIRF's are seen in figures **4-42** and **4-43**.

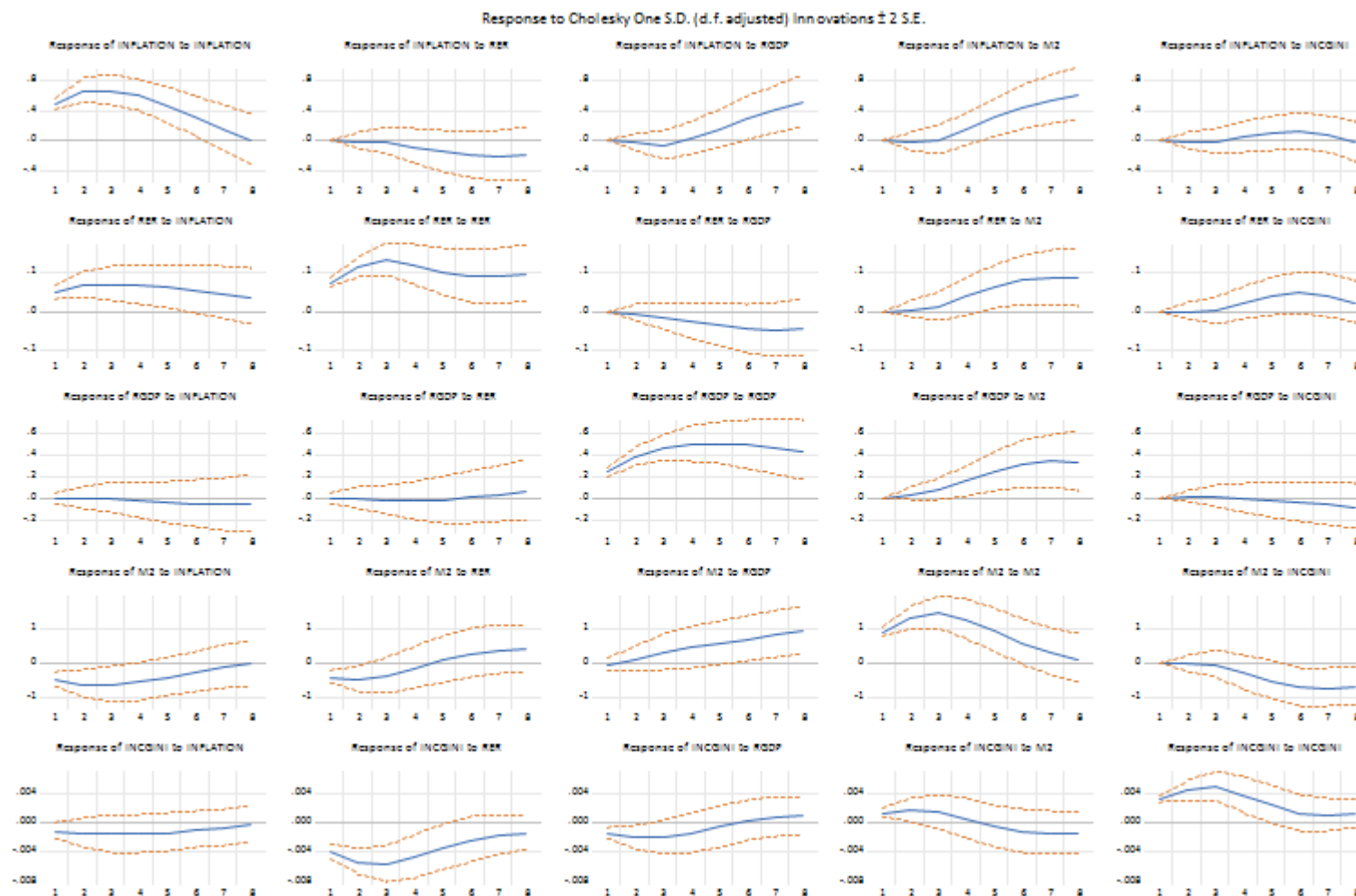


Figure 4-42: Change in MPI - Sensitivity Analysis - Income inequality model - Chinese Economy

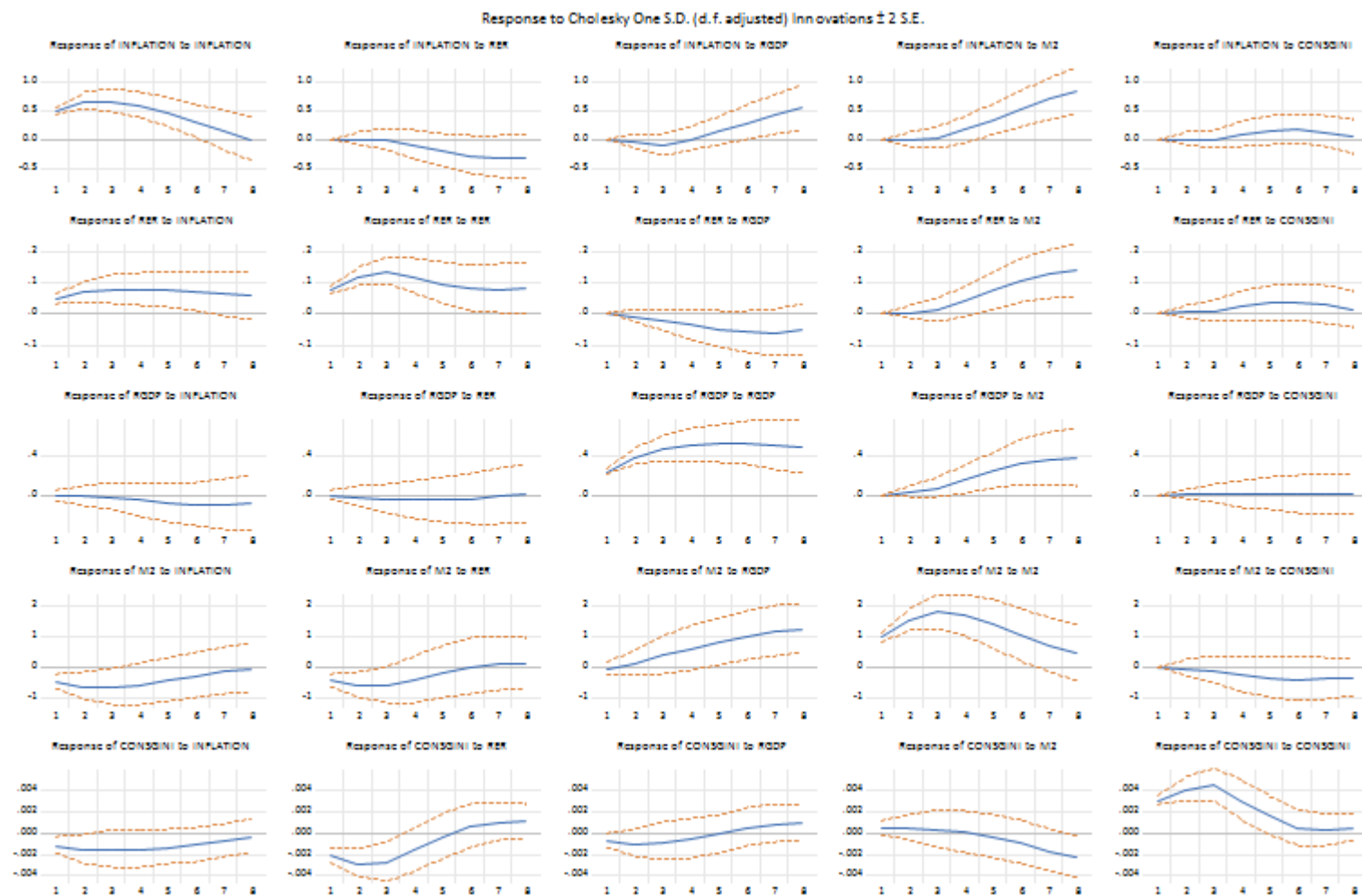


Figure 4-43: Change in MPI - Sensitivity Analysis - Consumption inequality model - Chinese Economy

In the case of South Africa, the SIRD's are seen in figures **4-44** and **4-45**. The response of income inequality after the change in monetary policy instrument is seen to be negligible when compared to the interest rate as monetary policy instrument. The other responses are seen to be robust. The response of consumption inequality is seen to have significant positive effect with change in monetary policy tool while in the original model; the response is seen to be unresponsive for majority of the period.

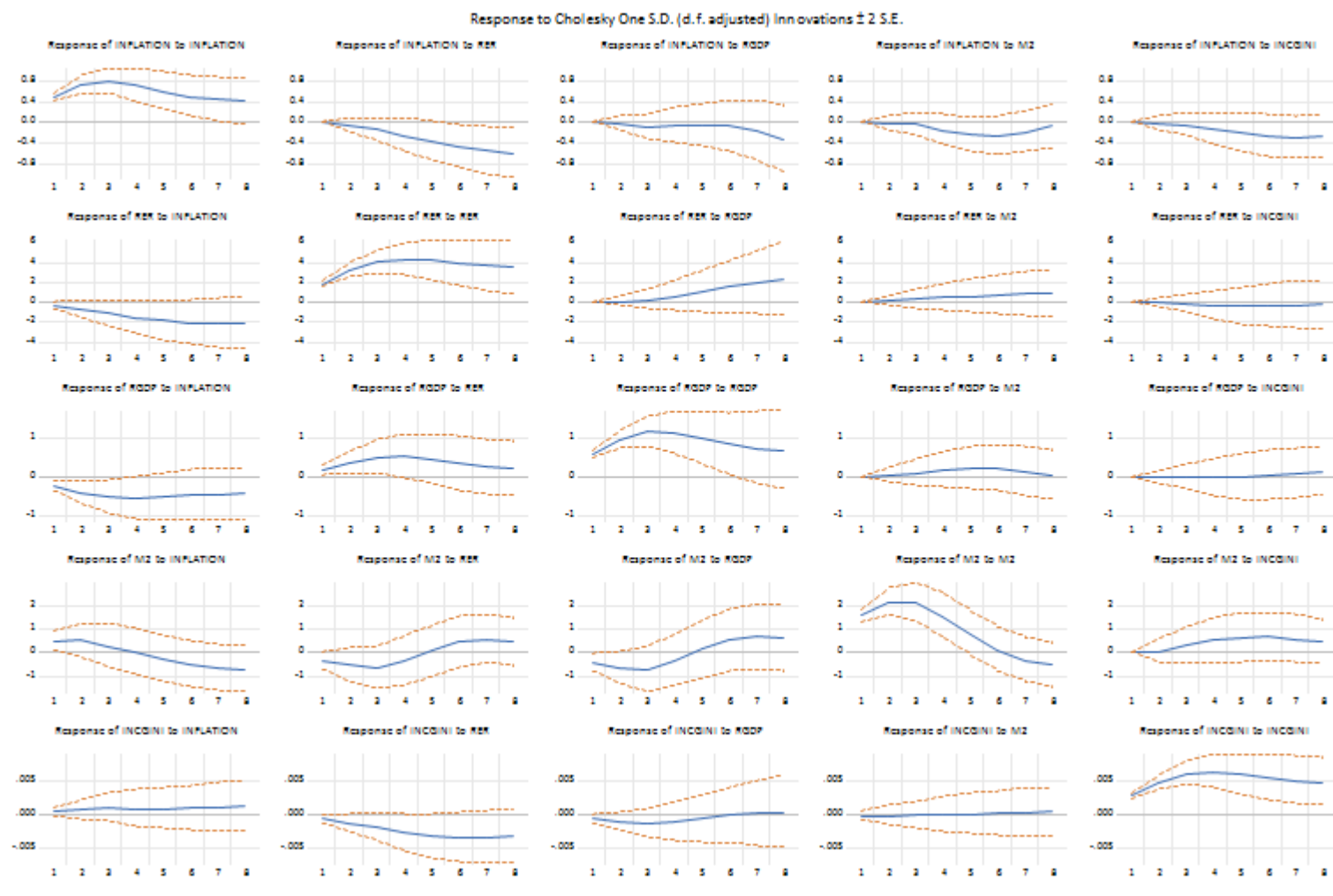


Figure 4-44: Change in MPI - Sensitivity Analysis - Income inequality model - South African Economy

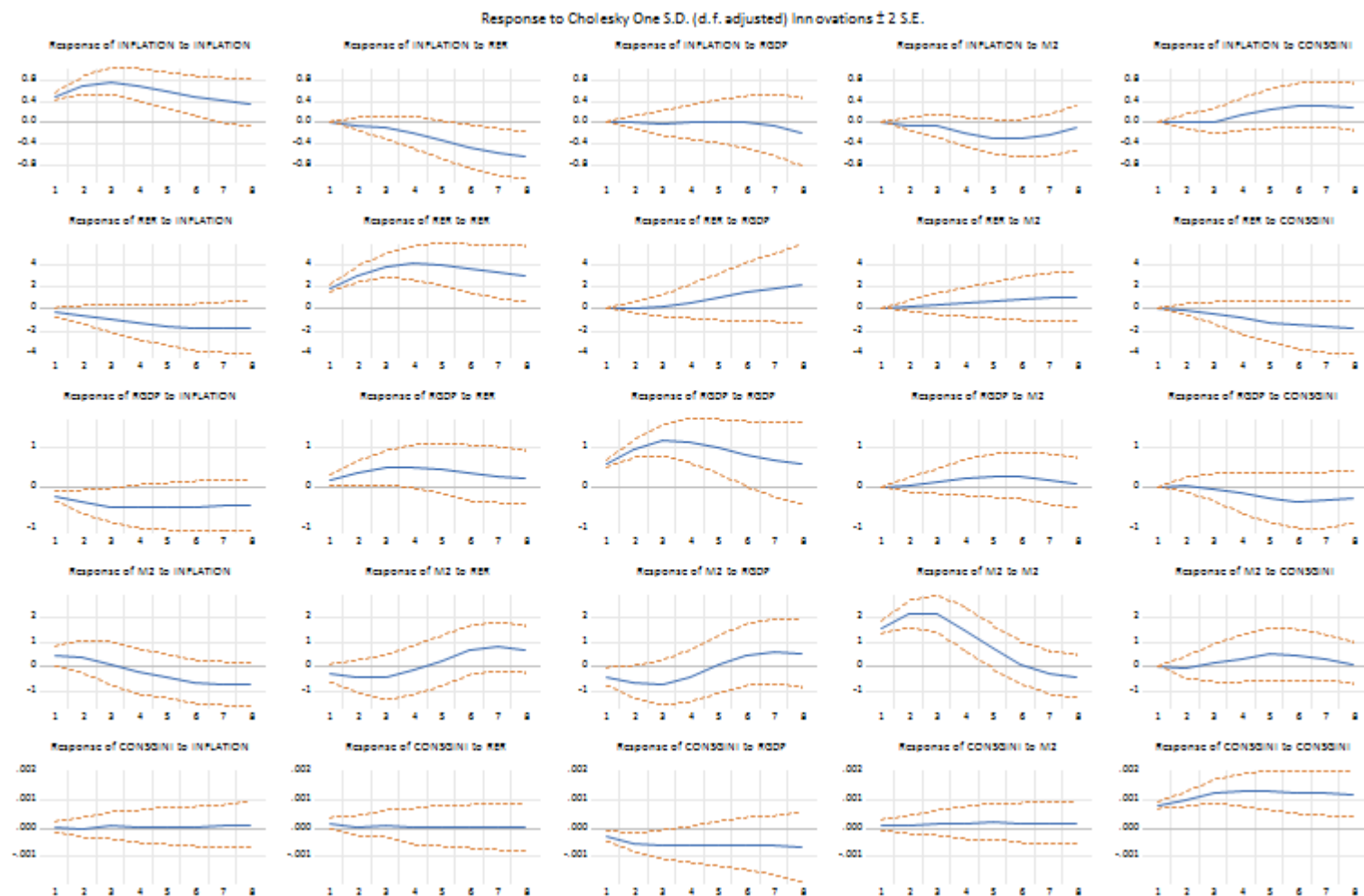


Figure 4-45: Change in MPI - Sensitivity Analysis - Consumption inequality model - South African Economy

In the Brazilian economy, the SIRFs after change in monetary policy instrument is seen in figure **4-46** and **4-47**. It can be seen that the response of income inequality after the change in monetary policy variable is seen to be unresponsive in the long and in the short run while in the case of original model remains significantly positive. Consumption inequality is seen to increase to an expansionary monetary policy and in the original model shows an increase to a contractionary monetary policy due to increase in interest rate. The other responses are seen to be robust.

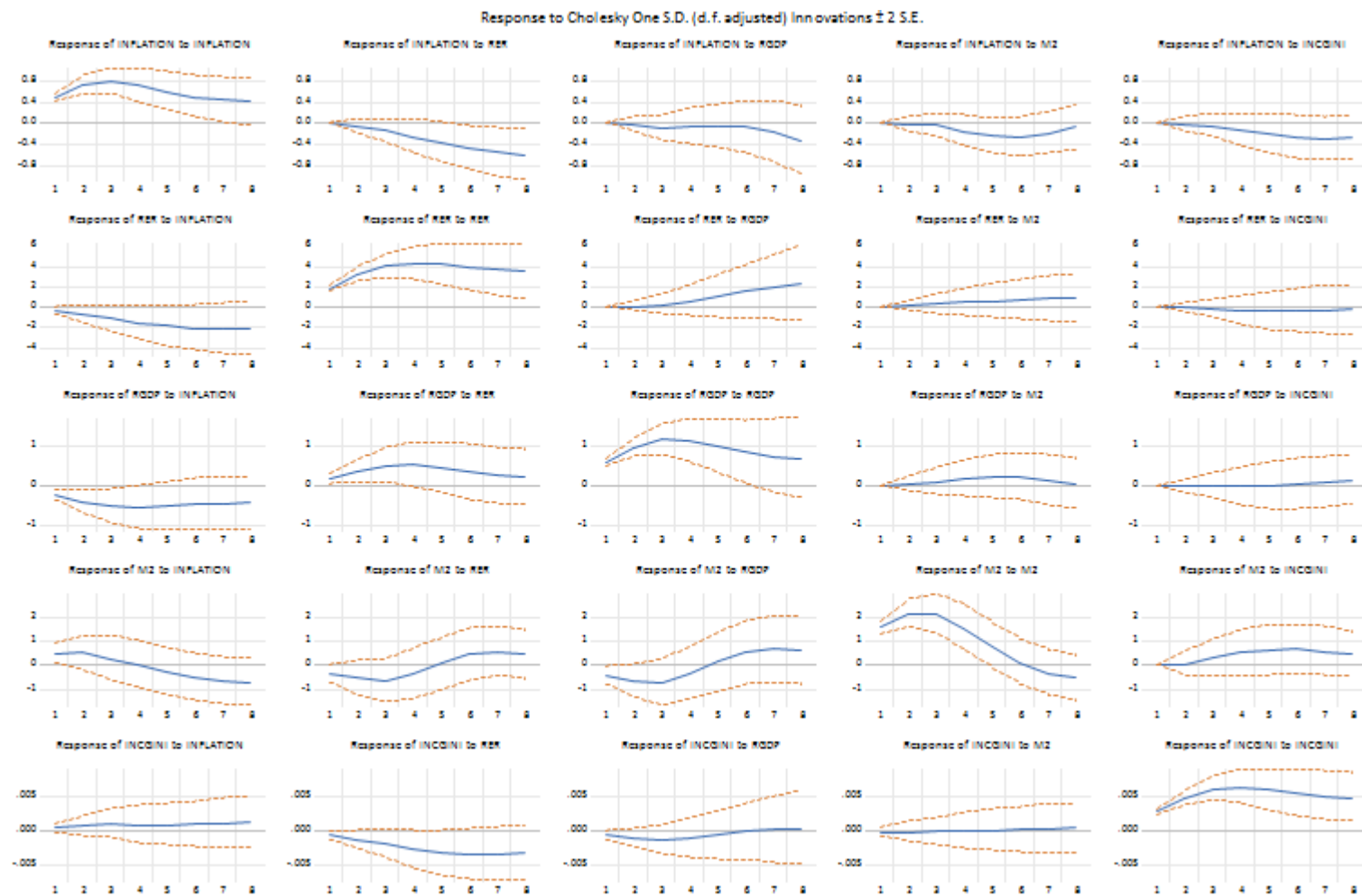


Figure 4-46: Change in MPI - Sensitivity Analysis - Income inequality model - Brazilian Economy

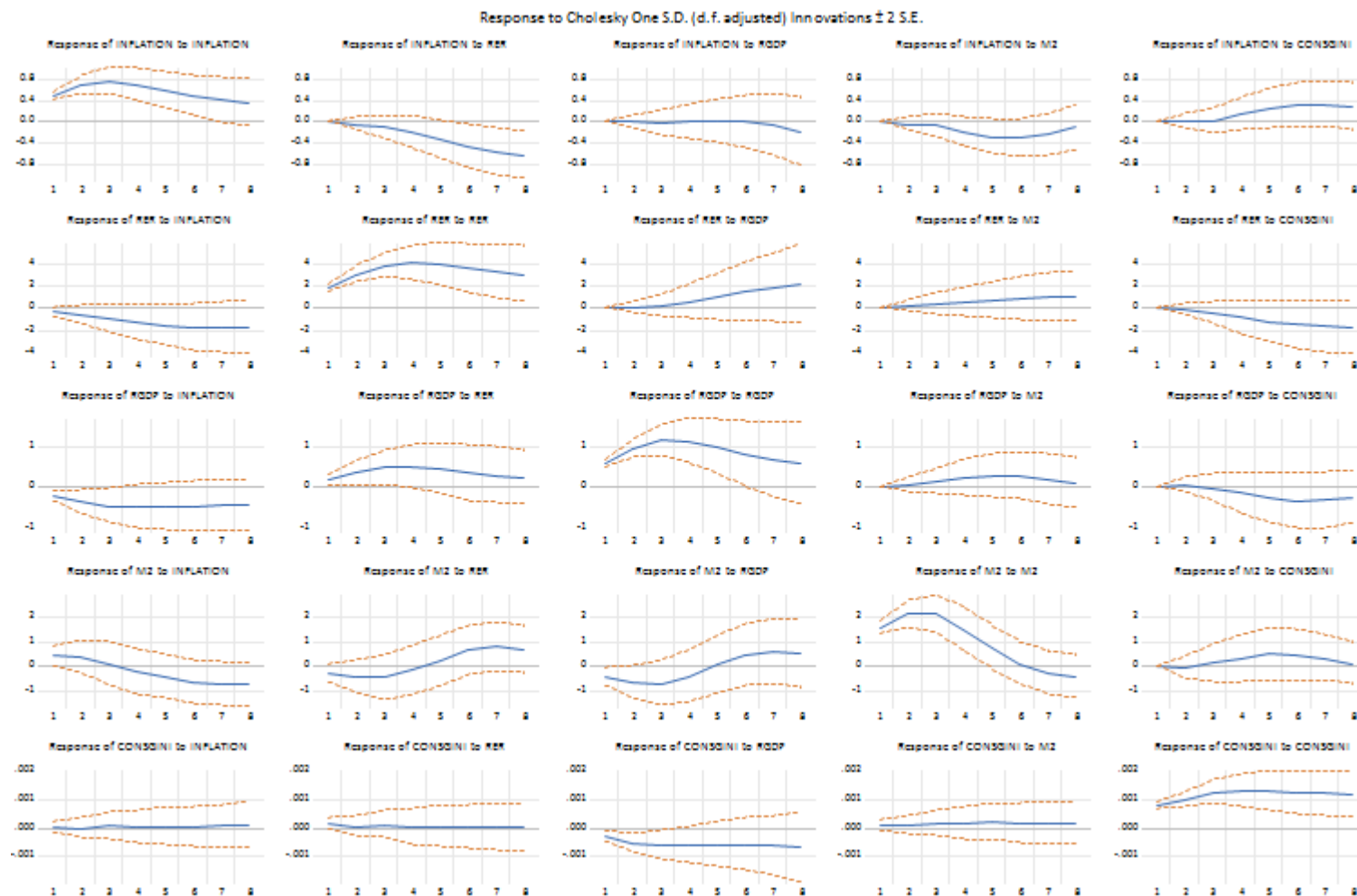


Figure 4-47: Change in MPI - Sensitivity Analysis - Consumption inequality model - Brazilian Economy

In the case of Russian economy, the SIRFs after the change in monetary policy instruments are seen in figures **4-48** and **4-49**. The response of income inequality is seen to be robust even after the change in the monetary policy variable. Expansionary monetary policy brings down income inequality after the monetary policy instrument is changed and the original model shows that contractionary monetary policy is seen to increase income inequality. Consumption inequality's response to expansionary monetary policy is seen to increase in the long run. In the original model, the response of consumption inequality is seen to be negligible.

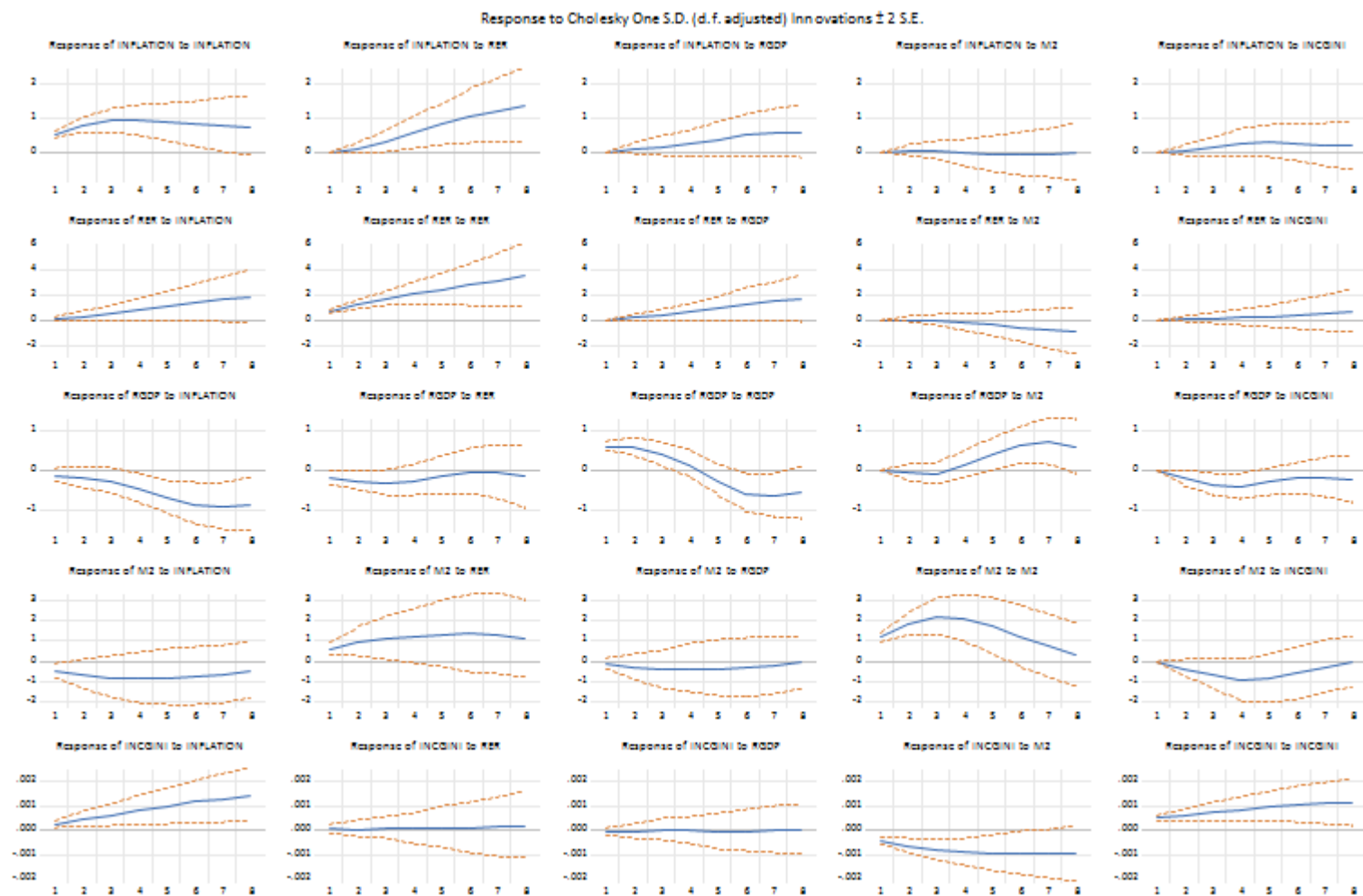


Figure 4-48: Change in MPI - Sensitivity Analysis - Income inequality model - Russian Economy

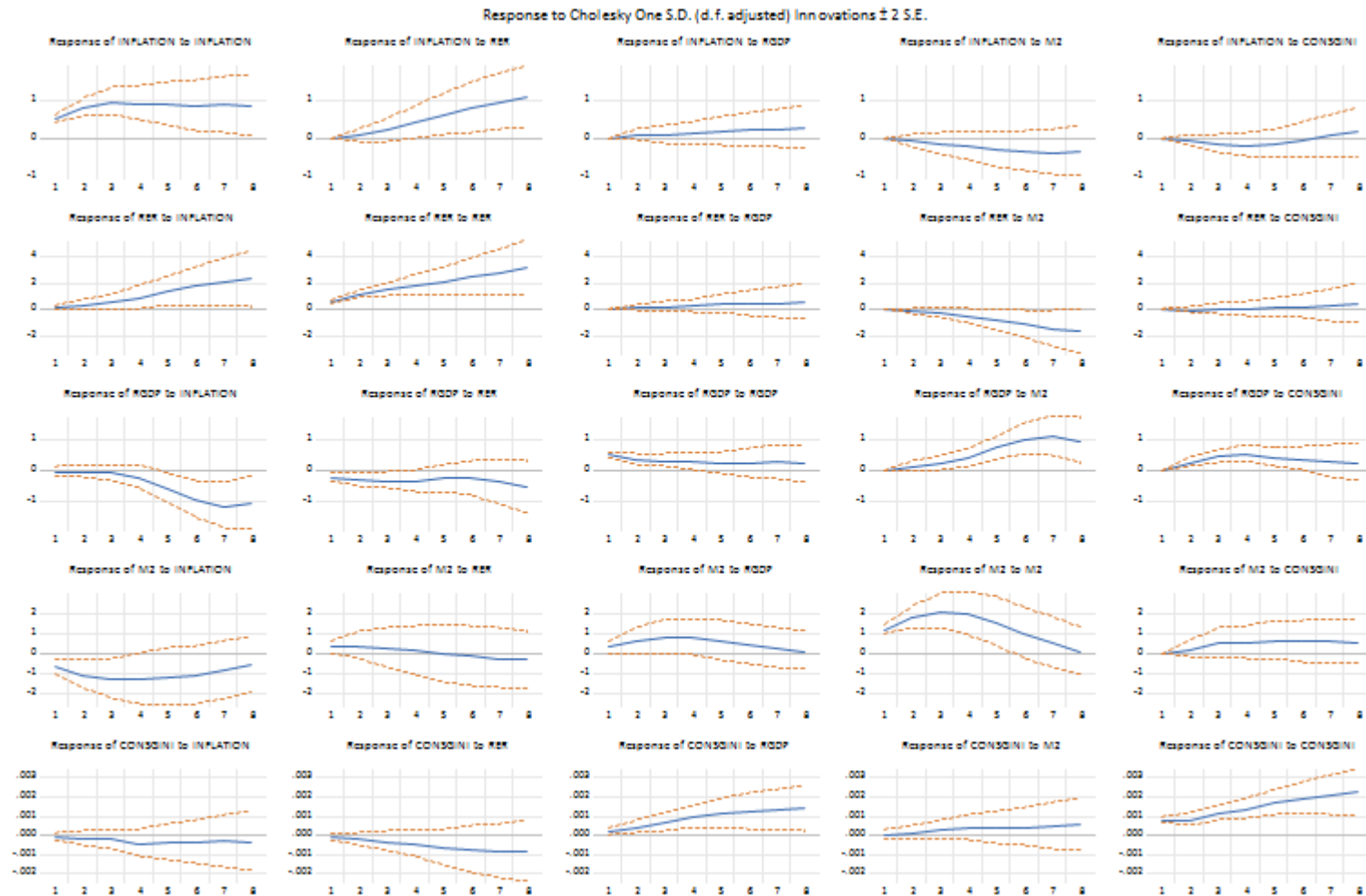
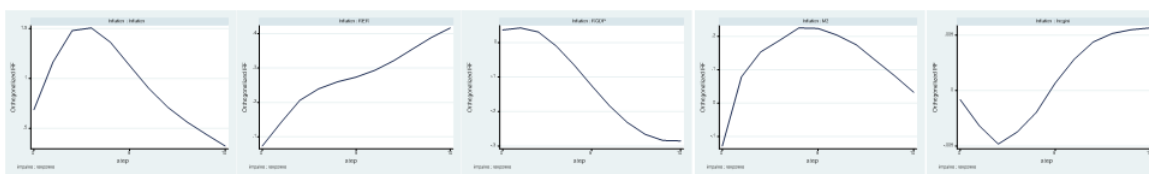


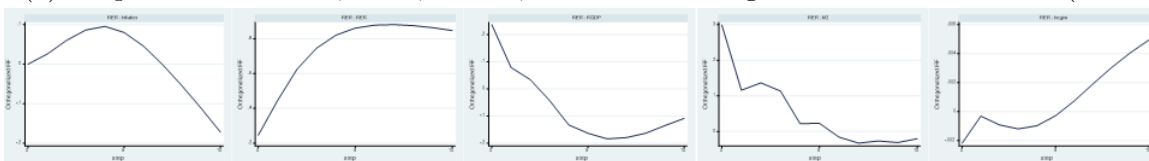
Figure 4-49: Change in MPI - Sensitivity Analysis - Consumption inequality model - Russian Economy

The analysis after change in MPI for the balanced and unbalanced panel data for income and consumption inequality are seen in figures 4-50, 4-51, 4-52 and 4-53 respectively. The balanced panel analysis shows that the responses of monetary policy to shocks in other variables are robust after change in MPI. The response of M2 to shocks in other variables are also seen to be qualitatively similar except for the case of real GDP growth and real exchange rate. For the rest of the cases, it is seen to be sensitive to change in monetary policy variable to M2. In the consumption inequality model, the response of consumption inequality to contractionary monetary policy is seen to be sensitive to change in monetary policy instrument.

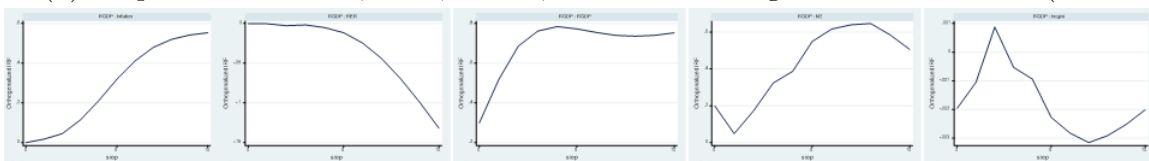
For the unbalanced panel VAR, the income inequality model shows that the response of M2 variable to shocks in real exchange rate is seen to be robust even after changing the monetary policy instrument. Income inequality's response to contractionary monetary policy after change in instrument is robust. The response of real exchange rate is also seen to be robust to change in monetary policy instrument. In the consumption inequality model, the response of consumption inequality is seen to be sensitive to change in monetary policy variable for the unbalanced panel VAR.



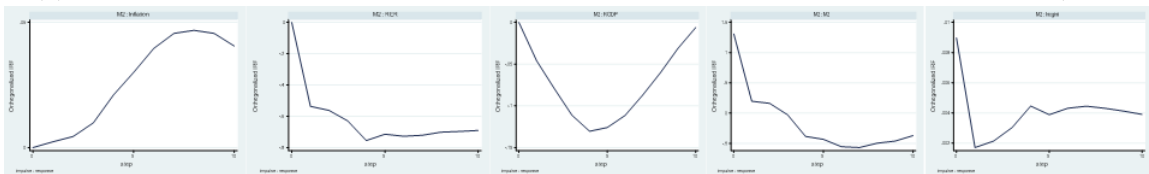
(a) Response of Inflation, RER, RGDP, M2 and Income gini to shock in inflation (left to right)



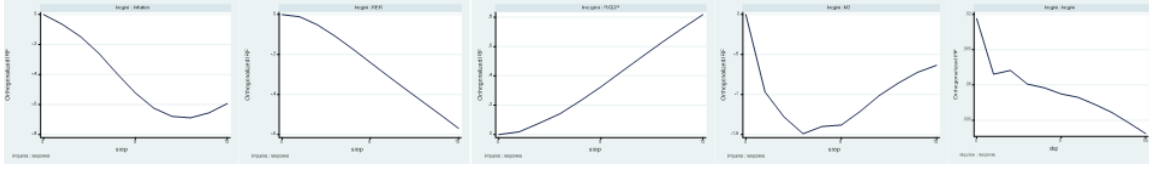
(b) Response of Inflation, RER, RGDP, M2 and Income gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, M2 and Income gini to shock in RGDP (left to right)

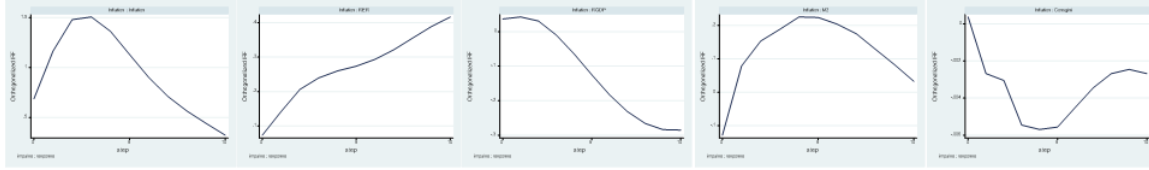


(d) Response of Inflation, RER, RGDP, M2 and Income gini to shock in M2 (left to right)

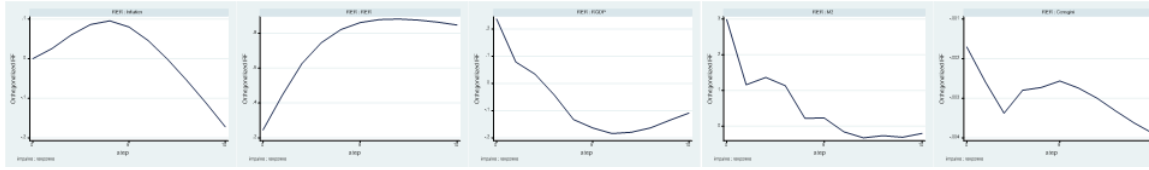


(e) Response of Inflation, RER, RGDP, M2 and Income gini to shock in Income gini (left to right)

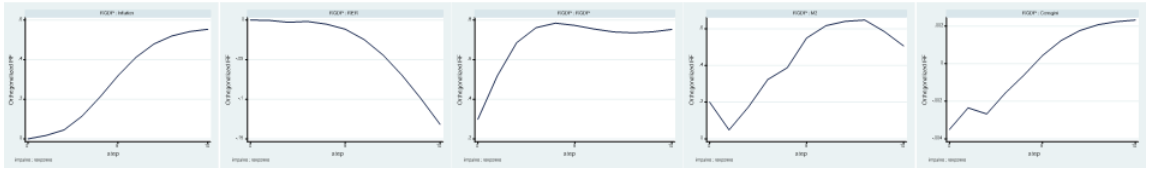
Figure 4-50: Sensitivity to change in MPI - Balanced panel VAR - Income inequality model



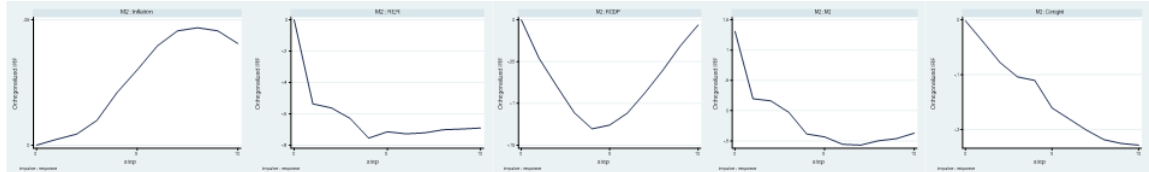
(a) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in inflation (left to right)



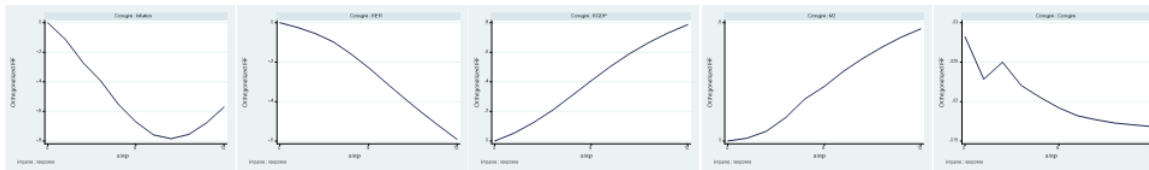
(b) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in RGDP (left to right)

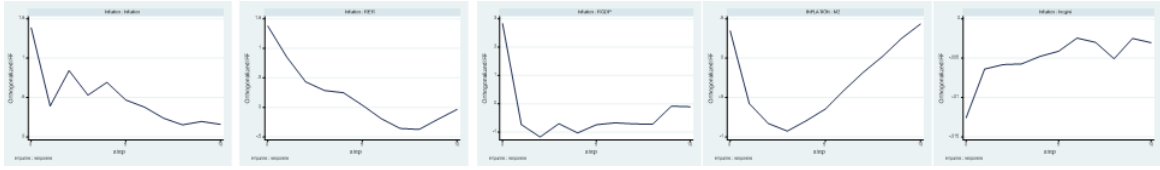


(d) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in M2 (left to right)

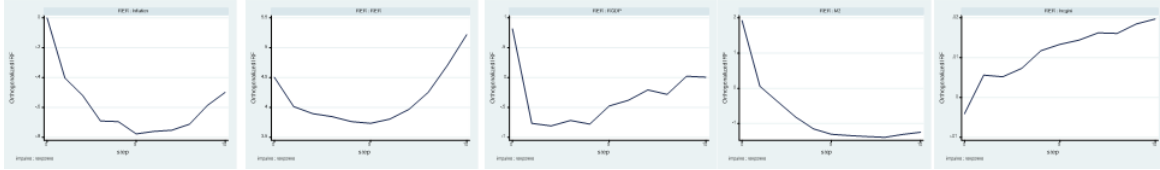


(e) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in Consumption gini (left to right)

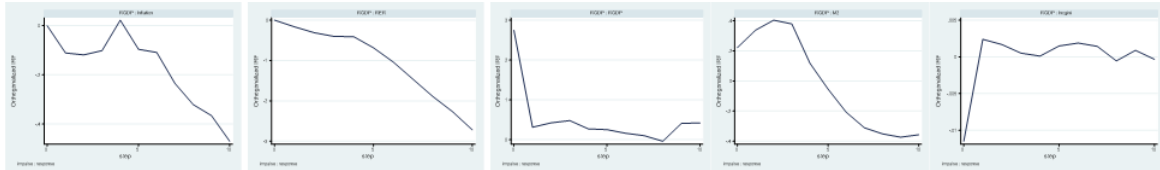
Figure 4-51: Sensitivity to change in MPI - Balanced panel VAR - Consumption inequality model



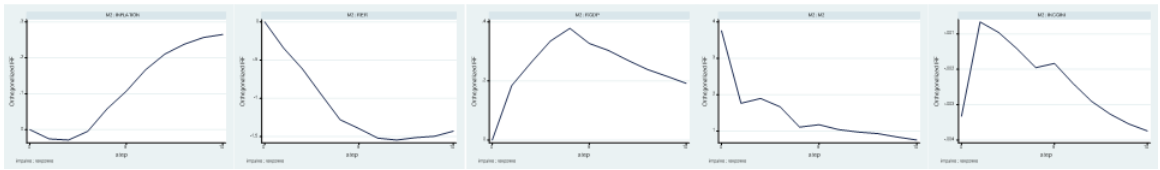
(a) Response of Inflation, RER, RGDP, M2 and Income gini to shock in inflation (left to right)



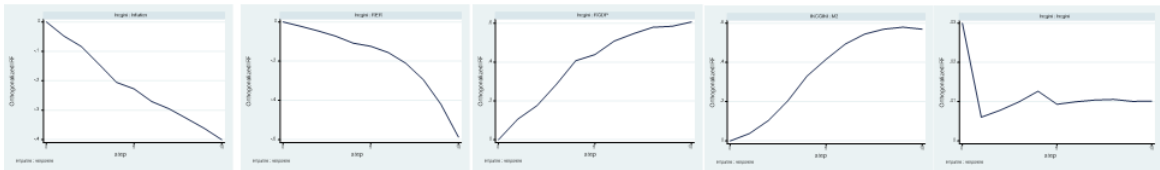
(b) Response of Inflation, RER, RGDP, M2 and Income gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, M2 and Income gini to shock in RGDP (left to right)

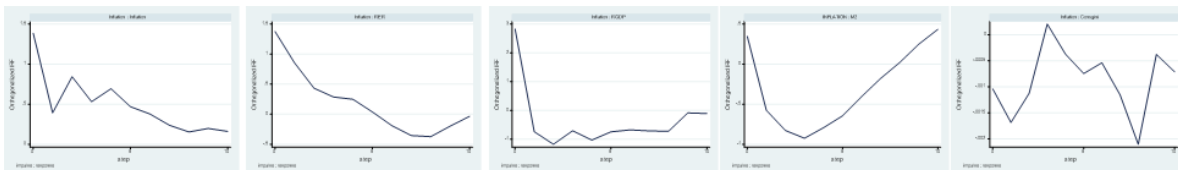


(d) Response of Inflation, RER, RGDP, M2 and Income gini to shock in M2 (left to right)

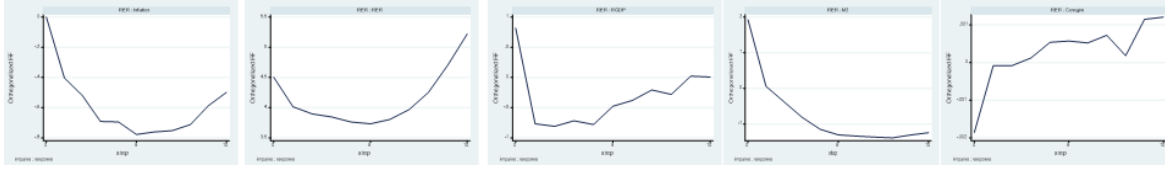


(e) Response of Inflation, RER, RGDP, M2 and Income gini to shock in Income gini (left to right)

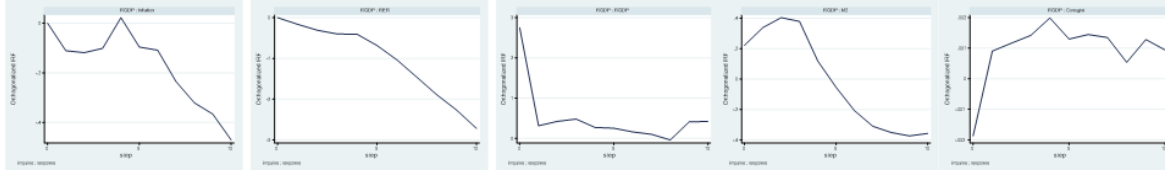
Figure 4-52: Sensitivity to change in MPI - Unbalanced panel VAR - Income inequality model



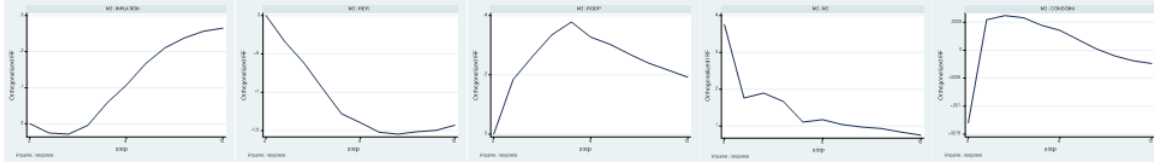
(a) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in inflation (left to right)



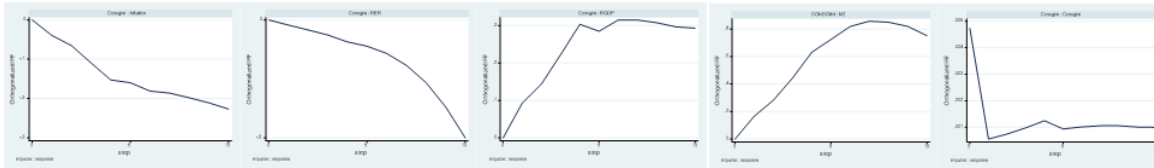
(b) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in RER (left to right)



(c) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in RGDP (left to right)



(d) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in M2 (left to right)



(e) Response of Inflation, RER, RGDP, M2 and Consumption gini to shock in Consumption gini (left to right)

Figure 4-53: Sensitivity to change in MPI - Unbalanced panel VAR - Consumption inequality model

From the results of the SVAR estimation for the income and consumption inequality models have shown negligible effects of shocks in all variables on the inequality measures, except for the case of South African economy. In the case of Indian economy, the effect is seen to be very negligible indicating that monetary policy, real exchange rate, real GDP growth and inflation lesser effects on income and consumption inequality. Studies such as Lenza and Slacrek (2018) find negligible effects of monetary policy on wealth gini. However, no studies by far have found negligible effects of monetary policy on income and consumption inequality. Moura and Schmidt (2018)'s analysis for the case of Brazil also shows that the effect of monetary policy is negligible. This can be due to the fact that as emerging economies, monetary policy may not have significant effect directly on income inequality and consumption inequality. In emerging economies, the inequality may be driven mainly by spatial reasons and less influenced by monetary policy measures. The effect of contractionary monetary policy is seen to be positive and long lasting only in the case of Russia.

Country	Effects of contractionary monetary policy on income inequality	Effects of contractionary monetary policy on consumption inequality	Channel of transmission
India	Positive	Negative	Earnings heterogeneity channel
China	Positive for one year following the shock and then negative	Negative	Ambiguous
South Africa	Positive	Positive but marginal	Savings redistribution channel
Brazil	Positive	Positive	Savings redistribution channel
Russia	Positive	Almost nil	Earnings heterogeneity channel

Table 4-1: Summary of Results: Effect of contractionary monetary policy shock on income and consumption inequality

Chapter 5

Conclusion

The SVAR analysis of the effect of monetary policy on income and consumption inequality shows that there is little effect of monetary policy shocks on income and consumption inequality. This indicates that the income and consumption inequality are driven by other factors and not due to monetary policy. In all the five countries under study, contractionary monetary policy does lead to increase in income inequality for at least four quarters, although the effect is minor. Since the positive response is seen for at least one year, which is a significant period of time, the channel of transmission these emerging economies can be in line with savings redistribution channel and earnings heterogeneity channel. Among the five countries, income inequality is most significantly affected by monetary policy in the case of South Africa. The effect is seen to be ambiguous in the case of China, with the response being positive and negative in the two year period following the shock. In the first year there is positive response to a contractionary monetary policy and in the second year it is seen to be negative. In the case of Russia, the response of income inequality to contractionary monetary policy shock is seen to be positive throughout the period indicating that there is no ambiguity at all. In the other countries, the response is seen to be positive for a significant period of time with very minor negative responses for a very short period. It is expected that the channel of transmission can be through earnings heterogeneity and savings redistribution since the countries are emerging economies and unemployment is one of the key issues facing the policy makers. Since the earnings heterogeneity channel talks about the disproportionate burden of unemployment on low income households, it can be expected that the contractionary monetary policy can increase income inequality. As far as consumption inequality is concerned, the results of the five countries show mixed results. In India and China, consumption inequality is seen to decrease to a contractionary monetary policy throughout the period following the shock. Income inequality increase following a contractionary monetary policy shock implies that the channel of transmission is through savings redistribution and earnings heterogeneity. Savings redistribution channel is expected to increase consumption inequality as well. So if the channel of transmission is indeed savings redistribution, it cannot have a negative effect on consumption inequality, leading to an ambiguity in the identification of channel. In explanation to this, it can be said that the effect can be different due to certain country specific characteristics such as the existence of financial development threshold and inflation threshold as pointed out in the literature. To support this with empirical evidence is beyond the scope of the study. But as a major

finding of this thesis, it can be said that there are factors beyond the transmission channels that can influence the responses of consumption inequality although income inequality's response may be in line with savings redistribution and earnings heterogeneity channel. It is definitely important to understand country specific characteristics to clearly understand the channel through which monetary policy affects both income and consumption inequality. For Russia, the response of consumption inequality is seen to be almost nil indicating that monetary policy does not have effect on consumption inequality and only increases income inequality. Similarly, for the case of South Africa, the effect of contractionary monetary is seen to be marginal on consumption inequality while it significantly increases income inequality. Only for the case of Brazil, the effect is in line with expectations indicating a strong presence of earnings heterogeneity channel. In Russia, since there is almost nil effect on consumption inequality, the channel of transmission is in line with earnings heterogeneity channel since savings redistribution channel affects both income and consumption inequality while the earnings heterogeneity channel talks only about income inequality. In South Africa and Brazil, the effect is seen to be in line with savings redistribution channel with both the income and consumption inequality positively in response to contractionary shock in monetary policy. Only for the case of China, the channel of transmission cannot be concretely identified due to the fact that there is ambiguity in the results. The understanding from the findings is that to establish the channel of transmission of monetary policy shocks to inequality can be concretely understood after looking at the country specific characteristics.

5.1 Limitations of the Study and Further Scope

The study focuses on understanding the effect of monetary policy shocks on income and consumption inequality in the case of the BRICS nations. The primary limitation of the study is that it fails to make a single panel version of the results in order to understand the panel dynamics. The hyperinflation situation in Russia and Brazil is seen to distort the results. Different method inflation measures can be used to see if the results are better. This can be used to generate a single panel that is balanced. Secondly, the method of identifying the monetary policy shocks is used using recursive identification method. The literature points out various other identification strategies which can be useful to generate a more advanced analysis. Thirdly, the inequality measure can be studied using other measures instead of gini index such as top 1% share of income or top 5% share of income which gives a better idea as to which section of the high income group reacts to monetary policy shocks in what way. Another limitation of this study is that it interpolates quarterly data for inequality using annual data. This is done to increase the amount of observations to estimate the model without losing the degrees of freedom. The availability of household survey data will be of an added advantage in case of getting quarterly data for the set which will enable us to get the actual figures instead of projections. Unfortunately, household survey data used only in the case of advanced economies and not developing nations. A further scope of study could be directed to find out how the economic performance can affect the channel of transmission. The results, particularly for the case of India and China are seen to be unsuccessful in explaining the difference in the response of consumption inequality from what is expected.

From the literature, it is pointed out that country specific characteristics such as financial threshold have significant effect on the response of consumption inequality to monetary policy shocks. The limitation of this study is that it fails to provide empirical support to this statement. Further studies can take up the case of India and China and estimate if there is any significance of the financial threshold to the response in consumption inequality. Various studies have pointed out that the financial development in the economy, position of business cycle etc have significantly affected the transmission mechanism of monetary policy to income inequality. Lastly, it is observed that the effect of monetary policy is not robust for a change in monetary policy measure. A more robust measure of monetary policy can be adopted like a monetary policy index using different monetary policy instruments for each country, which can be better to yield robust results and also to see a better picture rather than to just rely on one instrument.

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