Monetary Policy, Inequality and Financial Markets

By

Nwafor Chioma Ngozi

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Department of Economics

Adam Smith Business School

University of Glasgow

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Abstract

This thesis examines the reaction of monetary policy to income inequality and the effect of asset price changes and financial sector development on income inequality. The actions of monetary authorities in the U.S and elsewhere during the financial crisis period have had a major impact on financial markets. Given that financial asset prices respond quickly to new information about monetary policy shifts, the Fed's low interest rate policy stance that started in August 2007 led to a significant increase in asset prices, particularly stock prices. Stock prices appreciation transfers wealth to those households who already own stocks; generally speaking, the wealthier American households. Consequently, it is important to examine empirically the dynamics of monetary policy, asset prices and financial development on income inequality. First, we examined the response of monetary policy to income inequality. We tried to provide empirical answers to the following questions; is there any evidence that monetary policy responds to income inequality? If there is evidence of such a response, what is the nature-symmetric or asymmetric? Secondly, is there any significant relationship between changes in stock prices and income inequality? Thirdly, what are the implications of financial sector development on income inequality?

This area of literature draws from monetary economics, financial economics and welfare economics disciplines, and has become increasingly important given the massive levels of income inequality that is witnessed around the world. Chapter 2 of this thesis looks at the reaction of monetary policy to income inequality using data from the U.S. We provided evidence of a positive and significant reaction of monetary policy to income inequality measured using the income share accruing to the top 1 percent income earners. We also found evidence of asymmetric reaction of monetary policy to the income of the top 1 percent between 1960 and 2009. In chapter 3 we focused on the role of asset prices on income inequality using data from the U.S. We found that stock market developments and income of the top 1 percent wage earners are well integrated with the direction of causality running from stock returns to top 1 percent income share. One of the practical policy implications of this finding is that monetary policy stance that is directed towards the propping up of asset prices will have a concomitant effect on the income of the top 1 percent income earners.

Also in chapter 3 we used the Generalized Methods of Moment GMM to examine the reaction of inequality measured using the income share of the top 1 percent, the bottom 90 percent and the lowest fifth percent households to changes in asset prices. Our task here is to examine whether changes in both financial and non-financial assets affects everyone in the top and bottom of the income distribution the same way, or if there are remarkable differences on how these variables affect individuals within the top and bottom income percentiles. Our results detected widespread and subtle effects of asset prices on income at the selected percentiles of the income distribution**.** These findings hold practical implications for policy makers because the distribution of stocks and homes has important consequences on who benefits from asset prices appreciation and who is hurt by its depreciation. Finally in chapter 4 we analysed the distributional consequences of financial sector development on income inequality using a large unbalanced dataset of 91 countries, classified according to World Bank's income categories. The results in almost all the models suggested that increasing access to credit for households will reduce income inequality. This finding is important in the light of the potential for using financial development as a policy tool to reduce the widening income inequality around the world.

Table of Contents

List of Tables

List of Figures

Author's Declarations

I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

Signature:

Name: Nwafor Chioma Ngozi

Chapter 1

Monetary policy transmission channels: Theoretical foundation

(Stock prices and inequality transmission channels)

1.0 Introduction

Economic models that evaluate the effects of monetary and financial sector policies mostly focus on the aggregate implications of these policies while paying little or no attention to the distributional implications. From a practical perspective we reckon that distributional consequences deserve attention given that financial markets are imperfect and usually incomplete and household's access to them is often limited. These imperfections[1]limit economic agents' access to financial markets to insure against idiosyncratic and systematic shocks thus exacerbating the distributional effects of aggregate macroeconomic fluctuations and associated policy responses. The impact of monetary and financial sector policies in both emerging market economies and advanced economies are subject to a unique set of constraints such as political economy constraints[2].

Prasad (2013) noted that the political economy that surround distributional effects of macroeconomic policy choices for advanced countries can sometimes lead to policy measures that reduce aggregate welfare[3].Indeed, the choice of monetary policy stance can

[1]If financial markets were complete, distributional consequences of monetary policies will not be a problem given that monetary policy will affect macroeconomic variables such as inflation and growth with few distributional implications. In addition, if households can effectively insure against household-specific income risk, then specific policy choices may have aggregate welfare consequences and limited distributional consequences.

[2]The political economy constraints as was noted by Prasad (2013) for a developing economy range from-lack of central bank independence, the need to maintain exchange rate stability and weak transmission mechanism as a result of shallow financial markets.

[3]This proposition is evident in the United States were wealthiest Americans exert more political influence than their low income counterparts, Page et al (2013) thus having decisive power over certain macroeconomic policies. Page et al (2013) provided documented evidence which seems to suggest that the U.S political system is increasingly dominated by wealthy interests and that this tilting of political life toward business and the wealthy has served to undermine economic mobility and policy making process. Prasad (2013) highlighted some policies with significant distributional consequences. According to him, certain policies have serious implications for small politically powerful groups; an example is in trade theory, where the benefits of free trade distributed broadly amongst the population but the costs of opening up to foreign competition are borne by a relatively small group. He therefore, argued that in the absence of redistributive

have differential impacts on net borrowers relative to net savers; if there is a market where households can insure against this source of income shock, then the distributional effects would be reduced. Given that such markets do not exist even in advanced economies with well-developed financial systems; macroeconomic fluctuations that may initially have only small distributional effects will tend to be magnified. In addition, financial sector policies such as the legal changes in the U.S and elsewhere that allowed financial institutions to compensate for higher risk by charging higher interest rates to so called 'sub-prime' customers is one example of financial policies with huge distributional implications. While this policy improved access for those households that were previously shut out of these markets, the high level of leverage within the low income households led to an unsustainable path which resulted in default and financial crisis. The crisis period (2007-2009) witnessed significant increase in credit card debt and home foreclosure rates as a result of the inability of households particularly low income households to service their debt obligations as they fall due. In addition, these households are the worst hit in periods of significant financial crises.

This view is supported by both old and recent empirical literatures which showed that crises tend to have asymmetric effects on households at different spectrum of the income distribution. For instance, Baldacci et al (2002) posits that balance of payment and banking crises lead to large increases in poverty and income inequality. Recent studies such as Dijk (2013) show that banking crises have large social costs, including adverse effects on health, education and poverty. A survey of literature have also shown that it is not only crises and recessions that have asymmetric impact on households at different parts of the income distribution but also policies that are adopted to counteract these adverse macroeconomic events may also have significant distributional effects, Domac (1999) and Prasad (2013).

In most developed economies, monetary and financial sector policies have become one of the main lines of defence against macroeconomic shocks; this is especially true in the light of the 2007-09 financial crises were national central banks employed different ranges of conventional and unconventional monetary and fiscal policies to counteract the effects of the crisis. In addition, the crisis witnessed the re-design of financial sector regulation and supervision that are aimed at strengthening the resilience of the financial sector by

mechanisms that mitigate the losses of those hurt by more open trade, the political clout of the potential losers can lead to policy choices that have adverse aggregate welfare consequences.

improving the quality and quantity of capital as well as introducing additional capital requirements[4]. These policy prescriptions employed by monetary and financial authorities around the world have expanded, necessitating an analytical examination of more than just the aggregate effects of these policies[5]. This thesis focuses on monetary and financial market policies that have distributional consequences from a short-term or business cycle perspective[6] rather than on the determinants of longer-term changes in income inequality.

This thesis has three main goals. First it attempts to provide detailed analysis of the effects of monetary policy actions on income inequality in the U.S. We achieved this objective by estimating a forward looking augmented Taylor Rule using GMM estimation approach. We sought to provide empirical answers to the question of whether the Federal Reserve reacts to income inequality; and if they do, is there a possibility of asymmetric reaction with respect to income inequality. We employed three measures of income inequality namely; the income of the top 1 percent, the 90/10 wage differentials ratio and the GINI index of income inequality. Our results suggest that the Fed does not only react to income inequality measured using the income of the top 1 percent; we also found the presence of asymmetry in the response of monetary policy to the income of this group.

This is because although monetary policy tightens during periods of prolonged income increases, the Fed did not increase interest rates high enough to curb the increase in income as they would cut rates in the event of a decline in income. This sort of asymmetric reaction is similar to Fed's reaction to stock prices. For instance, Ravn (2011) found that a 5percent drop in the S & P 500 index increases the probability of a 25 percent basis point interest rate cut by one third, while no significant reaction to stock price increases was identified. The

[4]The global financial crisis exposed the shortcomings of regulation and supervision by showing that regulators and supervisors were not fully able to detect the accumulation of risks in the financial system, Claessens and Kodres (2014). Consequently, Group of Governors and Heads of Supervision, the oversight body of the Basel Committee on Banking Supervision, endorsed proposals that are aimed at strengthening global capital and liquidity regulation referred to as Basel III. Basel III has new capital ratio standards that require banks to keep an amount of capital as a percentage of their exposure, as well as a risk in minimum capital requirements.

[5]Although we did not study the distributional consequences of conventional and unconventional monetary policy directly; however, we analyzed the response of monetary policy to changes in three measures of income inequality. We found a positive and significant reaction of the policy rate to changes in the income of top 1 percent of the earnings population in the U.S. This study provides important insight on how monetary policy reacts to changes in income inequality. We reckon that changes in monetary policy stance of the Federal Reserve can have distributional effects through its impact on asset prices particularly stock prices.

[6]The distinction between short-term fluctuations and long term trend is not always a very clear one. For example, extreme macroeconomic events such as financial crises might have both short and long term effects in terms of the distribution of income and indeed wealth in an economy.

lack of reaction to other measures of income inequality in this study could suggest an indirect reaction to stock market. This is because the income of the top 1 percent exhibits high level of correlation with the S&P500 stock index. In addition, the income of the top 1 percent is closely tied to the peaks and valleys of the stock market-see figure 3.1 in chapter 3 of the present study. The guiding intuition is this; since monetary policy affects financial markets particularly stock market and stock market in turn affects the income of households within the top end of the income distribution, it seems plausible to suggest that the reaction of monetary policy to the income of the top 1 percent measure of inequality could be an indirect reaction to the stock market. Plethora of both empirical and theoretical papers supports the notion of a statistically significant reaction of monetary policy to equity prices while the response of income inequality to changes in stock return is a less explored area.

This leads to our second objective, the role of asset prices on the income of top 1 percent, lowest fifth percent and bottom 90 percent income earners in the United States. Specifically, we tried to determine whether there is some sort of endogeneity in financial market development and the income of the top 1 percent by conducting pair wise Granger causality tests. The focus on top 1 percent income earners allows us to evaluate a special subset of questions regarding the extent to which asset prices are particularly pro-rich. Our central hypothesis is that developments within the financial asset markets particularly stock markets can explain in part the dynamics behind the growth in the income of top 1 percent income earners in the United States.

In addition, we analysed the relationship between asset prices and income inequality. We studied this question empirically by looking at how income of the top 1 percent responds to changes in both financial and non-financial assets. Using the GMM estimator we analyzed the relationship between income inequality measured using the income of the top1 percent, lowest fifth percent and bottom 90 percent of the earning population and financial and non-financial variables. Our analysis allows us to examine whether changes in both financial and non-financial assets affects everyone in the top and bottom of the income distribution the same way, or if there are remarkable differences on how these variables affect individuals within the top and bottom of the income spectrum. The analysis expands our understanding of what is driving the changes in the income share of the rich in the United States.

The finding of a unidirectional causality from stock returns to top 1 percent income earners seems to suggest that the reaction of monetary policy to the top 1 percent variable as

was established in chapter two of this thesis could be a reaction to financial market development as opposed to a direct reaction to changes in the income of this group of individuals. This finding in part motivates the third objective of this thesis; the link between financial market development and income inequality for a large unbalanced dataset of 91countries classified according to the income categories defined by the World Bank (high income, middle-income, and the lower-income countries). We employed three measures of income inequality namely the GINI index of gross and net income, and income share of top1 percent of the population.

We tried to provide answers to the following questions; does financial market development reduce income inequality? Is there any evidence that financial market development favours high income earners more than the low income earners? Can we spot major differences within countries based on their stage/level of economic development? Or is the effect the same around the world, irrespective of country peculiarities? Specifically, the null hypothesis tested in the analysis is that well developed financial markets reduce income inequality since efficient credit allocation will allow household choices and decisions to be made based on economic optimality rather than inherited wealth i.e. the linear negative influence hypotheses of Galor and Zeira (1993).

The rest of the chapter is structured as follows; in section 1.1 we analysed the asset price channel and its role in monetary policy transmission. Section 1.2 is a brief survey of existing theoretical literatures on monetary policy and stock prices Sections 1.3 analyzed in great detail the optimal monetary policy in the presence of asset price misalignments from their economic fundamentals. In section 1.4 we looked at optimal interest rate rule in the presence of asset price disequilibria. Section 1.5 presents the analysis of the inequality channel of monetary transmission and in section 1.6 we presented an overview of findings from the first empirical chapter of this thesis. Sections 1.7 and 1.8 are the summary of previous empirical literatures on stock prices and income inequality and financial sector development and income inequality respectively.

1.1 Asset price channel and its role in monetary policy transmission

Asset prices such as stock prices and property prices may not be the main goal or instrument of monetary policy in the U.S or elsewhere, they are nonetheless important for

its realization, given that they are a component of its transmission mechanism[7]. Changes in stock market prices can affect the aggregate economy via its effect on investment spending. For instance, According to Tobin-Q-model, higher stock prices will lead to high investment spending thereby, increasing aggregate demand and output. Consequently, an understanding of how monetary policy induced changes in asset prices affect income inequality and propagates to other parts of the economy is fundamental to a successful implementation of monetary policy.

The Monetary Policy Committee (MPC) in most advanced and developing economies central banks set the short-term interest rate[8] at which the central bank deals with the money market. The decisions about this short term interest rate affect the economic activity and inflation through several channels, which are described collectively as the "transmission mechanism" of monetary policy .In this section we study the monetary policy transmission mechanism with particular focus on the asset price or wealth channel of monetary transmission.

The special focus on the asset price transmission channel is because we believe that the connection of income inequality (measured using the income of the top 1 percent of U.S earning population) to monetary policy may be via the link between interest rates and asset prices. According to the discounted cash flow model, stock prices are calculated as the present value of expected future net cash flows. Changes in the stance of monetary policy play a critical role in determining stock returns by altering the discount rate used by stock market participants in the discounted cash flow model or by influencing their expectations of future economic activity.

[7] Different authors have defined the monetary policy transmission mechanism in different ways, for instance Taylor (1995) describes the monetary policy transmission mechanism as the process through which monetary policy decisions are being transmitted to the real sector defined as the Gross Domestic Product (GDP) and inflation. Ireland (2005) sees the monetary policy transmission mechanism as the process through which policy induced changes in the nominal money stock or the short-term nominal interest rate impact real variables such as aggregate output and employment. The Federal Reserve Bank of Boston in their own definition describes the monetary policy transmission mechanism as comprising series of channels that transmit monetary policy decisions through a cause-effect function to the real economy. According to them, policy actions and announcements affect expectations about the future course of the economy and the confidence with which these expectations are held, as well as affecting other market interest rates, exchange rates, equity prices, real estate prices, amongst others. These changes in turn affect the spending, saving and investment behaviour of individuals and firms in the economy.

[8] Short term interest rate is one of the main instruments of central banks' monetary policy oriented on price stability, the changing of which can have an impact on the level of consumer prices by means of its effect on asset prices.

Policy-induced interest rates increases imply both higher discount rates and lower future cash flows, therefore, contractionary monetary police regime should be associated with a reduction in the price of stocks because of the higher discount rate used to discount the expected future returns and/or lower expectation of future economic activity. In contrast, expansionary monetary policy environment which is associated with low interest rates is generally seen as periods of increased economic activity, and higher earnings for businesses in the economy. Furthermore, expansionary monetary policy will result in increase in the value of stocks because financial market participants tend to re-balance their portfolios in an environment of sustained low interest rates.

The basic idea is straightforward: expansionary monetary policy which lowers interest rates will make bonds less attractive relative to stocks. The resultant effect will be increased demand for stocks thus increasing stock prices. This was precisely the mechanism at work in the United States and most advanced economies at the start of the recovery from the global recession. Stocks have been a huge beneficiary of the low interest rates environment in the U.S.

The top 1 percent income earners have enjoyed the benefits of rising corporate profits and stock prices orchestrated by the low interest rate regime. According to Saez (2013), the top 1 percent of U.S families captured as much as 93% of the income gains reported since 2009. But how might monetary policy affect income inequality? Monetary policy actions can trigger changes in financing conditions in the economy as well as on market expectations. These changes may lead to adjustments in asset prices e.g. stock market prices. Given that the ownership of stocks is largely concentrated within the top income spectrum, monetary policy stance that results to a rise in stock prices will benefit those households with large portfolios of equities thus increasing their pre-tax income, further widening the gap between them and the non-stock market participants. Monetary policy induced stock market fluctuations have important impacts on household wealth and must be monitored closely to evaluate the stance of monetary policy. In what follows is a succinct analysis of the major transmission mechanisms that have been highlighted in the literature.

The interest rate channel is the main monetary transmission channel at work in conventional macroeconomic models. The operating procedures of most central banks are similar, although institutional details may differ slightly from country to country. The key

point is that the central bank[9] chooses the price (interest rate) at which it will lend high-powered money to private sector institutions. A change in this rate known as the official rate is transmitted to other short-term wholesale money-market rates. Banks will therefore, adjust their standard lending rates (base rates), usually by the same amount of the official rate. This action will affect the interest rates that banks charge their customers on different products. The basic idea in the interest rate channel is that given some degree of price stickiness, an increase in the nominal interest rates will translate to an increase in the real rate of interest and the cost of capital. These changes are expected to result to a delay in consumption or a reduction in investment spending, Rotemberg and Woodford (1997) and Clarida, Gali and Gertler (1999).

Bernanke and Gertler (1995) however, suggested that the macroeconomic response to policy-induced interest rate changes is considerably larger than that suggested by traditional estimates of the interest elasticities of consumption and investment. They argued that mechanisms other than the interest rate channel may also be at work in the transmission of monetary policy. Other alternative mechanisms include the wealth or asset price channel and expectations and confidence channels. The asset price or wealth channel is built on the life-cycle model of consumption developed by Ando and Modigliani (1963). In this model, households' wealth is a major determinant of consumption spending. According to Ando and Modigliani, the connection of households' wealth to monetary policy comes via the link between interest rates and asset prices.

A policy-induced interest rate increase reduces the market value of securities, such as bonds, equities and real estate, reducing household resources and leading to a fall in consumption. Asset prices also play a critical role, albeit in a different manner from that of the wealth channel in the broad credit channel developed by Bernake and Gertler (1989).In this model, asset prices are particularly important given that they determine the value of the collateral that firms and consumers may present when borrowing a loan.

According to Bernake and Gertler (1989), in "frictionless" credit markets, a reduction in the borrowers' collateral will not have any effect in investment decisions: however, in the presence of information or agency costs, deteriorating collateral values will increase the premium borrowers must pay for bank financing; this in turn will reduce consumption and

[9] A central bank derives the power to determine a specific interest rate in the wholesale money markets from the fact that it is the monopoly supplier of high powered money known as "base money" comprising notes and coin plus bankers' deposits at the central bank.

investment. Consequently, monetary policy induced changes in market interest rates may be exacerbated through this "financial accelerator" effect.

The bank lending channel is another monetary transmission path. Banks play a more central role in this channel and they rely on reservable demand deposits as an important source of funds. The bank lending channel was first conceived by Roosa (1951) and was explored and developed by Bernanke and Blinder (1988), according to this channel, a contractionary police stance that results in the reduction of aggregate volume of bank reserves, will reduce the availability of bank loans. Given that a larger population of households and firms rely heavily or exclusively on bank financing, a reduction in loan supply will reduce aggregate spending.

The expectations and confidence channel is hinged on the premise that changes in monetary policy stance can influence expectations about the future course of real activity in the economy, as well as the confidence with which those expectations are held. Such expectations may affect other sectors of the economy through, for instance, changes in expected future labour income, unemployment as well as sales and profits amongst others. In addition, such changes in perception will also affect participants within the financial markets. The direction of the effect of policy changes on expectations and confidence are somewhat ambiguous and hard to predict.

For example, a tightening of monetary policy rate could be interpreted as an indication that monetary policy makers believe that the economy is likely to be growing faster than initially thought thus giving a boost to expectations of future growth and also increasing confidence. On the other hand, the same policy stance could be interpreted as signalling that policy makers recognizes the need to slow the growth in the economy in order to maintain the inflation target, this could weaken expectations of future growth and lower confidence.

1.2 Theoretical background: monetary policy and stock prices

We will now focus our attention on the asset prices or wealth channel of monetary transmission mechanism. To set the stage for our discussions in this section, we will provide a brief analysis of the "dividend discount cash flow model" which provides important insights on the stock market effects of changes in monetary policy stance. A fundamental principle of this model is that rational stock market participants expect to get two types of cash flows from their investments- dividends during the holding period and an expected

price at the end of the holding period. Given that this expected price is determined by future dividends, the price of a stock is the present value of expected future dividend. Following the notations in Ioannidis and Kontonikas (2006), the discounted cash flow model predicts that the stock price $(S)_t$ is the present value of expected future dividends $\left(D_{i+j}\right)$. Under the assumption of constant discount rate (R), the stock price at time t can be written mathematically as:

$$S_t = E_t\left[\sum_{j=1}^{K}\left(\frac{1}{1+R}\right)^j D_{t+j}\right] + E_t\left[\left(\frac{1}{1+R}\right)^K S_{t+K}\right] \quad (1)$$

Where, E_t is the conditional expectation operator based on information that is available to stock market participants at time t, R is the rate of return used by the stock market participants to discount future dividends, and K is the agents time horizon i.e. stock holding period. To derive equation (1) above, Ioannidis and Kontonikas (2006), assumed that there exist an investor with two alternative investments opportunities over a single period horizon: either to invest in a stock with expected gross return;

$$E_t\left[\frac{S_{t+1}+D_{t+1}}{S_t}\right] \quad (2)$$

or a risk-free bond with constant nominal gross return,

$$1 + R \quad (3)$$

The law of arbitrage implies that for the investor to be indifferent between the two alternative investments, both must yield the same expected return given as,

$$E_t\left[\frac{S_{t+1}+D_{t+1}}{S_t}\right] = 1 + R \quad (4)$$

solving forward the resulting expectational difference equation (4) yields equation (1) above. According to the standard transversality condition[10], as the horizon K increases the second term in the right hand side of equation (1) vanishes to zero i.e. a situation of no rational price bubbles,

$$\lim_{K\to\infty} E_t\left[\left(\frac{1}{1+R}\right)^K S_{t+K}\right] = 0 \tag{5}$$

Consequently the present value model is obtained;

$$S_t = E_t\left[\sum_{j=1}^{K}\left(\frac{1}{1+R}\right)^j D_{t+j}\right] \tag{6}$$

Eq. (6) implies that a change in monetary policy will affect stock returns in two major ways. First, it will have a direct effect on stock returns by changing the discount rate used by stock market participants in the model eq. (6). Contractionary monetary policy that results in a raise in interest rate will increase the rate at which the future values of firm's cash flows are capitalised leading to a reduction in stock prices. Fuhrer (1995) showed that the U.S monetary policy instrument the federal funds rate constitutes a source of major change for many long term market interest rates. Since the discount factors used by market participants are linked to market interest rates, a shift in the central bank's policy rate will also affect the discount factors because the central bank is able to influence market rates.

The second is an indirect effect via the relationship between interest rates and firms' future cash flows. A change in monetary policy rate is expected to affect a firms' stock value by altering expected future cash flows.

For instance, monetary policy easing is expected to increase the overall level of economic activity and stock prices will increase because of the expectations of higher expected future cash flows. This second channel assumes the existence of a link between monetary policy, the stock market and the real economy. Monetary transmission mechanism

[10] According to Kamihigashi (2006), transversality conditions are optimality conditions that are generally used with Euler equations to characterize the optimal paths of dynamic economic models. Kamihigashi (2006) suggests that a transversality condition enables an individual to single out the optimal path among those satisfying the Euler equation. Euler equation on the other hand is the condition that no gain can be achieved by slightly deviating from an optimal path for a short period of time.

literatures highlight four different channels through which fluctuations in the stock market may impact aggregate demand, the four channels are discussed in turn below;

Stock market effect on investment: Tobin's q[11] is defined as the ratio between a physical asset's market value[12] and its replacement value. Essentially, it is the market value of firms divided by the replacement cost of capital, Tobin (1969). This theory provides an important mechanism for how changes in stock prices can affect the economy. According to Tobin (1969), if q is high, the market price of firms is high relative to the replacement cost of capital, and new plant. In other words, high Tobin's q provides an incentive for companies to invest more in capital because they are worth more than the share price they paid for them. Companies can then issue stock at a high price relative to the cost of the facilities and equipment they are buying. Investment spending will therefore rise because the company can buy more new equipment with a small issue of stock.

The main point of Tobin's q[13] model is that there is a relationship between stock prices and investment spending. Monetary easing that make stocks more attractive than other alternative risk-free assets like bonds will result in an increase in stock prices, higher stock prices will lead to higher investment spending, aggregate demand and output thus leading to the transmission mechanism described by the following representation:
$M \uparrow \Longrightarrow P_s \uparrow \Longrightarrow q \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow$ where $(M \uparrow)$ indicates monetary easing, resulting to a rise in stock prices $(P_s \uparrow)$, this rise will increase Tobin $(q \uparrow)$, resulting to an increase in investment $(I \uparrow)$, thus leading to increase in aggregate demand and output $(Y \uparrow)$.

Firm balance sheet effect or credit view[14]: this transmission channel operates via the impact that improved firm's balance sheets have on investment. The presence of asymmetric information in credit markets implies that the ability of firms to borrow money depends on the value of the collateral they can offer. As the value of collateral increases, the ability to borrow and invest increases and vice versa. Expansionary monetary policy $(M) \uparrow$ that causes an increase in stock prices$(P_s \uparrow)$ along the lines described in this section increases the net

[11] $q = \frac{Market\ value\ of\ installed\ capital}{Replacement\ cost\ of\ capital}$

[12] For company whose stocks are quoted in the stock market, the market value of equity is calculated for a specific point in time by $(number\ of\ shares) \times (the\ company's share\ price)$.

[13] Tobin q assumes that firms finance investment by issuing equities (common stocks). In an environment of increasing stock prices, it becomes cheaper for firms to finance their investment because each share that is issued produces more funds. Therefore, a rise in stock prices will lead to increased investment spending.

[14] For a good survey of the credit view see- Bernanke and Gertler (1995), Cecchetti (1995), Hubbard (1995 and 2001) and Bernanke , Gertler and Gilchrist (1999).

worth of firms($NW \uparrow$), which reduces adverse selection and moral hazard problems and so leads to higher lending (L). Higher lending will result to higher investment spending and aggregate demand and output $(Y \uparrow)$.

Household wealth effects: This channel has been suggested by Modigliani (1971) and operates through the impact of wealth on household consumption. Modigliani's life cycle model states that consumption is determined by the lifetime resources of consumers. According to Modigliani (1971), an important component of households' lifetime resources is their financial wealth. Therefore, expansionary monetary policy$(M) \uparrow$ which raises stock prices$(P_s \uparrow)$raises the value of household wealth$(W \uparrow)$, thereby increasing the lifetime resources of consumers resulting to an increase in consumption$(C \uparrow)$. In an intertemporal model where households smooth consumption over time, wealth effects results to higher current and future consumption, stimulating aggregate demand and output.

Household liquidity effects: This is another way of looking at the balance sheet channel of monetary transmission. In the household liquidity channel, balance sheet effects work through their impact on household's desire to spend rather than on the lenders desire to lend, Mishkin (1976). In this channel, the possibility of households finding themselves in financial distress coupled with the asymmetric information about the quality of illiquid assets such as properties and consumer durables pushes households to hold more liquid financial assets like stocks which they could easily sell in the event of a negative income shock for their full value and raise cash.

As stock prices increases, the value of financial assets for households with large quantities of corporate stocks increases as well; consumer durable expenditure and investments residential home will also increase because these households have a more secured financial position and the possibility of finding themselves in financial distress is less likely. $M \uparrow \Rightarrow P_s \uparrow \Rightarrow Financial\ Assets \uparrow \Rightarrow C_d \uparrow, H \uparrow \Rightarrow Y \uparrow$, where C_d indicates a rise in consumer durable expenditure and $H \uparrow$ a rise in residential housing spending.

Plethora of empirical evidence has provided documented evidence on the stock price transmission channel. Thorbecke (1997) using different types of methodologies analyzed the relationship between monetary policy and stock prices in the United States. He found that expansionary monetary policy has a large and statistically significant impact on stock returns. In addition, Ioannidis and Kontonikas (2006), in a panel study found that in most of the countries examined a restrictive monetary policy stance decreases expected stock

returns. Rigobon and Sack (2001) employed an identification technique based on the heteroskedasticity of stock market returns to identify the reaction of monetary policy to the stock market. Their result suggested that monetary policy reacts significantly to stock market movements, with a 5% rise (fall) in the S&P 500 index increasing the possibility of a 25 basis point tightening (easing) by about a half. According to them, this reaction is roughly of the magnitude that would be expected from estimates of the impact of stock movements on aggregate demand. In addition, Wadhwani (2008) have argued that central banks can improve macroeconomic performance by reacting to asset price misalignments over and above their reaction to inflation forecasts. According to him, countercyclical monetary policy has the ability of offsetting the impact of such bubbles on output and inflation.

Our analysis thus far suggests that monetary policy has both direct and indirect effect on stock prices. The low interest rates environment since 2007 has encouraged investors to shift out of cash and into risky assets particularly equities. Monetary policy can affect wealth/income inequality through changes in asset prices and income flows. Majority of households in the U.S and elsewhere rely predominantly on labor incomes while for some other households, financial income, business income or transfers may be more important. Expansionary monetary policy that increases profits more than wages, will favor disproportionately families whose primarily source of income comes from business. As long as there is heterogeneity in economic agent's holding of financial assets, shifts in their prices will have an indirect effect on wealth distribution. Wolff (2012) in his analysis revealed that the richest 1 percent of American households held about half of all outstanding stock, financial securities, trust equity and business equity and 36 percent of non-home real estate in 2010.

In that same year, the top 10 percent owned more than 91 percent of all stock and mutual fund value as well as owning the vast majority of all the other investment asset categories. The remaining 9 percent were owned by the bottom 90 percent households. Given the uneven distribution of financial asset holdings, it seems inevitable that a rebound in stock prices would disproportionately favor wealthier income households. For instance, Fry and Taylor (2013) reported that the mean net worth of U.S households in the upper 7% of the wealth distribution rose by an estimated 28%, while that of households in the lower wealth spectrum dropped by 4% during the first two years of the nation's economic

recovery. According to them, these significant variations were driven by the fact that the stock market rallied during the 2009 to 2011 period while the housing market remained flat. In addition, the annual report from the Federal Reserve of St Louis reported that 62 percent of the wealth recovery through the end of 2011 has been the result of rising stock markets.

Wealthy households usually have their assets concentrated in stocks and other financial assets, while less affluent households have their wealth more heavily concentrated in the value of their residential homes. According to Fry and Taylor (2013) the differences in the performance of financial asset and housing markets from 2009 to 2011 explain most of the variances in the trajectories of income/wealth among high income and low income households.

1.3 Model of optimal monetary policy and asset price misalignments

In this section, we look at literatures that analysed the theoretical relationship between monetary policy and asset prices within the context of optimal policy rules. This analysis forms part of the theoretical foundation of the first empirical chapter of this thesis. As we alluded in the previous section, low interest rate environment can foster stock price bubbles, due to excessively optimistic expectations of higher expected future cash flows. However, the negative macroeconomic consequences from bubbles bursting and financial imbalances unwinding has led some commentators to question the monetary policy orthodoxy of exclusive focus on price stability, with its role in preventing financial instability restricted to policies that mitigate the fallout when it occurs, Greenspan (2002).

The aftermath of the sub-prime mortgage collapse and the wider correction to stock value and other asset prices at the peak of the collapse has seen the re-emergency of the debate on whether it is appropriate for monetary policy to react to asset price movements and/or financial imbalances over and above their effects on inflation expectation. Large numbers of both empirical and theoretical papers have tried to provide answer to this question by developing macroeconomic models where aggregate demand is affected by both household consumption wealth and balance sheet effects. Cecchetti et al (2006) and Kontonikas and Ioannidis (2005) argued that reaction of interest rates to asset price misalignment from fundamentals can reduce overall macroeconomic volatility. Indeed, Crockett (2003) suggested that monetary regime with an exclusive focus on short-term inflation control may be insufficient protection against the build-up of financial imbalances

which forms a fundamental element of financial instability. In his view, monetary authorities should tighten monetary policy sufficiently pre-emptively to lean against excessive credit expansion and asset price misalignments.

In addition, empirical evidence by Kontonikas and Montagnoli (2004), using data from the United Kingdom and Chadha et al (2003) in a panel analysis of United Kingdom, United States and Japan provided evidence in favour of the inclusion of asset prices as elements of central bank's reaction function. Majority of the empirical papers sighted above based their analysis on the augmented Taylor rule, where the nominal interest rate responds positively to inflation, demand pressures and asset prices. Our thesis is that monetary policy induced asset price inflation can feed-back into further income and wealth inequality. This is because households within the top spectrum of the income distribution constitute bulk of financial market participants. Consequently, an additional monetary response to asset price movements which in turn affect the income of the top 1 percent can narrow the income gap and reduce inequality, albeit in the short-run.

Using a structural backward-looking model of a closed economy where asset prices affect future inflation indirectly, through wealth effects on aggregate demand, Kontonikas and Montagnoli (2006) showed that optimal monetary policy should systematically respond to the non-fundamental component of asset prices. Their model expanded the standard Ball (1999) and Svensson (1997) specification by including asset prices which are assumed to evolve stochastically via the influence of fundamental and non-fundament (momentum trading) factors. The model is represented by the following equations:

$$\pi_{t+1} = \pi_t + ay_t + \varepsilon_{t+1}, \quad (7)$$

$$y_{t+1} = \beta_1 y_t - \beta_2(i_t - E_t[\pi_{t+1}]) + \beta_3 q_t + \eta_{t+1}, \quad (8)$$

$$q_t = q_t^* + q_t^{NF} = q_t^* + b\Delta \mathrm{q}_{\mathrm{t-1}}, \quad (9)$$

$$q_t^* = -\delta_1(i_t - E_t[\pi_{t+1}]) + \delta_2 E[y_{t+1}] + u_t, \quad (10)$$

Equations (9) to (10) represent the structure of the economy. Where y_t is the deviation of log output from its steady-state level (output gap), π_t is the deviation of inflation rate from target, i_t is the monetary policy instrument (one-period nominal interest rate), q_t denotes log of real asset prices and q_t^* the fundamentals. In Kontonikas and Montagnoli (2006) q_t is defined as an equity index. $\varepsilon_{t+1}, \eta_{t+1}, u_t$ represent exogenous random shocks to aggregate demand, inflation and asset price fundamentals. The random disturbances in this model are assumed to be mutually uncorrelated $i.i.d$ processes with zero means and constant variances.

Equation (7) is a standard accelerationist backward-looking "Non-Accelerating Inflation Rate of Unemployment" (NAIRU) type Philips Curve where the change in inflation is a positive function of lagged output gap and the inflation shock. Rudebusch (2002) considered a hybrid Philips curve:$\pi_{t+1} = \mu_\pi \pi_t + (1 - \mu_\pi) E_{t+1}[\pi_t + 2] + a y_{t+1} + \varepsilon_{t+1}$, he opines that accelerationist Phillips curve ($\mu_\pi \approx 1$) can be derived from models of price-setting behaviour. The inclusion of inflation inertia in the inflation equation means that disinflations will be costly with respect to the output losses; therefore, there exists a trade-off between inflation and output in the short-run. Equation (7) implies a vertical long-run Phillips curve since lagged inflation enters the model with a unity coefficient. Equation (7) provides no role for expected future inflation in the inflation adjustment equation. The sensitivity of inflation to excess demand is captured by the parameter a which is a positive constant.

Equation (8) the demand side equation posits that aggregate demand is a positive function of past level of asset prices via consumption wealth effects and investment balance sheet effects. For instance, a consistent increase in asset prices will reduce the perceived level of households' financial distress resulting in a boost in consumption spending. In the aggregate demand equation, parameter β_3 is very important because it indicates the size of asset price movements' effects on output. The absence of no wealth/balance sheet effects will result to $\beta_3 = 0$ and equation (8) will look like the conventional dynamic IS curve. In this model, monetary authority takes into account the impact of asset prices on aggregate demand; in other words, they take the effect of q_t on y_{t+1} and its magnitude into cognisance. This implies an assumption of symmetric information between financial market participants and the central bank. By conditioning y_{t+1} on q_t, the model allows the output

gap to be affected by both the fundamental (q_t^*) and the non-fundamental (q_t^{NF}) component of the asset price.

The dynamic evolution of asset prices q_t, and their underlying fundamentals q_t^*, is represented by equations (9) and (10). This dynamic evolution follows a partial adjustment mechanism where the observed asset prices are not always equal to their fundamental value. Equation (9) posits that actual asset prices is made up of two components namely, the fundamental q_t and the non fundamental component $q_t^{NF} = b\Delta q_{t-1}$. The non-fundamental component stipulates that, if asset prices have increased in the past ($\Delta q_{t-1} > 0$) there is a positive "momentum" effect on their current level ($b > 0$). Essentially, market participants bid up the demand for stock holdings in expectations that past capital gains will continue in the future. The size of b is crucially important in determining the divergence of q_t from its fundamental value q_t^*. For instance, if the value of b is very high, the stronger the effect from past asset price changes and therefore q_t can diverge[15] significantly from its fundamental value, q_t^* albeit in the short-run.

However, once the asset prices revert, at some unknown future date, the downward effect on aggregate demand could be bigger. According to Kontonikas and Montagnoli (2006) stability of the asset price path requires that the parameter b satisfies: $0 \leq b < 1$. Equation (10) represents the fundamental component of the asset price in line with the dividend asset pricing model. Therefore, the model postulate a positive effect from expected future dividends which is assumed to depend on expected output and a negative effect from real interest rates. A random disturbance term u_t is included in the fundamentals' process to account for uncertainty.

1.4 Optimal interest rate rule

The interest rate setting of the central bank in the model is such that the bank chooses the nominal interest rate i_t, that affects contemporaneous real asset prices, next period's output gap, and two-period ahead inflation while contemporaneous inflation and output gap are predetermined by the bank's previous interest rate decisions and current exogenous shocks. Once the model is solved, equations (7) to (10) can be written compactly as

[15] Note that in this model, the divergence of q_t form q_t^* is not regarded as an explicit bubble because the authors did not assign any probabilistic structure to its evolution, Kontonikas and Montagnoli (2006).

$$y_{t+1} = \varphi_t + v_{t+1}, \quad (11)$$

$$\pi_{t+1} = k_t + \varepsilon_{t+1}, \quad (12)$$

Where $\varphi_t \equiv \lambda_1 y_t - \lambda_2(i_t - \pi_t) + \lambda_3 b\Delta q_{t-1}$ is the control variable of the central bank, as π_t, y_t are predetermined when i_t is chosen and $k_t \equiv \pi_t + ay_t$ is the state variable at time t. The central bank's intertemporal quadratic loss function L in this model is assumed to penalize both inflation and output gap volatility:

$$L = \frac{1}{2} E_t \sum_{i=1}^{\infty} \tau^i [\pi_{t+i}^2 + \lambda y_{t+i}^2] \quad (13)$$

Where $\lambda \geq 0$ is the relative weight attached by the central bank on output stabilization. τ is the discount factor, $0 < \tau < 1$. Equation (13) which is the central bank's loss function reduces to a weighted average of the conditional volatility of inflation and output in the absence of the discount factor. It is apparent from equations 11 and 12 that at time t when the interest rate is chosen, the only state variable is k_t. Consequently, Kontonikas and Montagnoli (2006) defined the value function in terms of k_t only, $V(k_t)$. Substituting equations 11 and 12 the constraints in the value function and applying Bellman's dynamic programming principle they obtained:

$$V(k_t) = \min_{\varphi_t} E_t \left\{ \frac{1}{2} [(k_t + \varepsilon_{t+1})^2 + \lambda(\varphi_t + v_{t+1})^2] + \tau V(k_{t+1}) \right\} \quad (14)$$

The optimal path for the control variable φ is derived as:

$$\varphi_t = -\left(\frac{a\tau}{\lambda + a^2\tau}\right) k_t + \left(\frac{\tau\lambda}{\lambda + a^2\tau}\right) E_t[\varphi_{t+1}] \quad (15)$$

The solution to the model equation (15) is of this form $\varphi_t = ck_t$. In terms of the interest rate that is set by the policymaker, Kontonikas and Montagnoli (2006), used the definitions of $\varphi_t, k_t, \lambda_1, \lambda_2, \lambda_3$, and q_t to derive the optimal rule for the nominal interest rate i_t:

$$i_t = f_\pi \pi_t + f_f y_t + f_{q-q^*}(q_t - q_t^*) \quad (16)$$

Where $f_\pi = 1 - \frac{c(1-\beta_3\delta_2)}{\beta_2+\beta_3\delta_1}, f_y = a + \frac{\beta_1 - ca(1-\beta_3\delta_2)}{\beta_2+\beta_3\delta_1}$, $f_{q-q^*} = \frac{\beta_3}{\beta_2+\beta_3+\delta_1}$ are the weights on interest rate, inflation, output and asset price misalignments from their fundamentals respectively. According to the "Taylor principle" the inflation coefficient, f_π, should exceed the value of 1, to be sure that the real interest rate responds adequately to inflationary pressure.

Equation (16) is the rule for adjusting nominal interest rates that is the augmented Taylor rule; this rule predicts that the central bank should react to asset price misalignment. In the presence of wealth effects ($\beta_3 > 0$) monetary authorities should raise interest rates in response to higher misalignments $(f_{q-q^*} > 0)$ in addition to their reaction to inflation and output. Based on the discussions so far, it is evident that the optimal monetary policy reaction to asset prices depends on first the role of asset prices in the monetary policy transmission mechanism and secondly the source of the asset price changes. For instance, if asset prices increase is as a result of pure economic fundamentals ($\Delta q_t = \Delta q_t^*$), monetary policy will not react directly to asset price however, if the movement is as a result of non-fundamental factors such as excessive expectations of future economic developments or the so called "irrational exuberance" then optimal monetary policy will systematically respond to the non-fundamental component of asset prices increase.

Kontonikas and Montagnoli (2006) analysis shows that within the context of optimal central bank behaviour, asset price disequilibria should be an element in the monetary authority's feedback rule. In the absence of a relationship between aggregate demand and asset prices $\beta_3 = 0$ there will be no reason for monetary policy to react directly to asset prices misalignments $(f_{q-q^*} = 0)$ therefore the feedback rule which implements optimal policy takes the form of a standard Taylor rule with the interest rate being an increasing function of inflation and output gap.

$$i_t = f_\pi \pi_t + f_y y_t \quad (17)$$

Where the inflation and output gap weights are $f_\pi = \left[1 - \frac{c}{\beta_2}\right] > 1$, $f_y = \left[a + \frac{\beta_1 - ca}{\beta_2}\right] > 0$

Furthermore, if financial markets are efficient and observed asset prices are equal to their intrinsic value $(b = 0)$, there will not be any direct reaction of monetary policy to asset prices. In such a situation, monetary policy takes into account asset prices, indirectly with a lag through their demand wealth effects.

The analysis so far suggests that asset price misalignments should be given an explicit role in the central bank's reaction function and not just be considered as instruments to help predict future output and inflation. As stock prices are highly positively correlated with the top 1 percent income and since large ownership of equities is skewed toward the top of the income distribution, it seems plausible to argue that the top 1 percent can be used as proxy for the stock market. This view is consistent with some aspects of the heterogeneous agent, incomplete market model of Favilukis (2011) that showed that the observed pattern of stock prices has played a major role in increasing wealth inequality. In his model stock returns are positively correlated with changes in inequality since stock market participants are wealthier households and benefit disproportionately from a stock market boom. Taking these points into consideration, we conducted a formal test on the empirical relationship between top 1 percent household income and stock price returns in chapter three of this thesis. The result from the analysis showed that stock price changes can explain significantly variations in the income of the top 1 percent earning population in the United States.

Consequently, it seems that the reaction of monetary policy to the income of the top 1 percent, a segment of the population that is critical to understanding inequality in the United States could be a reaction to the stock market. The idea is that if interest rate is raised high enough to curb asset price misalignments from their fundamental values it will affect the income of these households thus narrowing the income distribution at least in the short-run. Furthermore, the assertion that the reaction of monetary policy to the top 1 percent income could be seen as a reaction to the stock market is further buttressed by the fact that the reaction of monetary policy to this variable is similar to that seen in most Taylor rule models augmented with asset prices see- Borio and Lowe (2002), Cecchetti et al (2000), Kontonikas and Ioannidis (2005) and Chadha et al (2003) amongst others as well as empirical literatures on asymmetric monetary policy reaction to stock prices.

In the case of asymmetric monetary policy reaction to asset prices, the central idea according to Greenspan (2002) is that monetary authorities should not respond to asset price bubbles but should stand ready to implement policies to mitigate the fallout from financial

imbalances typical of asset price booms unwinding when it occurs and, hopefully ease the transition to the next expansion-the so called "Greenspan put." In other words, it is not desirable for the central bank to increase interest rate in the presence of asset price disequilibria as suggested in the model we discussed above however, it is desirable for them to step in and provide liquidity in other to prevent stock prices from falling below the levels justified by the underlying fundamentals of the economy. Hoffman (2009) found evidence of asymmetric policy reaction to stock prices; according to her, the Fed lowered interest rates when stock prices fell, but did not raise interest rate in the boom period. In the case of the present study, we found a similar sort of asymmetry to the top 1 percent proxy for inequality.

1.5 The inequality channel of monetary transmission

Although our view is that the response of monetary policy to the income of the top 1 percent could be an indirect response to asset prices as opposed to a direct response to the income of this segment of the population. Some theoretical literatures have argued in favour of the inclusion of inequality in the central bank's reaction function. This school of thought hinge their argument on the premise that the choice of monetary policy rules such as inflation targeting, nominal GDP targeting, Taylor rule amongst others has effect on the variances of real GDP and inflation and therefore, has differential consequences for households in the different levels of the income spectrum. Furthermore, distributional outcomes affect the business cycle and influence the aggregate trade-offs faced by monetary authorities, these trade-offs, includes the rate of growth of aggregate output/unemployment as well as price stability.

Extending, Shapiro and Stiglitz's (1986), efficiency wage model to incorporate inequality, Furman and Stiglitz (2004) showed that higher unemployment results in greater inequality; and the marginal contribution to inequality from a given increase in unemployment is rising in the degree of initial inequality. According to them, the consequences of these relationships is that if there are adverse business cycle fluctuations, then a higher initial degree of inequality will exacerbate the adverse social and economic consequences of business cycle fluctuations. Therefore, the representative agent models, by assuming no inequality, may have significantly understated both the welfare cost of fluctuations and their implications for economic policy.

The theoretical paper of Areosa and Areosa (2006) provides insights into the inequality channel of monetary transmission. They incorporated inequality into the general equilibrium model with sticky price by introducing agents with different productivities, wages and financial market accesses into the model. Their model showed that there is a channel from interest rate to inflation through inequality and that the welfare-based objectives of monetary policy include inequality stabilization. In addition, they showed that higher levels of financial exclusion are associated to bigger welfare losses and to smaller interest rate variability. Thus providing explanation to why the observed interest rate paths are less volatile than optimal policies implied by most theoretical models of the monetary transmission. In what follows is an abridged analysis of Areosa and Areosa (2006) inequality channel of monetary transmission.

1.5.1 Model economy

The model economy comprises households, firms and the governments. There are two infinitely-lived household agents: financially excluded (FE) agents who do not own any assets and financially included (FI) agents that have access to financial markets. At time 0, financially included agents are endowed with capital stock of the economy and human capital; the financial excluded agents are endowed with only human capital. Financially excluded agents are assumed not to save. Therefore, financially included agents hold all of the capital the economy possesses in every period. Economic agents that are excluded from the financial system in this model are also unable to buy stocks and they receive differential treatment from the government. Consequently, only financially included consumers receive dividends and pay lump-sum taxes.

This assumption is in line with the evidence presented in this thesis. Using data from the Survey of Consumer Finance and PSID[16], Wolff (2000) showed that about one-third of U.S. households hold no investment assets at all, while another third holds only a minimum amount of liquid assets. The remaining third holds more than 90 percent of all investment assets. In this model, money is explicitly seen as a unit of account and therefore, does not appear in either the budget constraint or utility function. In addition, monetary policy is

[16]PSID is panel study of income dynamics by University of Michigan. It is a longitudinal survey of a representative sample of U.S individuals and families which started in 1968

specified in terms of an interest rate rule; as a result; money is not introduced overtly in the model. The Gini index for consumption is used in this economy as the inequality variable.

1.5.2 Households

The model assumes a continuum of infinitely-lived agents indexed in the unit interval. A fraction of households $\lambda \in (0,1)$ called financial excluded (FE) agents do not own any assets while the remaining fraction known as financially included (FI) agents $1-\lambda$ of households has access to financial markets. The letters "e" and "i" are used to index variables associated to FE and FI consumers.

The type k representative household preferences are represented by:

$$U_0^k \equiv E_0\left\{\sum_{t=0}^{\infty}\beta^t\left[\frac{\left(C_t^k\right)^{1-\sigma}}{1-\sigma}-\frac{\left(H_t^k\right)^{1+\omega}}{1+\omega}\right]\right\}, k \in \{e,i\}, \tag{18}$$

Where $0<\beta<1$ denotes the discount factor, C_t^k is an index of consumption goods and H_t^k is the number of hours worked at period t. These households offer labour in a perfectly competitive market with fully flexible wages. They equally buy differentiated goods in a retail market and combine these goods into a composite good using a Dixit and Stiglitz (1977) aggregator:

$$C_t^k \equiv \left[\int_0^1 C_t^k\,(\mathcal{Z})^{\frac{\theta}{\theta-1}}\,d\mathcal{Z}\right]^{\frac{\theta}{\theta-1}}, \theta>1, \tag{19}$$

Where $C_t^k(\mathcal{Z})$ is the demand for differentiated goods of type $\mathcal{Z}$. Type k household minimizes the total cost of obtaining differentiated goods indexed by a unit interval $[0,1]$, taking as given their nominal prices $P_t(\mathcal{Z})$. Cost minimization gives a demand curve of the form:

$$C_t^k(\mathcal{Z}) = C_t^k\left(\frac{P_t(\mathcal{Z})}{P_t}\right)^{-\theta}, \tag{20}$$

Where the aggregate price level P_t is defined to be

$$P_t \equiv \left[\int_0^1 P_t\,(\mathcal{Z})^{1-\theta}\right]^{\frac{1}{1-\theta}} \tag{21}$$

1.5.3 Financially included households

The financially included households in each period $t = 0,1,2,\ldots$, make a choice for consumption C_t^i, labour H_t^i and nominal bonds portfolio β_{t+1} to maximize equation (18) subject to a sequence of period budget constraints that must hold with equality in equilibrium:

$$E_t\{Q_{t,t+1}B_{t+1}\} \leq B_t + W_t^i H_t^i + \Pi_t^i - P_t C_t^i - T_t^i, \tag{22}$$

Where $Q_{t,t+1}$ is the stochastic discount factor used for computing the nominal value at period t of one unit of consumption goods at period $t+1$, W_t^i is the nominal wage rate for financially included households, Π_t^i denotes nominal dividend income, and T_t^i represents the nominal value of the net lump sum taxes.

In equilibrium, the following first order conditions must hold with a positive risk-free nominal rate of interest at period t, i_t:

$$1 + i_t = \left[BE_t\left\{\left(\left(\frac{C_{t+1}^i}{C_t^i}\right)^{-\sigma}\right)\frac{P_t}{P_{t+1}}\right\}\right]^{-1}, \tag{23}$$

$$\left(C_t^i\right)^{\sigma}\left(H_t^i\right)^{w} = \frac{W_t^i}{P_t}, \tag{24}$$

Regarding the fact that $E_t\{Q_{t\,t+1,}\} = (1+i_t)^{-1}$.

1.5.4 Financially excluded households

Households from this group are excluded from financial markets and do not own assets. These households maximize equation (18) subject to the budget constraint:

$$P_t C_t^e \leq W_t^e H_t^e, \quad (25)$$

Where W_t^e is the nominal wage rate for financially excluded households. Economic agents that are excluded from the financial system in this model are also unable to buy stocks and they receive differential treatment from the government. Consequently, only financially included consumers receive dividends and pay lump-sum taxes. Given that equation (25) holds with equality in equilibrium, financially excluded agents just consume their contemporaneous labour income. The associated first order condition is equivalent to equation (24):

$$(C_t^e)^{\sigma}(H_t^e)^{\omega} = \frac{W_t^e}{P_t}, \quad (26)$$

Combining equations (25) and (26) yields

$$(C_t^e)^{1-\sigma} = (H_t^e)^{1+\omega} \quad (27)$$

1.5.5 Firms

The goods market is made up of monopolistically competitive firms indexed in unit interval. Each of the firms in this model economy $\mathcal{Z}$ manufactures a differentiated good $\mathcal{Z}$ using Cobb-Douglas technology:

$$Y_t(\mathcal{Z}) = A_t[H_t^e(\mathcal{Z})]^q \left[H_t^i(\mathcal{Z})\right]^{1-q} \quad (28)$$

Where $Y_t(\mathcal{Z})$ denotes the level of output at period t of firm $\mathcal{Z}$ while $H_t^e(\mathcal{Z})$ and $H_t^i(\mathcal{Z})$ are the total number of working hours hired from each type of agent by this firm. The variable $A_t > 0$ is an exogenous technology factor while $q \in (0,1)$ and $1-q$ are the productivity factors associated with each type of agent.

Market clearing in this model is given as $Y_t(\mathcal{Z}) = \lambda C_t^e(\mathcal{Z}) + (1-\lambda)C_t^i(\mathcal{Z}) + G_t(\mathcal{Z})$, where $G_t(\mathcal{Z})$ represents government demand for goods produced by firm $\mathcal{Z}$. One of the assumptions of the model is that government purchases an aggregate G_t of form equation

(19) of all goods in the economy, consequently, the government's demand for each good $\mathcal{Z}$ is given by a demand curve equivalent to equation (20). Thus, the following demand curve for each good $\mathcal{Z}$ is obtained:

$$Y_t(\mathcal{Z}) = Y_t\left(\frac{P_t(\mathcal{Z})}{P_t}\right)^{-\theta}, \tag{29}$$

$Y_t \equiv C_t + G_t \equiv \lambda C_t^e + (1-\lambda)C_t^i + G_t$ is a composite index equivalent to those specified in equ. (19) that denotes aggregate demand. Given that the criterion for minimum cost is expressed by $W_t^e H_t^e(\mathcal{Z})/q = W_t^i H_t^1(\mathcal{Z})/(1-q)$, equations (28) and (29) are used to derive the number of working hours for each type of economic agent:

$$H_t^k \equiv \frac{1}{\lambda_k}\int_0^1 H_t^k(\mathcal{Z})d\mathcal{Z} = \frac{1}{\lambda_k}\left(\frac{1-q}{q}\right)^{qk}\left(\frac{W_t^e}{W_t^i}\right)^{qk}\frac{Y_t Z_t}{A_t}, k \in \{i,e\}, \tag{30}$$

Where $(\lambda_i, q_i) = (1-\lambda, q), (\lambda_e, q_e) = (\lambda, q-1)$, and $Z_t \equiv \int_0^1 \left(\frac{p_t(\mathcal{Z})}{p_t}\right)^{-\theta} d\mathcal{Z}$ is a dispersion measure for prices.

All firms face the same nominal marginal costs MC_t^n given by:

$$MC_t^n = \frac{1}{A_t}\left(\frac{W_t^e}{q}\right)^q\left(\frac{W_t^i}{1-q}\right)^{1-q} \tag{31}$$

To the extent that an individual's firm production function exhibits constant returns to scale and input prices are fully flexible in the perfectly competitive markets, its marginal cost does not depend on its output level.

1.5.6 Flexible-price equilibrium

The optimal pricing decision for any firm $\mathcal{Z}$ under flexible prices takes the conventional form:

$$P_t(\mathcal{Z}) = \frac{\mu}{1+\tau}MC_t^m, \tag{32}$$

Where $\mu = \frac{\theta}{\theta-1} > 1$ is the firm's desirable mark-up. The subsidy for output $0 \leq \tau < 1$ offsets the effect on imperfect competition in the goods markets on the steady state level of output. Combining equations (31), (24) and (26) yields the following expression for the real marginal cost:

$$MC_t \equiv \frac{MC_t^n}{P_t} = \frac{1}{A_t}\left(\frac{Y_t Z_t}{A_t}\right)^{\omega} (Y_t - G_t)^{\sigma} \Delta(\delta_t), \tag{33}$$

Where factor

$\Delta(\delta_t) \equiv \left(\frac{\delta_t^{\sigma}}{q(\lambda)^{\sigma+\omega}}\right)^{q} \left(\frac{(1-\delta_t)^{\sigma}}{(1-q)(1-\lambda)^{\sigma+\omega}}\right)^{1-q}$ is a function of δ_t, defined as the financially excluded agents' share of total consumption.

$$\delta_t \equiv \frac{\lambda C_t^e}{C_t} \tag{34}$$

Combining equations (32) and (33) yields:

$$\frac{P_t(Z)}{P_t} = \frac{\mu}{1+\tau}\frac{1}{A_t}\left(\frac{Y_t Z_t}{A_t}\right)^{\omega} (Y_t - G_t)^{\sigma} \Delta(\delta_t). \tag{35}$$

Equation (35) shows that relative prices depend on the distribution of consumption characterized by δ_t. Areosa and Areosa (2006) used a different definition of potential output in order to make this model comparable with the existing literature. Consequently, potential output, Y_t^f, defined as the output that would prevail under flexible wages and prices and under equal consumption, i.e. $C_t^e = C_t^i$, given current real factors such as technology, government purchases e.t.c., must satisfy:

$$1 = \frac{\mu}{1+\tau}\frac{1}{A_t}\left(\frac{Y_t^f}{A_t}\right)^{\omega} \left(Y_t^f - G_t\right)^{\sigma} \Delta(\lambda). \tag{36}$$

Inequality decreases the potential output Y_t^f since $\Delta(\lambda) > 1$. In addition, if there is an excess of unqualified people $\lambda > q$, Y_t^f decreases with λ. Condition $\lambda > q$ reflects that

there are more unqualified people than firms are willing to hire, increasing their costs. In this model, it is not possible to change the percentage of financially excluded consumers without changing the percentage of less qualified people. This explains why condition $\lambda > q$ links these two apparently distinct characteristics. Representing steady state values with an over bar, equation (36) reduces to

$$1 = \frac{\mu}{1+\tau}(\bar{Y})^{\omega+\sigma}\Delta(\lambda), \tag{37}$$

Where $\bar{A} = 1$ and $\bar{C} = \bar{Y}$. The equal consumption flexible-price equilibrium output level expressed in terms of percentage deviations around the steady state, is expressed as

$$\hat{Y}_t^f = \frac{\sigma\hat{G}_t+(1+\omega)\hat{A}_t}{\omega+\sigma}, \tag{38}$$

Equation (38) is the same expression for the natural rate of output in the standard New Keynesian framework, being $\hat{Z}_t \equiv (Z_t - \bar{Z})/\bar{Z}$ for all variables Z_t, except for $\hat{G}_t \equiv G_t/\bar{Y}$.

1.5.7 Dynamic equilibrium

To analyze the transition dynamics, Areosa and Areosa (2006) derived the log-linear version of the model around a steady state with zero inflation, equal consumption for all economic agents, without government spending ($\bar{C}^e = \bar{C}^i = \bar{C} = \bar{Y}$). In the log-linear model, firms set prices as in the sticky price model of Calvo (1983), this allows for the real effects of monetary policy. During each period, a fraction α of firms are not allowed to change prices, while the other 1-α, is allowed to change prices.

1.5.8 IS curve and inequality evolution

An intertemporal IS equation is used to represent the demand side of the model. This is the log-linear version of equation (23):

$$\hat{C}_t^i = E_t\{\hat{C}_{t+1}^i\} - \sigma^{-1}[\hat{\imath}_t - E_t\{\pi_{t+1}\}], \tag{39}$$

Where π_t is the inflation rate. Similarly, equations (27) and (30) are used to obtain:

$$\hat{C}_t^e = \left(\frac{1+\omega}{1-\sigma}\right)\left[\hat{Y}_t - \hat{A}_t - \left(\frac{1-q}{1-\lambda}\right)\left(\frac{\sigma}{1+\omega}\right)\hat{\delta}_t\right] \quad (40)$$

The log-linearization of (34) yields:

$$\hat{\delta}_t = \hat{C}_t^e - \hat{C}_t \quad (41)$$

Defining $x_t \equiv \hat{Y}_t - \hat{Y}_t^f$ as the output gap measure and using equations (39) to (41), the following IS curve is obtained:

$$x_t = E_t\{x_{t+1}\} - \varphi\left[\hat{\imath}_t - E_t\{\pi_{t+1}\} - r_t^f\right], \quad (42)$$

Where $\varphi \equiv \eta\sigma^{-1}$ and $\eta \equiv 1 + \frac{\lambda(\omega+\sigma)}{1-q\sigma-\lambda(1+\omega)}$. The real interest rate that stabilizes the output gap, r_t^f, called the natural rate of interest evolves according to:

$$r_t^f \equiv \varphi^{-1}\left[\left(\frac{1+\omega}{\omega+\sigma}\right)\eta E_t\{A_{t+1} - A_t\} + \left(\frac{1-(1+\omega)\eta}{\omega+\sigma}\right)E_t\{\hat{G}_{t+1} - \hat{G}_t\}\right] \quad (43)$$

The slope of the IS curve changes from positive to negative when financial exclusion changes from high to low. This is in line with Bilbiie (2005). It is important to mention that η also varies with q in this model. If $\eta > 1$, the impact of the interest rate on the output gap is more intense than in the standard New Keynesian model.

Equations (40) and (41) is combined to write $\hat{\delta}_t$ as a function of x_t:

$$\hat{\delta}_t = \left(\frac{1}{1+\gamma}\right)\left[(\sigma + \omega)x_t + \hat{G}_t\right], \quad (44)$$

Where $\gamma \equiv \sigma\left(\frac{\lambda-q}{1-\lambda}\right)$. The Gini index for consumption given by $g_t = -\lambda\hat{\delta}_t$, is used in this economy as the inequality variable[17]. The evolution of the Gini index, obtained from

[17] If contemporaneous consumption C_t is normalized to unity, or 100 percent of consumption and imposing that $C_t^e < C_t^i$ the model yields $g_t = -\lambda\hat{\delta}_t$. If on the other hand $C_t^e > C_t^i$ then $g_t = \lambda\hat{\delta}_t$. The Gini index

the substitution of equation (44) from the IS curve and the replacement of $\hat{\delta}_t$ as a function of g_t, provides an insight on how monetary policy affects inequality.

$$g_t = E_t\{g_{t+1}\} + \varphi^{\delta}\left[\hat{\imath}_t - E_t\{\pi_{t+1}\} - r_t^{\delta}\right], \tag{45}$$

Where $\varphi^{\delta} \equiv \eta^{\delta}\sigma^{-1}$, $\eta^{\delta} \equiv (1-\lambda)(\eta-1)$ and r_t^{δ}, the real interest rate that stabilizes g_t is defined as

$$r_t^{\delta} \equiv r_t^{f} - \frac{\varphi^{-1}}{\omega+\sigma} E_t\{\hat{G}_{t+1} - \hat{G}_t\} \tag{46}$$

If $\eta > 1$, inequality increases with the interest rate. The difference between the real interest rates that stabilize the output gap and the Gini index is based on the evolution of government spending.

1.3.2 New Keynesian Philips curve

Calvo (1983) model results to an aggregate supply of the form given in equation (47):

$$\pi_t = \xi \widehat{MC}_t + \beta E_t\{\pi_{t+1}\} \tag{47}$$

Where $\xi \equiv (1-\alpha)(1-\alpha\beta)/\alpha > 0$ and $\widehat{MC}_t$ is the percent variation of real marginal costs. A log-linearization of the real marginal costs expressed in equation (33) yields:

$$\widehat{MC}_t = (\omega+\sigma)x_t + \frac{\gamma}{\lambda} g_t \tag{48}$$

Equation (48) stipulates that marginal costs are proportional to the output gap that would occur if consumption of both financially included and financially excluded agents

thereafter, is given by $|\lambda\hat{\delta}_t|$, which assumes only positive values as a measure. In this model, it does not matter for inequality measured using Gini index of consumption that agents consumes more, what matters is the consumption differentials amongst agents. Areosa and Areosa (2006), defines $g_t = -\lambda\hat{\delta}_t$. The sign helps to identify which agents are increasing their consumption. Inequality is said to be increasing if financially excluded agents are reducing their consumption.

were equal. The second term in equation (48) corrects this measure by the inequality effect. Combining equations (47) and (48) yields the New Keynesian Phillips curve (NKPC).

$$\pi_t = kx_t + \beta E_t\{\pi_{t+1}\} + k^{\delta} g_t \tag{49}$$

Where $k \equiv \xi(\omega + \sigma)$ and $k^{\delta} \equiv \xi\gamma/\lambda$

Combining equations (44) and (47) yield the New Keynesian Phillips Curve (NKPC) in a more familiar format:

$$\pi_t = k^{*} x_t + \beta E_t\{\pi_{t+1}\} + u_t \tag{50}$$

Where $k^{*} \equiv k\left(\frac{1}{1+\gamma}\right)$ and the shock u_t is given by:

$$u_t \equiv -\xi\left(\frac{\gamma}{1+\gamma}\right)\hat{G}_t \tag{51}$$

Result 1 (Inequality channel) Equation (45) which shows how monetary policy affects inequality, with equation (48), the inequality augmented NKPC, lead to the first inequality channel of monetary transmission that predicts a channel from interest rate to inflation through-out inequality when λ ≠ q. According to this channel, if there is an excess of unqualified people $(\lambda > q)$, inflation increase with inequality $\left(k^{\delta} > 0\right)$. Financial exclusion (λ) decreases the inequality-inflation trade-off $\left(k^{\delta}\right)$. On the other hand, if $\lambda > q$, the output-inflation trade-off is higher than in the standard New Keynesian model $(k^{*} < k)$. Furthermore, a shock u_t arises as a function of the share of government spending that impact the real interest rate that stabilizes inequality r_t^{δ} but not the natural rate of interest (r_t^{f}).

1.5.9 Optimal monetary policy

The policy objective function is derived by taking a second-order approximation of the aggregate utility of all agents given by:

$$W_0 = \lambda U_0^e + (1-\lambda)U_{0,}^i \quad (52)$$

Where U_0^e and U_0^i are defined in equation (18).
This yield:

$$W_0 = -\Omega E_0\{\sum_{t=0}^{\infty}\beta^t L_t\} + tip \quad (53)$$

Where "*tip*" denotes terms independent of the actual policy such as constants and terms involving only exogenous variables while L_t. The central bank's intertemporal quadratic loss function, *L* penalizes both inflation, output and inequality:

$$L_t \equiv \lambda_x X_t^2 + \lambda_\pi \hat{\pi}_t^2 + \lambda_\delta g_t^2 \quad (54)$$

Where $\lambda_{x,}\lambda_\pi$ and λ_δ are functions of the structural parameters of the model and $\lambda_x + \lambda_\pi + \lambda_\delta = 1$.

Result 2 (inequality objective) According to equation (54) the objective of a monetary policy that is consistent with welfare maximization should include inequality stabilization g_t^2, as well as inflation and output gap stabilization ($\hat{\pi}_t^2 \; and \; x_t^2$). In addition, the relative importance of g_t^2 on loss function L_t decreases when the two types of agents (financially excluded and financially included agents) are equally represented, monetary authorities should not pay too much attention to variations in inequality and should rather direct their attentions to the evolution of inflation and output gap. The results from Areosa and Areosa (2006) corroborates the findings of Fowler (2005) that found empirical evidence that a Gini based monetary feedback rule is compatible with several features of the U.S economy.

Maximizing equation (53) subject to the constraints in equation (49) and the equation that determines the dynamics of g_t in equation (33) provides the following criterion under commitment:

$$\hat{\pi}_t = -\frac{1}{k*\theta}\left[k(x_t - x_{t-1}) - \Psi\left(\frac{\eta^\delta}{\eta}\right)(g_t - g_{t-1})\right] \quad (55)$$

Equation (55) is the optimal target criterion which represents a policy rule that is optimal from a timeless perspective, Giannoni and Woodford (2005). This suggests that inflation should be accepted as long as it is negatively proportional to changes in output gap corrected for variations in inequality over the same period. According to Areosa and Areosa (2006) it is not optimal to maintain zero inflation and a zero output gap in the face of variations in inequality. If $\lambda > q$, the coefficient on x_t in first order condition $k(k^*\theta)^{-1} = (1+\gamma)\theta^{-1}$ is greater than standard value θ^{-1}.

The optimal policy within this context results in greater inflation variability for a given level of variations in output gap in the presence of inequality. The key intuition is that stabilizing inflation will become more costly if $\lambda > q$. As $\hat{\imath}_t$ increases, x_t decreases, and this serves to reduce inflation. However, the direct effect in g_t of the increase in the nominal interest rate partly makes up for the deflationary impact of a contractionary monetary policy. Equilibrium variations in inflation will be higher given that it is more costly in terms of the output gap to control inflation.

To implement the target rule, the authors obtained an optimal instrument rule via the substitution of equations (42), (45), and (47) in the optimal criterion equation (55):

$$\hat{\imath}_t = \emptyset_\pi E_t\{\pi_{t+1}\} + \emptyset_x E_t\{x_{t+1}\} + \emptyset_\delta E_t\{g_{t+1}\} + \emptyset_{x-1} x_{t-1} + \emptyset_{\delta-1} g_{t-1} + \epsilon_t \qquad (56)$$

Where the $\acute{\emptyset}_j^s$ are functions of the structural parameters of the model while composite shock ϵ_t is defined according to

$$\epsilon_t \equiv \varphi \emptyset_x r_t^f - \varphi^\delta \emptyset_\delta r_t^\delta, \qquad (57)$$

Which is the average weight of the natural rate of interest and the real interest rate that stabilizes g_t. In line with Evans and Honkapohja (2006), equation (56) is the expectation-based reaction function. According to Areosa and Areosa (2006), if monetary policy authority commits itself to set interest rates according to this reaction function at all times, then the rational-expectations equilibrium is necessarily determinate. They opined

that substituting equation (55) in equation (57) will result to a similar model in Woodford (2003b) and therefore, the result applies.

Calibrating the models represented by equations (42), (45), (49) and (57), and solving them numerically, Areosa and Aerosa (2006) showed that under the optimal plan, higher levels of financial exclusion are associated to bigger welfare losses and that the impact of the interest rate on inequality, η, and output gap, η^{δ}, increases with λ. Furthermore, they showed that inflation stabilization becomes more costly at the same time, since nominal interest rate generates opposite impacts on g_t and x_t. Consequently, the equilibrium variation of $\pi_t, x_t,$ and g_t becomes very high. Their result suggests that welfare loss and interest rate variability evolve in opposite directions with financial exclusion under the optimal plan. The authors suggested that interest rate volatility is avoided in their model because of its impact on inequality, that increases with λ that is financial exclusion. Their model provides explanation on why the observed interest rate paths are much less volatile than optimal policies implied by macroeconomic frameworks.

From the perspective of economic agent's decisions, an increase in interest rate orchestrated by the monetary shock will cause financially included (FI) agents to shift consumption and save. In addition, market clearing forces will cause firms to reduce their production and consequently, the demand for labour and wages paid to both agents. A reduction in wages and working hours will cause financially excluded (FE) agents to reduce their consumption as well since they channel all their current labour income to consumption.

The theoretical model of Areosa and Areosa (2006) expands our understanding of how monetary policy may affect inequality. By incorporating inequality into the standard New Keynesian framework and introducing two types of agents with different productivities, wages and access to financial markets, they showed that monetary policy influences both output gap and inequality which in turn affect inflation. In addition, they derived a welfare-based loss function for the monetary authority that includes inflation, output gap and inequality and suggested that monetary policy influences both output gap and inequality, which in turn affect inflation.

An aspect of this theoretical analysis that is relevant to the current thesis is that monetary policy induced increase in financial asset prices will favour those agents that have access to financial markets and hold assets (referred to as financially included households FI) more than those agents that are excluded from the financial markets (financially

excluded households FE) thus, widening the income gap between them. Arguably, the FOMC's response to low levels of resource utilization at the depths of the global recession, by keeping its primary policy instrument, the federal funds rate, at very low levels and by initiating large-scale asset purchases contributed to a strong rebound in stock prices. As we showed in section 1.1.2 one of the channels through which these policies operate is by putting upward pressure on the prices of financial assets particularly stocks, thus benefiting those households with large quantities of such assets through either realized capital gains or high dividend payments. The finding of a positive and statistically significant reaction of income of the top 1 percent to changes in stock prices confirm the empirical relationship between stock prices and the income of households within the top income spectrum. This allows us to conclude that the reaction of monetary policy to the income of this segment of the population is an indirect reaction to the stock prices.

We further sought to infer the monetary policy preferences with respect to the top 1 percent income inequality proxy. We want to see whether the interest rate setting of Fed differs during periods of sustained increase and decrease in the income of top 1 percent income earners. Our aim is to determine whether monetary policy reacts to this measure of income inequality in a symmetric or asymmetric manner. Our result suggests the presence of asymmetry in the response of monetary policy to the income of this group. This is because the Fed did not increase interest rates high enough to curb the increase in income of the top 1 percent as they would cut rates in the event of a decline in their income. This sort of asymmetric reaction is similar to Fed's reaction to stock prices. This further confirms the high level of correlation between this variable and stock price.

1.6 Monetary policy and income inequality

Widening income inequality in both developed and developing countries pose one of the greatest challenges to policymakers. Although the study of income inequality-its causes, its consequences and its potential policy implications has a long history in economics, few researchers have studied empirically the reaction of monetary policy to income inequality and the causal relationship between inequality and asset prices. By exploring the reaction of monetary policy to income inequality and evaluating the causal relationship between income inequality and financial assets (particularly equities) our research establishes an empirical link between Fed's policies and income inequality. Our focus is on the ways in which

monetary policy-fuelled asset price increases[18] can feed-back into further income and wealth concentration.

The guiding intuition is that sustained expansionary monetary policy stance will greatly benefit the upper classes because of increase in the price of their large holdings of corporate equities, due for the most part to low interest rates. Given that large ownership of equities is skewed toward the top of the income distribution, individuals at the top of the wealth distribution will take advantage of the strength in equity markets; therefore, steep rise in stock prices as a result of ease monetary policy or asymmetric reaction of monetary policy to stock prices will further increase the concentration of net worth and exacerbate inequality. Our findings bear implications for the 'leaning against the wind' and "mopping up" debate with regards to the response of monetary policy to asset price misalignments.

Like we mentioned in section 1.1, the interest rate channel is one of the main channels through which monetary policy affects aggregate demand, and also net borrowers as well as net savers[19]. The interest rate channel can reduce aggregate demand by reducing the consumption of both savers and borrowers. In carrying out its mandate of price stability and maximum employment, the Fed's action might affect households differently. This effect will depend amongst other things whether these households hold inflation-protected assets or have labour market skills that can protect them from a down business cycle and whether they are net savers or net borrowers, Prasad (2013). Niggle (1989) suggests that the Fed's policies since the late 1970s is a major driving force behind the growth in inequality.

Our finding in chapter two that monetary policy reacts to inequality measured using the income of the top 1 percent income earners in the U.S provides justification for monetary authorities to recognize distributional rather than just aggregate consequences when calibrating their policy stance. In addition, the result provides somewhat empirical support for Areosa and Areosa (2006) theoretically model that derived a welfare-based loss function for the monetary authority that includes inflation, output gap and a measure of inequality.

[18]Asset prices are considered as a key link in the transmission mechanism of monetary policy. Extensive literature on the relationship between monetary policy and asset prices provides evidence linking expansionary monetary policy to equity and commodity price booms, Gerlach and Assenmacher Weshe (2008), Pagano, Lombardi and Lanzuini (2010)

[19]The effect of interest rate on these variables is different. For instance restrictive policy stance that results to a higher savings rate will benefit savers via higher returns on savings. However, if this is accompanied by higher cost of borrowing, it can affect the borrowing costs and therefore, affect consumption demand of net borrowers.

Specifically we observed that the estimated coefficient of income inequality is positive and significant, suggesting a restrictive policy stance in the face of increases in the share of income going to the top 1 percent and monetary easing in the presence of a decline in incomes of this group. However, the lack of reaction to the other two measures of inequality seems to suggest that this reaction to the top 1 percent could be as a result of the high level of correlation between this variable and the stock market. Having said that, the finding concurs with the conclusions of Galbraith, Giovannanoni and Russo (2007) and Coibion et al (2012) that inequality is not outside the scope of the issues with which the Federal Reserve deal with.

As we have argued in chapter two that one of the channels through which monetary policy affect income inequality is via its' impact on the value of household's financial wealth changes as a result of changes in asset prices particularly stock prices[20]. For instance, a Bank of England's report in (2012) suggests that the Bank's policies of quantitative easing (QE) had benefited mainly the wealthy. Specifically, the report opines that the QE program had increased the value of stocks and bonds by 26 percent and about 40 percent of those gains went to the richest 5 percent of British households, Bank of England (2012). The same effect was observed in the U.S as was noted by Randazzo (2012) who argued that the Fed's quantitative easing policy is a regressive redistribution program that has increased wealth for those already engaged in the financial market.

According to him, wealthier households with more disposable income will have more ability to invest in equities than those households within the lower income brackets[21].Wolf (2012), argues that at the start of the recovery in 2009, the S&P 500 index in real terms rose by 62%, whereas median home prices increased by just 2 percent in real terms these rebounds have helped to lift the earnings and the net-worth of those American households who own stocks. Coibion et al (2012) highlighted other channels through which monetary policy affects distribution in an economy. According to their study, the net implication of monetary policy on income inequality depends on the relative importance of

[20]Heather (2011) opined that high income families benefit more from increased stock prices and corporate profits. Therefore, income inequality is further exacerbated when wages for workers, who do not own stocks, fails to increase by a similar amount.

[21]The Fed's monetary easing after the 2007-09 financial crisis helped boost stock prices resulting in a wind fall for equity investors. Haltom (2012) maintains that the ultra-low interest rate environment during the pre-crisis period had a negative effect on households that rely on interest income, such as seniors. According to him, these households are affected differently depending on where they stand in the wealth distribution.

different monetary policy transmission channels. For instance, expansionary policy stance that raises profits more than wages will favour households with claims to ownership of capital (in most cases high income households).

The quantitative easing policy undertaken by most advanced economies is an example of expansionary policy stance that raises profits more than wages; the decreasing interest rate, as a result of QE, increased borrowing and investment opportunities for corporations. According to Nelson (2013), successful investments effectively resulted in higher profits, that typically went to top executives and shareholders, who are wealthier; poorer workers did not experience similar benefits, this worsens the distribution of income. In addition, higher inflation may also hurt households with limited access to financial markets (mostly low income households) and therefore hold more of cash than inflation protected assets. Albanesi (2007) opines that inflationary actions on the part of monetary authorities would represent a transfer of income from low-income households toward high income households. This is because low income households tend to hold more cash than their high-income counterparts hence this will increase both income and consumption inequality.

Although, the redistributive effect of inflation is still inconclusive, in another work related to this point Levell and Oldfield (2011) examined the spending patterns and inflation experience of high and low-income households over the past decade in the U.K; they concluded that the main losers from inflation are low-income households and those for whom state benefits make up the largest component of their income. According to them, inflation rates in recent years have been predominantly high for goods (food and energy) that make up a larger share of the budget of low-income households.

In other to infer the Fed's monetary policy preferences and provide a good interpretation of the estimated parameters from the Taylor rule model, we analysed the interest rate behaviour of the U.S monetary authorities by taking into account possible asymmetry in the loss function. This leads us to the second empirical finding of this thesis the finding of asymmetric monetary policy reaction with respect to top 1 percent income earners. This sort of asymmetry seems identical to the Fed's reaction to equity prices, Ravn

(2011) and Hall (2011)[22] and Hoffman (2009) that found asymmetric reaction of monetary policy to stock prices.

This notion suggests that monetary policy should react to asset market bursts and not to booms in asset prices (cutting interest rates aggressively in response to decreases in stock prices but not increasing as much as they would cut it in the event of a decline). Given that the holding of financial assets particularly stocks is highly concentrated within the top income class, asymmetric policy reaction to stock prices will exacerbate income inequality because it increases the income of those households already participating in the stock market. This assertion is supported by our empirical findings in chapter 3 where we found a unidirectional causality that runs from the stock market to the income of the top 1 percent of U.S. population.

1.7 Stock prices and income inequality

The discussions above point to the fact that change in financial asset prices particularly stock prices is a major transmission channel through which monetary policy stance affect income inequality. Recent empirical studies provide documented evidence in favour of inequality increasing effects of stock price changes. For instance Sawhney and Dipietro (2006) found that increases in stock market wealth have a positive and significant effect on income inequality across the 73 countries they studied. Their work showed that increasing stock market wealth will lead to increase in the income of the top quintile while it reduces the share of income of the bottom quintile. Kristal (2010) argues that the historic stock market boom of the 1980s and 1990s worsened income inequality via a shift in the allocation of national income from labour to capital. According to Kristal (2010) the growth in capital income in the 1980s up until the late 2000s was much more concentrated amongst high income households.

Das and Mohapatra (2003) in their panel study of 11 emerging economies investigated the distributional consequences of stock market liberalization over the periods

[22]The study of Ravn (2011) reveals that a 5% drop in the S &P 500 index increased the possibility of a subsequent 25 basis point interest rate cut by 33% during the period under review (1998-2008). In addition, Hall (2011) using an augmented Taylor rule model with lagged stock price deflation found that stock price deflation led to a highly significant cut in interest rate. Her study also showed that the inclusion of stock price deflation led to an improvement in the fit of the Taylor rule. Finally, Hoffmann (2009) also found asymmetric monetary policy reaction to stock prices during the Greenspan/Bernanke period (1987-2008). According to her, the Fed lowered interest rates, when asset markets bursts, but did not raise them when they boomed during the Greenspan era.

1986 to 1995 and found that the gains from stock market liberalization appears to have benefited the top income earners more than the rest. Specifically, they observed a pattern that seems to indicate that income share growth accrued almost wholly to the top quintile of the income distribution at the expense of the middle class which they defined as the three middle quintiles of the income distribution. They provided evidence that showed that the income of those individuals at the lowest quintiles of the income distribution remained effectively unchanged in the event of the liberalization. The research of Das and Mohapatra (2003) corroborated the findings of Bekaert et al (2000c) that found an increase in the mean income of the top income quintiles post liberalization.

Nguyen (2012) explored income inequality-asset price nexus under the Fama-French three factor model and found a significant relationship between income inequality and the rate of market participation which in turn influences the rate of returns on stocks. In a panel study of 154 countries, Zhang (2008) showed that a rise in the GINI coefficient of 0.01percentage point is associated with up to 2 percent reduction in stock price to dividend ratio. She concluded that an increase in income inequality increases the rate of return in the stock market due to a lower overall price level. Furthermore, Zhang's study found a connection between income inequality and the stock market via the interest rate channel. In a recent theoretical paper, Favilukis (2012) using the general equilibrium model showed that stock returns are positively correlated with changes in inequality because stock market participants are on the average rich households who benefit disproportionately from a stock market boom.

Piketty (2010) opines that one of the reasons for the unequal distribution of household income is the decrease in the share of total income from wages and other labour compensation and an increase in the share from capital gains, bonuses, and stock options. The later are more concentrated among higher income households. The run-up in stock market prices from 1995 through 2000 further helped to fuel the increase in the share of income going to those households within the top echelon of the income distribution. In summary, there is no doubt that change in asset prices is one of the channels through which Fed's policies affect the distribution of income. A major take away from the findings of chapter three is that macroeconomic policies that are targeted towards the propping up of stock market could exacerbate income inequality.

1.8 Financial sector development and income inequality

Bulk of empirical evidence supports the notion that financial development reduces income inequality and poverty. Increasing access[23] to credit market will expand the social-economic opportunities of agents' from low income households and reduce the intergenerational persistence of relative income, Becker and Tomes (1986). In a panel study of both developed and developing countries, Beck, Demirguc-Kunt and Levine (2009) found that financial development disproportionately raises income of the poorest quintile and that it reduces inequality. In addition, Li, Squire and Zou (1998) observed that financial development lowered inequality and increased the average income of the bottom 80th percentile of the population. Townsend and Ueda (2006) in their study provided an indirect mechanism in which changes within the financial sector can affect inequality. According to them, changes in the financial system can influence both aggregate production as well as the allocation of credit, each of which may change the demand for low-and high-skilled workers with implications on the distribution of income.

Demirguc-Kunt and Levine (2009) posits that financial developments can potentially affect the extent to which an individual's economic opportunities are determined by individual skill and ability. Indeed, access to finance[24] is at the core of an individual's ability to realize his/her economic aspirations thus, reducing the gap between the rich and the poor and to some extent the degree to which the gap persists across generations. The following studies also provided documented evidence that financial sector development leads to a reduction in income inequality; Liang (2006) using a dynamic panel estimation GMM

[23]It is important to understand what "access" means within the context of financial development and income inequality. Fernando (2007) discussed different dimensions of access to finance which is very helpful in giving us a fuller understanding of financial development-inequality nexus. According to Fernando (2007) full access to finance is when a person is able to use formal and semiformal financial services at any point in time without any inhibition. An agent could have partial access to financial services via 8 dimensions namely; scope dimension where the agent have access to only some products and services provided by the formal and semiformal sources. For instance, some people may have access to deposit facilities but no access to credit facilities or insurance products. Institutional dimension is a situation where an agent has access to services offered by only semiformal institutions but no access to those provided by the mainstream financial institutions. The quantity and price dimensions is where agents have access to a pre-specified small amount of credit which may not be able to meet their financial needs while the price dimension is a situation where a person has access but not at a competitive prices. Quality dimension is access to poor quality products and services. As Fernando (2007) articulated, financial institutions might discriminate by particular characteristics, such as gender where for instance only men may have access while women may not; age where youth and elderly agents may not have access while others may have and race and occupational dimensions.

[24]In line with literature, we define finance as the ability of financial contracts, markets and intermediaries to facilitate the screening of investment opportunities; the monitoring of investments after providing funding; and the pooling, trading and management of risk, Demirguc-Kunt and Levine (2009).

approach in studying the impact of financial development on income inequality in rural and urban China found a negative and linear relationship between financial development and inequality in both rural and urban China, providing yet another empirical support to inequality reducing effect of financial development.

The empirical findings in chapter four of the present thesis suggest that credit to private sector by deposit money bank and other financial institutions have a significant negative relationship with GINI index of net inequality in all the countries. This result indicates that increasing access to finance narrows the gap in income distribution, indicating that financial policies matter because financial institutions influence the ability of agents to obtain the capital they need to succeed and improve their standard of living, Bath et al (2006). Bulk of empirical research seems to be unanimous in their conclusion that improvements in financial markets widens economic opportunities, reduce inequality and narrows the distribution of income.

That financial development seems to reduce income inequality in majority of the countries included in our datasets does not mean that access to finance is a magic wand capable of lifting low-income households out of poverty. In addition, it does not in itself support the use of political economy factors (especially the influence of policy makers) in using excessive extension of credit to middle and low income households to improve consumption and therefore, sustain aggregate demand in the face of stagnating middle and lower class income[25]. However, we argue in favour of the general consensus that better access to financial services can play a potentially key role in inclusive growth and development particularly within the developing countries.

Indeed, promoting savings[26] amongst low income households to achieve long-term goals like homeownership, ownership of financial assets or pension income may help in reducing the huge income differentials. Demirguc-Kunt and Levine (2009) in their review of

[25] This view was popularised by Rajan (2010), Reich (2010) Kumhof et al (2012) amongst others, these authors suggested that the political response to the insidious problem of income inequality in America and elsewhere was excessive extension of credit to households' particularly low income households. According to them, easy access to credit was a way of boosting their purchasing power in the face of stagnating real wages. Rajan and others argued that increasing consumer indebtedness that supported consumption for most households in the face of stagnant income was largely driven by pressure to maintain aggregate consumption.

[26] For a detailed typology of savings policies, see Pater Tufano and Daniel Schneider's Policies Addressing Savings, Homeownership and Debt among Low-Income Families in Barr and Blank (2011). They discussed policies such as 'coerced (mandated) savings such as social security', to programs that make it hard not to save such as 'automatic enrolment in employer-sponsored savings plans' amongst others

theories of how savings behaviour affects intergenerational income dynamics argued that saving is the most obvious channel through which richer households remain comparatively rich, since richer parents bequeath more assets to their children than do poorer ones. If the finding of a unidirectional causality (refer to chapter three) that runs from stock market to the income of the top 1 percent of the population is anything to go by, it seems plausible to argue that lower-income households have less-wealth than high-income families because they have less capacity to save.

In summary, our results suggest that asset prices can explain in part the super concentration of income at the top end of the income spectrum. Therefore, monetary policy reaction to the income of the top 1 percent could be a reaction to asset prices because the ownership of financial assets is skewed within the high income households. Consequently, the inherent asymmetry in relying on "mopping up" (i.e. monetary authorities should not lean against the wind with respect to asset prices, but rather be ready to clean up in case of a rapid drop in asset prices by cutting interest rates aggressively) is likely to reinforce the income differentials between households that own financial assets and those that do not own such assets. Therefore, monetary authorities can improve overall macroeconomic performance and to some extent tighten the income distribution by reacting to asset price misalignments in a symmetric manner.

Chapter 2

Monetary Policy and Income Inequality

(Does Fed React to Income Inequality?)

2.0 Introduction

The inequality monetary policy transmission mechanism we reviewed in chapter one of the current thesis suggests that monetary policy influences both output gap and inequality which in turn affect inflation. This channel implies that the objective of a monetary policy that is consistent with welfare maximization should include inequality stabilization as well as inflation and output gap stabilization. This chapter examines the reaction of monetary policy in the U.S to income inequality. Given the persistent income inequalities in the U.S and the not so clear reaction of monetary policy to income inequality, we hypothesize that monetary policy observes changes in income inequality when calibrating their policy stance. Our second hypothesis is that monetary policy reacts asymmetrically to income inequality. Specifically, this chapter is concerned with what the Federal Reserve observes when setting monetary policy stance and whether there is some sort of asymmetry in their reaction to income inequality. To explore this, we specified a forward looking augmented Taylor Rule model by adding another macroeconomic dimension: inequality- a topic that Federal Reserve officials particularly under the chairmanship of Alan Greenspan have frequently maintained to be "outside the scope…of the issues with which we (Federal Reserve) deal" Greenspan (1998).

More recently, the Federal Reserve is starting to take a greater interest in this topic. Some academic economists as well as analysts are asking whether financial inequality in the U.S will become part of the Fed's decision-making process[27]. The question is, whether the Fed reacts to inequality. The present chapter is an attempt to provide an empirical answer to this question by considering the relationship between the monetary policy rate on one hand,

[27] A recent research report from Credit Suisse research analysts Neal Soss and Dana Saporata published on CNBC stated that "the issues of growing income and wealth disparity in the U.S is gaining stature among Federal Reserve officials and may become the next important macroeconomic variable for monetary policy, Frank (2012). According to this report some members of the FOMC, have highlighted that inequality "undermines the ability of the economy to grow sustainably and efficiently" and could lower the long-term growth rate.

and inflation, output gap and inequality on the other. Finding a reaction to any of our measures of inequality could mean in principle that the Fed does take issues of income inequality into consideration when determining the monetary policy stance. Past empirical studies on the distribution of income in the United States report tremendous increase in the degree of inequality occurring since the early 1980s. Most of these studies report significant increase in the share of income going to the top quintile, decile and 1 percent of income earners at the expense of reductions/stagnations in the shares going to the bottom quintile and bottom 90 percent, Atkinson (2008), Argitis and Pitelis (2001), Davies et al (2009) and Milanovic (2011). The fall in the share of labour wages in total income and the increase in the share of profits, and executive bonuses in total income which started around the 1980s led to widening income gap between wage earners and earners of capital income. This trend in inequality has brought about significant level of threat to social cohesion not only in the U.S but elsewhere. This is a disturbing phenomenon especially as it is now becoming evident that a 'rising tide does not lift all boats[28]'.

The 'occupy protests[29]' around the world is an indication of the increasing public displeasure against extreme income and wealth inequality. Just recently, the World Economic Forum's Global Risk Report rated inequality as one of the top global risks of 2013[30]. Consequently, policy makers are now realizing that the economic orthodoxy which asserts that increasing inequality is not only an inevitable effect of economic growth, but also a relevant pre-condition for growth no longer holds[31], Lewis (1954). To solve the insidious problem of economic inequality requires that we understand the role of government policies particularly monetary policy in driving this trend. Most analyses of the

[28] The aphorism 'a rising tide lifts all boats' is associated with the notion that improvements in the general economy will benefit all agents in that economy. Consequently, government economic policies should be targeted to the general macroeconomic environment first. This aphorism is mainly attributed to President John. F Kennedy who used it in a 1963 speech to defend a dam project. The president's remarks is available on http://www.presidency.ucsb.edu/ws/index.php?pid=9455

[29] http://occupywallst.org/

[30] The Global Risks Report 2013 is an analysis of 50 global risks in terms of impact, likelihood and interconnections. This report is based on a survey of over 1000 experts from industry, government and academia. The report highlights the severe income disparity followed by unsustainable government debt as the top two most prevalent global risks, the full report is available at http://reports.weforum.org/global-risks-2013/

[31] The logic of the 'pro-inequality' argument is that given that savings are essential to increase productive capacity which will translate to higher rates of growth, income has to be redistributed towards the group that save and invest- the rich in order to ensure capital accumulation and growth. According to the proponents of this model, an economy with a high concentration of income within the top income distribution is more likely to grow faster than one with a more equitable distribution of income, Lewis (1954).

increase in income inequality have cited skill-biased technological change, changes in Federal and State tax systems, reduction in the bargaining power of union, globalization and financialization amongst others, as the causes of the phenomenon while monetary policy is not often mentioned as a likely source. Without denying the contributions of these factors, some academic economists and financial experts consider the Fed's policies at least since the late 1970s[32] a major driving force behind the growth in inequality, Niggle (1989). Researchers such as Galbraith (1998) have argued that the change in monetary policy goal and policy instrument from full employment to fighting inflation with the use of short term interest rate since the early 1970s brought about repeated sequence of recessions. According to him, the high unemployment that these recessions produced resulted in significant increase in inequality. Consequently, the Federal Reserve through its 'reputable chairmen Arthur Burns, Paul Volcker and Alan Greenspan stands primarily (though not solely) responsible for the rise in inequality'.

A narrative which identified the role of monetary policy in propping up inequality in the post-crisis era considers the Federal Reserve's policies a major force behind the recent surge in the stock market. According to this narrative, since the depth of the 2007 financial crisis the Dow Jones industrial average has more than doubled, increasing about 16 percent in 2013 alone. In addition, at the start of the recovery in 2009, the S&P 500 index in real terms rose by 62%, whereas median home prices increased by just 2 percent in real terms Wolf (2012). These rebounds have helped to lift the earnings and the net worth of those American households who own stocks. The gains in Dow Jones industrial average and S&P 500 have benefited the wealthy disproportionately given that the richest 10 percent of households own more than 81 percent of stocks, as measured by value, Wolf (2012).

This narrative seems to suggest that monetary easing drives up the prices of assets, especially financial assets. And most of these financial assets are owed by the wealthiest 5

[32] The debate over the role of restrictive monetary policy stance (high interest rate) in increasing/ decreasing income inequality is still open with authors piling in both positions. Researchers such as Galbraith (1998) have argued that the change in monetary policy goal and policy instrument from full employment to fighting inflation with the use of short term interest rate since the early 1970s brought about repeated sequence of recessions. According to him, the high unemployment that these recessions produced resulted in significant increase in inequality. Consequently, the Federal Reserve through its 'reputable chairmen Arthur Burns, Paul Volcker and Alan Greenspan stands primarily (though not solely) responsible to the rise in inequality'. While Galbraith argues that disinflation will increase income inequality through the unequal income effects of the associated recession, Austrian economists suggests the opposite effect: according to them, income inequality will increase if Federal Reserve pursues an expansionary policy stance that increases inflation. Their view is that inflation will lower real wages and raise real profits because wages are stickier than prices.

percent of Americans. According to data from the Federal Reserve, the top 5 percent own 60 percent of the nations' individually held financial assets. They own 82 percent of the individually held stocks and more than 90 percent of the individually held bonds, Frank (2012). Consequently, the Fed's aggressive monetary easing and interest rate policies have helped to re-inflate the stock market in 2009 and 2010, thereby, creating a two-speed recovery where the wealthy have recovered much of their wealth as stocks doubled in value. However, the bottom income earners which depend on their houses and jobs for their wealth remained stuck in the recession.

Financial Analysts such as Lowrey (2012 and 2013) and researchers such as Mishel and Finio (2012) found that inequality in terms of both income and wealth has widened since the recession. According to them, top 1 percent of earners have accounted for all of the income gains in the first two years of recovery. The top 1 percent witnessed an income growth of about 11.2 percent while the incomes of the 99 percent have declined by about 4.0 percent. Proponents of the Fed propping up inequality in the post-recession period have argued that the Fed's unconventional monetary policies[33] aimed at boosting housing and stock prices, including buying approximately $40 billion in mortgage-backed securities each month has helped to reduced mortgage rates and made it cheaper for millions of families to either buy a house or free up some cash by refinancing.

However, this windfall has disproportionately favoured top income earners because households at the top end of the income spectrum are the ones that are most likely to meet the credit standards to refinance and are individuals with enough cash to buy, Irwin (2013). Reducing income inequality may be one of a few goals which Federal Reserve agrees to. However, the post-financial crisis period has seen the re-emergence of inequality as a major macroeconomic risk. As a result, the link between monetary policy and income inequality has been a subject of great debate particularly within the financial press.

The potential reaction of monetary policy to income inequality has been largely ignored in mainstream economics literature. Most of the empirical studies see- Powers (1995), Dollar and Kraay (2000), Mocan (1999), Romer and Romer (1998) amongst others,

[33] Irwin (2013) argues that the Fed's policies, including the purchase of $85 billion in bonds each month using newly created money are directly targeted at housing. According to him, $40 billion of those purchases are of mortgage-backed securities, which imply that the money is being channelled directly to the housing market. Irwin posits that a second implication/consequence of Fed's easing is to boost the prices of other assets, including stock prices. He maintains that these channels through which monetary policy affects the economy tend to benefit those with high income and wealth.

on monetary policy and income distribution have focused on the indirect effects of policy on income inequality via the inflation or unemployment channels none of these studies have analyzed how monetary policy responds to changes in personal income distribution directly. Two outstanding exceptions are the studies by Coibion et al (2012) they were interested in studying whether U.S monetary policy has significantly contributed to changes in consumption and income inequality and the study of Galbraith, Giovannaoni and Russo (2007) that relied on the term structure of interest rates as a measure of exogenous policy actions to quantify the effects of monetary policy on earnings inequality.

The study of Coibion et al (2012) provided documented evidence that suggested that contractionary monetary policy shock raises the observed inequality across households income, labour, earnings, expenditures and consumption, with the effects being largest for expenditure inequality. They therefore, concluded that monetary policy has played a major role in driving recent historical inequality patterns in the U.S. Galbraith, Giovannaoni and Russo (2007) on the other hand found that pay or earnings inequality in manufacturing reacts to the term structure, and therefore, partly to the rate-setting decisions of the Federal Reserve. They concluded that inequality is a direct product of monetary policy choices and that it is not outside the scope of the issues with which the Federal Reserve must deal.

The present study seeks to close the gap in literature by analyzing the reaction of monetary policy to income inequality. To that effect this chapter used a forward looking Taylor rule model to examine empirically the reaction of monetary policy on income inequality measured using the Gini index of inequality, income share going to the top 1 percent income earners and 90/10 income differentials. Our principal innovation to the standard Taylor rule specification is the inclusion of the three measures of income inequality. This allows us to determine whether there is any evidence that the Federal Reserve has reacted to changes in income inequality as well as the nature of this reaction (whether it is symmetric or asymmetrical). Providing empirical answers to these questions has significant implications to policy makers. This will help monetary authorities in understanding how shifts in policy stance affect income inequality.

2.1 Measures of income distribution

The two broad measures of income distribution are – the functional distribution of income and the personal distribution of income. The functional distribution of income

examines the distribution between the main factors of production (labour and capital)[34], Giovannoni (2010). The functional distribution of income shows the shares of wages and salaries (labour income) and profits, interest and rents (capital income). This measure also shows the sources of primary income earned through participation in economic activity. From a neo-classical perspective, each factor of production is rewarded according to its marginal productivity, International Labour Organization (2008). Consequently, shift in labour income share to capital income are explained as the result of either changes in factor productivity or as a result of changes in the labour/capital ratio used in production. In other words, labour shares will decline if production becomes more capital-intensive.

However, many economists including, Krueger (1999), Diwan (2001), Bentolia and Saint-Paul (2003) Daudey and Garcia-Penalosa (2007) have challenged this assumption arguing that it provides a simplistic explanation for the failing labour share and that it ignores other important determinants. Explaining shifts from labour income to capital income from the neo-classical perspective seems to be contrary to the conventional wisdom in economics which suggests that the functional distribution of income is to some extent empirically stable, although there are variations in the explanations of the causes of this stability, Kramer (2010). Kaldor (1961) provided stylized facts that confirm this long-run stability. However, modern Keynesian/Kaleckian theories suggest that functional income distribution strongly depends on political and economic factors.

The second measure is that of personal distribution of income. This refers to the distribution of income among households or individuals, irrespective of the source of the income, Giovannoni (2010). Income can accrue to a household or an individual from both labour activity and capital revenues, as well as from pensions and other transfers from the government, Serrano (2007). In the United States changes in the share of the top income earners have been large enough to affect overall personal inequality in a massive way. According to Giovannoni (2010), the total increase of the GINI coefficient of about 8 points can be explained by the rise in the share of the top 1 percent alone. His study showed that GINI inequality indexes are sensitive to excluding or including top incomes. Krugman (2012) provided corroborative evidence to this finding in his recent book 'End This

[34] The labour share measures compensation which include benefits, pension and labour part of self-employment while the capital share covers interest, rent, business payments and the capital share of self-employment income, dividends and other realized investment returns such as capital gains, Giovannoni (2010).

Depression Now' in which he argued that the top 1 percent income earners accounts for approximately half of the increase in the GINI coefficient during the 1980s and 2000.

2.1.1 Functional and personal income distribution

Recent evidence in the functional distribution of income suggests a significant decline in the share of labour in the national income in most advanced countries since the 1980s, Guerriero and Kunal (2012). Consequently, adequate attention should be paid to the distributional consequences of shifts in factor shares because of its role in promoting overall income inequality. Daudey and Garcia-Penalosa (2007) documented the link between labour share and capital share of income in the national income. According to them, when falling labour shares are accompanied by a corresponding increase in the capital shares, then it is the owners of capital who will benefit from such a shift. Given that capital incomes are far more concentrated than incomes from labour, overall income inequality tends to increase when incomes from capital grow at the expense of labour incomes.

To get a handle on the functional distribution of income, it is instructive to look at how the two components of labour and capital are measured and defined. Both labour and capital contribute to the production of goods and services in an economy; therefore, each will be compensated with income in return. By definition, the labour share shows how much of the national income accrues to labour, International Labour Organization (2008). It is generally calculated as the ratio of total compensation of employees (wages and salaries before taxes as well as employer's social contribution) over a product or income aggregate such as Gross Domestic Product (GDP) or Gross National Income (GNI).

The stability of labour share has been a major foundation in macroeconomic models at least since the work of Kaldor (1957) indicating that workers participate fully to economic development. The idea is that as industrial economies became more prosperous, the total incomes both of workers and capital owners will grow at almost exactly the same rate therefore; the division of national income between labour and capital will remain constant over a prolonged period of time with little fluctuations. This was the case during much of the past century which made the subject of functional distribution of income of little importance in academic research. However, research has shown that labour shares are subject to substantial change overtime.

In a panel study done by Harrison (2005) for a sample of over 100 countries, she found that before 1993, labour's share in national income fell on average by 1 percentage point per decade in poorer countries, however, this rate increased to 3 percentage points per decade after 1993. For advanced countries she showed that labour share grew by 2 percentage points per decade before 1993 but then fell 4 percentage points per decade. Diwan (2001) provided evidence of this negative trend in labour shares in his study in which he disaggregated trends by regions instead of just by broad income groupings as was done by Harrison (2005). By his account, labour shares have been falling since the late 1970s in most OECD countries; since the early 1980s in Latin America and since the mid 1970s in Africa.

In the U.S for instance, the share of labour income fell by 5 percentage points or more between 1980 and 2006-2007 before the global financial crisis. One of the major causes of the declining labour share and rising share of capital in the United States has been the growing dominance of the financial sector over the real sector of the economy as well as changes in corporate governance that is aimed at maximizing shareholder value, (the so called financialization), Milberg and Winkler (2007) and Palley (2007). Other determinants of failing labour share includes: technological changes, globalization, reductions in the bargaining power of labour amongst others, Guerriero and Kunal (2012). Research from the International Institute for Labour Studies (2011) revealed that the declining labour share in the national income have not been uniform across workers with different levels of education and skills. Studies on advanced economies that have disaggregated total labour compensation by categories of workers found that the declines in labour shares were driven by the falling labour shares of low and medium-skilled workers.

The study found that the labour share in ten developed economies that were studied fell by 12 percentage points for low-skilled workers between 1980s and 2005, while it increased by 7 percentage points for highly skilled workers. According to this report, removing the compensation of the top 1 percent income earners will lead to a massive drop of the labour share, showing the sharp increase in wages and salaries (including bonuses and exercised stock options) of top executives within the top income distribution in the U.S and other English speaking countries. We will explain albeit briefly several theories that have been advanced in the literature to explain the fall in labour share. The three potential explanations are examined in turn below:

Technological change: Mainstream neoclassical economic model argues that wages are at least partially determined by labour productivity, i.e. the contribution of workers to output, while capitals are partially determined by the contribution that capital goods make to output. The neoclassical model used "capital augmenting" theory to explain the redistribution of labour income to capital income. The theory posit that a shift from labour to capital would result if technological change is capital augmenting that is if technological change improves productivity of capital more than it does that of labour-the implications would be a fall in labour share and an increase in wage share other things being equal. A fundamental flaw with this theory however, comes from the concept of "joint production". The fact that most goods are produced by labour in combination with capital makes it difficult to determine the marginal contribution of labour and capital to output, Reed and Himmelweit (2010). The significance of technical change in explaining changes in U.S wage structure is a source of continuing debate, see- Lemieux (2006), Autor,Katz and Kearney (2008), Acemoglu and Autor (2012) for recent studies. The same logic is used to explain increase in inequality as being the result of 'skill-biased technological change'. The narrative suggests that skilled workers are now relatively more productive relative to unskilled workers because of technological advancement; as a result, they command high wages, Autor et al (1999) and Card diNardo (2002).[35]

Globalization: Another widely cited reason for falling labour share in many mainstream economic analysis has been the globalization of economic activity. Two major consequences of globalization has been the liberalization of product markets and increased mobility of capital across national borders which mean that firms can bid down wages by threatening to relocate production elsewhere. Another consequence of globalization that is advanced in theoretical literature is increased wage competition from low-wage high-skill economies like China and India, leading to pressure on wages in advanced economies and outsourcing of employment to developing economies, Rodrik (1997) and Onaran (2011).

Researchers often link international trade to the decline in relative wages for less skilled workers in most advanced economies. Economic theory suggests that international trade affects the prices of products in both exporting and importing countries and this also affects the price of labour- i.e. wages within countries by influencing the demand for labour.

[35] Both authors linked advancement in technology as a major contributor to increased wage inequality in the U.S from 1970s to the 1990s.

Changes in product prices as a result of competition from imports will alter the profit opportunities facing firms. Firms will therefore, respond by moving resources to industries in which profitability has risen and away from those in which it has fallen. Trade flows will result in a shift in the demand for labour if more workers are needed in newly profitable sectors. If labour supply is fixed, these demand changes will lead to an increase in wages given that workers will demand a premium for switching into more profitable industries, Slaughter and Swagel (1997).

Financialization: Recent studies on the decline of labour share of national income have linked it to financialization loosely defined as the dominance of the financial sector over the real sector, Palley (2007). According to Karanassou and Sala (2012) this dominance has an impact on the functional distribution of income between labour and capital, since financialization made it possible for firms to invest in financial assets as an alternative to investment in productive capital. In addition, financialization led to the increase in shareholder value orientation which encouraged 'short termism' as managers were more interested in increasing the stock prices of their firm. It also led to the expansion of executive compensation which exacerbated income inequality. The authors in their empirical study of the distributional consequences of capital accumulation, globalization and financialization in the U.S argues that financialization does not influence functional distribution of income but instead has a direct impact on personal income. By their own account, financialization factor explains 83.3 percent of the increase in the GINI index during the 1997-2001 intervals.

There seems to be no unanimous agreement on the relative importance of each explanatory factors mentioned above. Recent attempt to quantify the relative contribution of the different explanatory factors in explaining the fall in labour share have yielded mixed results. For instance a study done by the European Commission in 2008 and International Monetary Fund IMF in the same year revealed that technological change and globalization of trade and production has been the main contributors to falling labour share in the U.S and other OECD countries. These studies provided evidence which seems to suggest that the impact of changes in labour market institutions have a minor role in explaining this trend.

In a recent panel analysis for the determinants of declining labour share for advanced economies, Stockhammer (2012) finds financialization to be a major culprit, although the study found globalization and reductions in labour bargaining power as important

contributors, it however, found technological effect to be marginally significant. To summarize, despite the fact that mainstream economists tend to favour technological change as the main explanation of the falling wage share, empirical evidence on this is still inconclusive, one thing that is clear from the literature is that falling labour share is an important channel of increasing income inequality.

Another major contributor to the increasing income inequality particularly in the United States has been changes in the income share accruing to the top income earners. These changes in the share of the top income earners have been large enough to affect overall personal income inequality quite significantly. According to a report by Levine (2012) during the periods 1979-2006, about 91% of all income growth in the U.S went to the top 10% of income groups. Within the same period, the highest paid 1 percent of the U.S population more than doubled their share of total income from about 10 percent to almost 23 percent. However, 'the average real incomes for the bottom 90 percent of Americans over the periods 1973 to 2002 fell by 9 percent' Piketty and Saez (2006). Levine (2012) opined that more than a quarter of all American workers in 2007 were earning poverty-level wages.

2.2 Changing trends in income inequality in the U.S.

The focus of this section is to provide a detailed analysis of the trends in the distribution of household income from 1963 to 2010 using data from the U.S. Census Bureau and other sources. The levels of inequality that is been witnessed in the U.S. and some other industrialized economies are in fact economically damaging and could inhibit economic growth. This is because concentration of wealth and capital within few hands depresses demand, a point that Rajan (2010) used in analyzing the link between income inequality and financial crisis.

There seems to be some consensus amongst scholars that income inequality in the United States is at historic highs, the income gap between the rich and the poor has been on the increase since the early 1980s. Some studies provided estimates which suggest that the top 1% of Americans hold nearly 50% of the wealth which is much greater than the levels witnessed before the Great Depression in the 1920s, Davies et al (2009), and Keister (2000). A substantial downward swing in inequality was witnessed in the U.S in the 1920s; however, since then the United States have become much more unequal Milanovic (2011). As was noted by Milanovic the real per capital income in the U.S was 65 percent above its

1980s level and inequality within the same period increased from about 35 to 40 or more Gini points; reflecting a significant adverse movement in income distributions.

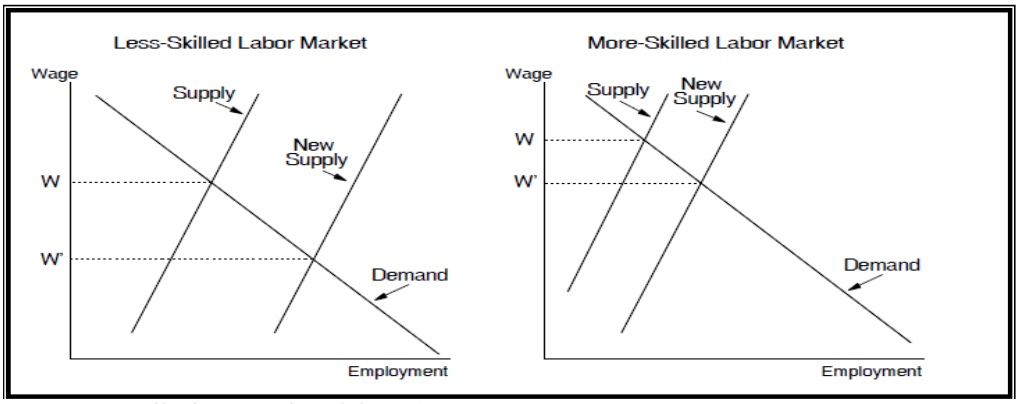
A 2011 analysis by the U.S Congressional budget office showed that the dispersion of household income rose somewhat consistently between 1979 through 2007 with the exception of 1990-1991 and 2001 recessions. The income share going to the top 1 percent income earners has accelerated following the 2007-08 financial crises. Both national and world leaders are now interested in finding a genuine solution to the increasing income disparity between the rich and the poor because they have seen that extreme income inequality can be economically inefficient, politically corrosive and socially divisive. This underscores the importance of the current empirical analysis.

The American society has even been more unequal when it comes to wealth, Heathcote et al (2010). The study of Piketty and Saez (2006) reveals that wealthiest 1 percent of Americans increased their share of corporate wealth from 38.7% to 57.5% between 1991 and 2003. The concentration of wealth at the top also experienced growth during 1962-2004, this period saw the wealth of the bottom 80 percent of the population decreased from 19.1% to 15.3% and this wealth was shifted to the wealthiest 5% of the population Piketty and Saez (2006). In addition, the Congressional Budget Office (2011) reports that about one in six households have no net wealth at all and nearly one-third of households (30%) have a net worth under $10,000. Since 1979-2007 there has been a widening inequality between wages and profits in the U.S economy, real output per hour increased by 1.91 percent while the real average hourly earnings of non-supervisory workers fell by 0.04 percent. This implies that there has been a transfer of income from labour to capital. Similarly, real profits in the corporate sector within the same period increased by 4.6% while real employee compensation grew by only 2% Congressional Budget Office (2011).

There is no single answer behind this increase in income inequality. The 2007 Economic Report of the former President of United States George Bush categorized some of the possible explanation for the observed increase in income inequality into three broad groups namely, “supply side factors, demand-side factors and institutional factors”. Both the supply and demand side factors can be explained by a simple model of the labour market that rewards higher skilled workers more than less skilled workers. From this perspective, supply side factors can generate an increase in inequality if they bring about an outward shift

in the supply curve in the market for less skilled workers relatively more than the supply curve in the market for more skilled workers. Such shifts as shown in figure 2.1 have the tendency of making wages fall by a greater amount in the less skilled labour market than in the more skilled labour market, thus increasing inequality.

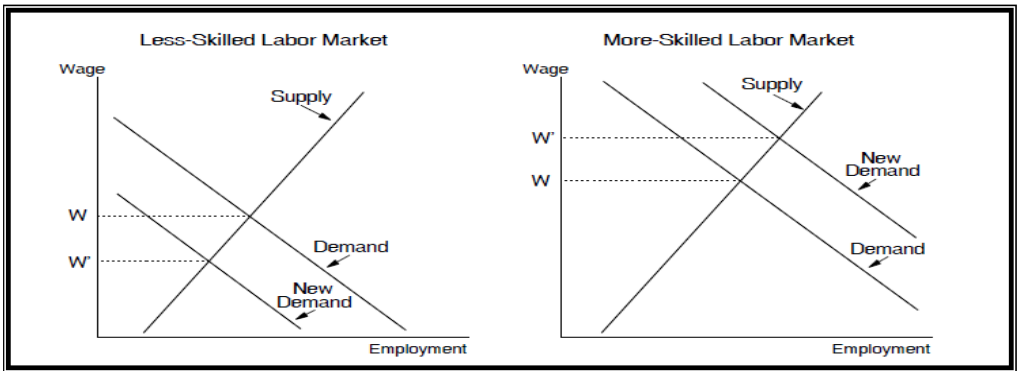
Figures 2.1: Increasing inequality may occur because of shifts in the supply curve in the less-skilled and more skilled labour market



Source: Council of Economic Advisers (2007)

This disproportionate supply shift in the labour market has been largely attributed to the increasing numbers of immigrants in the labour market as well as women who have less work experience than their male counterpart. Similarly, the demand side factors will influence the relative wages of more and less skilled workers if they caused the demand curve in the market for more skilled workers to shift outward by more than that in the market for less skilled workers. These changes would inadvertently increase wages in the more skilled labour market, as shown in figure 2.2 increasing inequality.

Figures 2.2: **increasing inequality may occur because of shifts in the demand curve in the less-skilled and more skilled labour market**



Source: Council of Economic Advisers (2007)

Some possible explanations for this sort of asymmetry in the labour is the so called "skilled-biased technological change" Bound and Johnson (1992), Acemogl (2002) or "college Premium". Other factors include institutional arrangements within the labour market, such as the reducing influence of unions, Card (2001) and a reduction in the real value of the minimum wage. These two factors have led to lower returns for workers in the lower tail of the earnings distribution. Strong unions have in the past provided wage premiums to such workers. Trade liberalization, demographic shifts, rising immigration amongst others have also been sighted as some possible causes of the increasing income inequality, Feenstra and Hanson (2008), however, the relative importance of each of these factors could be difficult to determine precisely.

Politicians saw the distributional issues within the United States as a means of gaining political popularity; hence the problem of wage inequality became somewhat bipartisan. The debate on the appropriate response to the widening income inequality in the United States is a source of concern to both politicians and Central bankers alike. In the words of Alan Greenspan the former Federal Reserve chairman in Neckerman (2004), "you cannot have a market capitalist system if there is a significant mood in the population that its rewards are unjustly distributed" More recently, politicians and political office holders have continued to echo their concerns about the insidious problem of income inequality.

For instance in 2006 Secretary of the Treasury Henry Paulson; was quoted as saying that the benefits of strong economic expansion in the U.S. has been skewed in favour of the rich. According to him, many Americans do not see significant increases in their take-home pay. Their increases in wages are being wiped out by high energy prices and increasing health-care costs, amongst others –; Remarks at Columbia University; August 1, 2006 in Bartels (2008).

Similarly, the former president of America George W Bush in one of his State of the Economy Reports Jan. 31 2007 acknowledged the problem of income inequality as a major concern within his administration and the seeming confusion with regards to how to tackle it. According to him; some of American citizens worry about the fact that the economy is leaving working people behind. The president acknowledged that the state have an obligation to help ensure that every citizen shares in the country's future. Politicians in the U.S. admit the fact that income inequality is real; and it's been rising for more than 25 years.

The question according to President Bush is whether the authorities should respond to income inequality with policies that help lift people up, or tear others down.

More recently, members of the World Economic Forum in a 2012 survey maintains that the widening economic disparities between the rich and the rest is one of the two main global risks over the next decade alongside the reduction in global governance. From looking at all these narrative evidences, it is quite clear that the government has been highly concerned over the continuing increase in income inequality since the 1980s; however, the challenge for policy makers has been on the right policy tools that can be employed in other to reduce its negative impact. While some level of income inequality might be helpful because it can signal stronger rewards to work, innovation and creativity which will inadvertently improve the economic prospects of both the rich and the poor; high levels of income dispersion may be both socially and economically harmful.

A plethora of narrative evidence seems to support the notion that social conflicts are always on the increase when inequalities are seen to be increasing significantly, Stiglitz (2012) and Norton et al (2011). Indeed, economic researchers and commentators are of the opinion that the widening of income inequalities that occurred prior to the 2007-2009 financial crises was one of the root causes of the crisis Rajan (2010). In the next section we will look at how income inequality has been widening in the U.S with particular emphasis to the share of national income going to the top income households.

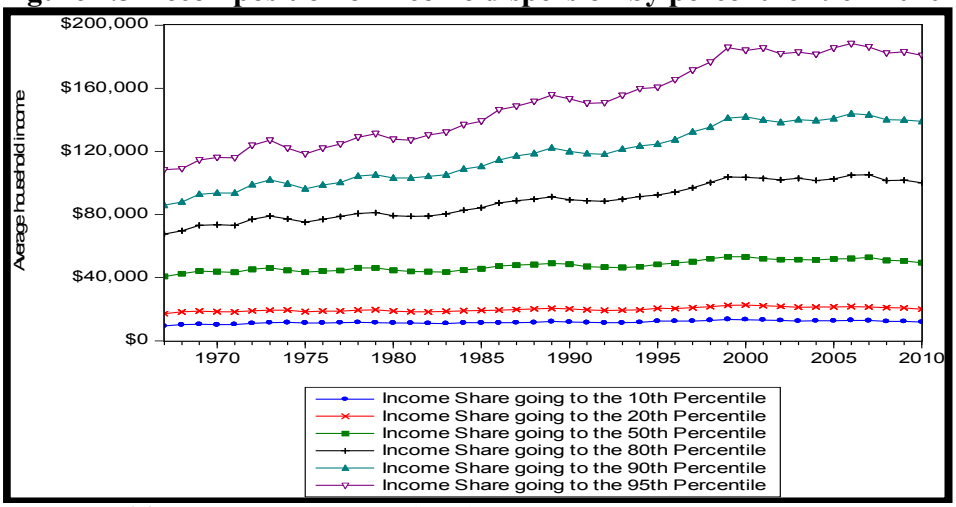
2.2.1 Evolution of top and middle-class income in the U.S:

A striking feature of the income[36] dispersion data reveals that the top-half inequality[37] has witnessed a somewhat steady upward trend while the bottom-half inequality has stagnated over the 40 year period. The shares of aggregate household income separate households into income percentiles and estimate the share of income received by each percentile. Inequality will be said to be on the increase if the share of income going to the lowest percentiles is decreasing while the share of income going to the highest percentiles is increasing. While the average incomes of the richest households in the U.S have witnessed a

[36] Household income comprises primarily of wages and salaries and also includes income from self-employment, interest, dividends, rentals, retirement and government transfers US Census Bureau (2011).
[37] The top-half inequality refers to the 95/50 inter-percentile ratio while the bottom half inequality refers to the 50/20 inter-percentile ratio.

steady increase, the middle-class households have dwindled or at best remained stagnant- (see figure 2.3 decomposition of income dispersion by percentile).

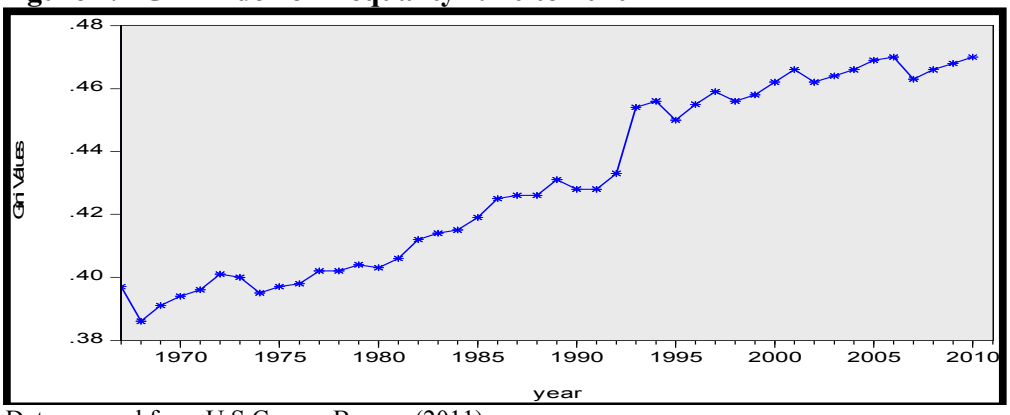
Figure 2.3 Decomposition of income dispersion by percentile 1967-2010



Data sourced from U.S Census Bureau (2011)

Figure 2.3 reveals that the income of the 95th, 90th and 80th percentiles have been in some sort of an upward trend during the period under review while that of the 50th, 20th and 10th percentiles have largely remained somewhat stagnant. In addition, figure 2.4 (Gini index of inequality) also shows an upward trend starting from the 1970s. Between 1967 and 2008, the average household income that accrued to the Top percentile rose from 43.6 percent to 50.3 percent while the share of aggregate household income received by the bottom and middle income percentile has decreased from 4.0 percent to 3.1 percent and 17.3 to 14.7 percent respectively within the same period.

Figure 2.4 Gini index of inequality 1970 to 2010



Data sourced from U.S Census Bureau (2011)

An analysis of the income distribution by percentiles reveals that in 1967, the 95th percentile of household income was approximately 2.67 times higher than the 50th percentile; by 2005 it was 3.58 times higher. This was a period of rapid economic growth and strong job creation in America and elsewhere, however, the economic benefits from these expansionary periods benefited the top-income groups more than their medium and low income counterparts. The top income percentile received vastly more income than the households in the bottom percentile. Much of the increase in income inequality was driven by the share of total income that went to the richest 1 percent of households.

An examination of the share of total market income going to the top deciles (Figure 2.5: Top deciles income share) showed that the total income going to this group of income earners was as large as 48% during the period leading to the 1930s great depression. The top deciles income share fell rapidly during the 1930s and remained stable below 35% between the 1940s-1970s. It started to increase gradually since the early 1980s and is now close to the 50% levels that were observed during the 1920s before the Great Depression. This implies that about 50% of the total income in the U.S is absorbed by the top deciles.

Figure 2.5: Top deciles income share excluding capital gain 1920 to 2010

Data sourced from Alvaredo, Atkinson, Piketty and Saez (2009) updated

One can argue that the evolution of income inequality in American has been largely driven by the trends at the very top of the income distribution, as households at the upper spectrum of the income distribution have continued to accrue a larger share of the nation's total income. The 2007-2008 recessions seem not to have reversed the long run trend in the

top deciles income share. Although (figure 2.5 Top deciles income share) revealed a sharp decrease in the share of income going to the top deciles at the peak of the global financial crisis 2008-2009, this fall was followed by a strong rebound since 2009. This rebound seems consistent with the experience of the previous economic downturn. For example the income share of the top 10% fell between 2001 and 2002 economic downturn in the U.S this fall was followed by a rapid recovery to the previous trend in 2003-2007. The growing trend in income inequality can also be seen when we examine trends in real income growth per family between the top 1 percent and bottom 99 percent from 1993 to 2008 as is shown in Table 2.1 below.

Table 2.1 Real annual income growth by groups 1993-2008

	(1) Real annual growth average income	(2) Real annual growth top 1% incomes	(3) Real annual growth bottom 99% incomes	(4) Fraction of total growth or (loss) captured by Top 1%
Full Period 1993-2008	1.30%	3.94%	0.75%	52%
2001 Recession, 2000-2002	-6.0%	-16.8%	-3.3%	57%
Great Recession 2007-2008	-9.9%	-19.7%	-6.9%	47%

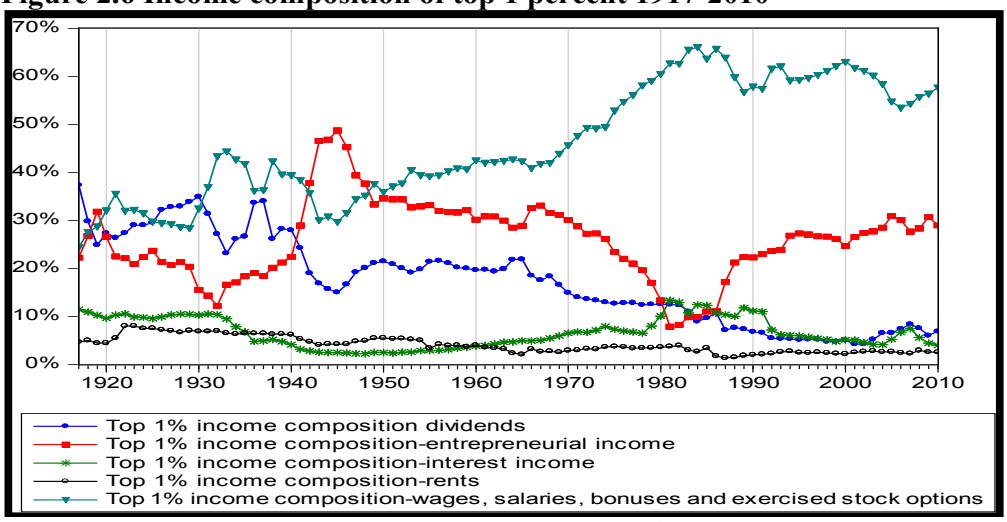
Data sourced from Alvaredo, Atkinson, Piketty and Saez (2009)

For instance from 1993 to 2008, average real family income grew by an annual growth rate of 1.3 percent but 52 percent of that growth accrued to the top 1 percent while 48 percent of that growth went to the bottom 99 percent of US families. The drop on the income growth of the top 1 percent was largely as a result of the global financial crisis. Piketty and Saez (2008) noted that prior to the crisis from 2002 to 2007 average real family incomes grew by 3.0 percent annually; however, a whopping 65 percent of that growth was amassed by the top 1 percent while only 35 percent went to the bottom 99 percent, thus substantiating the fact that the top 1 percent of income earners captured more than half of the economic benefits of that period.

The top 1 percent income earners were not penalized during the 2007-2008 great recession as much as they gained during the economic growth that ended in 2007, although they absorbed more loss than the low income earners. Table 2.1 shows that the average real family incomes contracted by 9.9% during the great recession and the top 1 percent

absorbed only 47% of that contraction. Finally, it is important to observe the changes in the composition of income for the top income earners in the U.S (see figure 2.6 income composition of top 1%).

Figure 2.6 Income composition of top 1 percent 1917-2010



Data sourced from Alvaredo, Atkinson, Piketty and Saez (2009) updated

The composition of incomes for this group of households has changed between 1929 and 2007. In both years the share of wage income which comprises salaries, bonuses, pensions and exercised stock options has continued to be on the increase surpassing that of capital income that includes rent, dividends and interest. A closer analysis of income composition of the top 1 percent reveals a rapid increase in entrepreneurial income (made up of business income as well as income from partnerships and corporations) since the early 1940s up until the early 1950s. This was followed by a significant decrease in income from this source and it has remained low when compared to that of wage income. Much of the increase in wage income came from the different forms of bonuses both cash and stock options amongst others given to high performing executives who form majority of individuals that belong to the top 1 percent income group.

2.3 The income-redistributive transmission channels:

In this section we analyzed the different channels through which monetary policy can affect income inequality. There are, in principle, a number of different ways through which changes in monetary policy can affect income distribution both in the short and long run.

The impact of monetary policy on income distribution in the short run can be seen through the cycle in economic activity generated by the policy change and in the long run via changes in inflation reached at the end of the adjustment period. Furthermore, the stock market channel is another important channel through which monetary policy can affect household distribution of income. Economists posit that restrictive monetary policy leads to lower stock prices because of the increase in the discount rate used by market participants, Crowder (2006). In addition, stocks underperform during tight monetary policy periods, as higher interest rates restrict risk appetite and make it relatively expensive to buy stocks on margin.

Furthermore, portfolio substitution implies that investors/consumers tend to trim down the equity component of their portfolios in an environment of restrictive monetary policy in order to lock in higher rates on term deposits. Higher deposit rates induce investors/consumers to save rather than invest in relatively risky assets such as stocks and real estate, the effect of both portfolio substitution and high margin lending is depressing stock prices. To the extent that stock prices reduces in the short term as a result of restrictive monetary policy[38], lower stock prices will reduce the capital gain income that accrues to high income earners since stock ownership tend to concentrate within the high income brackets thus a reduction in inequality.

Contractionary monetary policy shocks affect income distribution through other different channels. First, the decrease in economic growth, aggregate income and employment as a result of increase in interest rates will exacerbate income inequality. In an open flexible exchange rate economy, the output and employment loss is reinforced by a real appreciation which adds to unemployment. Since unemployment tend to affect mostly low-skilled workers since hiring and firing costs are generally higher for skilled than un-skilled workers, this makes inequality to increase in the short run[39]. The degree of increasing

[38] There is typically a substantial lag between the time that Federal Reserve commences tightening monetary policy and when equity prices falls. For instance the Federal Reserve began raising short-term interest rates in June 2003, U.S equities continued on an upward momentum until October 2007 almost 3 years. The lag effect was attributed to investor confidence that the economy was growing strongly enough for corporate earnings to absorb the impact of higher interest rates in the early stages of tightening while others attribute this to monetary policy asymmetry. The asymmetry school of thought implies that the Fed although started monetary tightening, did not raise interest rates high enough to curb the increases in stock prices as they would cut rates in the event of a recession.

[39] In addition, the real appreciation distributes its effects on employment disproportionately among different sectors, mostly affecting export industries. The impact on income distribution will depend on the relative concentration of low-skilled labour in export industries.

income inequality will depend on the sensitivity of investment and consumption to higher interest rate and lower expected demand as well as on the elasticity of employment to output fluctuations amongst others.

The increase in unemployment can be exacerbated by the presence of downward nominal wage rigidities, thereby making the slowdown in nominal wage rises to lag behind the reduction in inflation orchestrated by the monetary restriction, Leidy and Tokarick (1998). Given that unemployment is likely to affect low-skilled workers more than their highly skilled counterparts; this will further deteriorate the impact of monetary restriction on inequality. Another way through which monetary policy can affect income distribution is through the real interest rates channel at least in the short run. Given that a reduction in the money supply growth leads to an increase in both nominal and real interest rates, the increase in real interest rate will tend to make the net borrowers worse off and the net lenders better off, augmenting income inequality since there are more net lenders at the top than at the bottom of the income distribution. The worsening effect of the real interest rate channel on income inequality is stronger if financial institutions are more prompt to raise loan rates than deposit rates, Atkinson (1999).

In the short run, restrictive monetary policy seems to have predominantly worsening effect on inequality. Expansionary monetary shocks will also lead to an increase in income inequality if it results to high inflation. This is because, high levels of inflation can erode the purchasing power of money and this can affect income distribution in different ways. According to Ferreira et al (1999), low income earners are less likely to protect their living standards from inflationary shocks than high income earners because of the existence of entry barriers in most non-money financial markets. In addition, these groups of income earners hold significant proportion of their wealth in cash, thus exposing them disproportionately to purchasing power erosion by inflation. On the other hand, restrictive monetary policy that results to lower inflation in the long run can improve income distribution by slowing down the erosion of monetary financial assets and the real value of non-indexed public transfers such as unemployment benefits and pensions. Since transfer recipients are typically low income earners this would reduce inequality.

Furthermore, in the short run, some tension can exist between the dual mandate of price stability and maximum output growth and employment. For instance, in a situation where there is an upward pressure on prices accompanied by a slowing output and

employment- especially when an adverse supply shock, such as spike in energy prices, has occurred, an attempt to restrain inflation pressure could compound the weakness in the economy or an attempt to reduce employment losses could aggravate inflation. In such situations, monetary authorities are faced with a dilemma and must decide whether to focus on reducing price pressures or cushioning loss of employment and output. Also, the possibility that an expectation of increasing inflation might get built into decisions about prices and wages, could add to the inflation inertia thus, making it more difficult to achieve price stability.

In other words, reducing inflationary pressure via a restrictive policy stance can result in slowing of employment, and moving to counter the weakening of the labour market by easing monetary policy stance can result to high levels of inflation. Consequently, the use of monetary policy to actively manage aggregate demand and maintain macroeconomic equilibrium has some important distributional implications. For instance, the Fed can stimulate demand via monetary policy with very low interest rates; however, very low interest rates may worsen the distribution of income if they lead to low or negative real returns for a large number of savers. Also, low policy interest rate environment can reduce the cost of borrowing for companies- which are owned disproportionately by relatively wealthy individuals so companies can borrow at zero real rates and invest at much higher returns.

The Austrian economists have identified some channels through which changes in monetary policy can affect income inequality. Three of these channels namely; income composition channel, financial segmentation channel and portfolio channel tend to push inequality in the same direction in response to expansionary monetary policy while the other two are somewhat ambiguous in their response. According to the Austrian perspective the first channel- the income composition channel is based on the idea of income heterogeneity across households with regards to their primary sources of income. Given that majority of households rely primarily on income from labour while others get larger shares of their income from business and financial investments, an expansionary monetary policy shocks that raise profits more than wages will tend to benefit disproportionately households with claims to ownership of firms thus leading to higher inequality in response to monetary policy shifts.

The second channel, the financial segmentation channel is developed on the premise that economic agents that trade in financial markets are more likely to be affected by changes in the money supply before other agents; therefore, an increase in money supply will redistribute income toward those agents that are connected to financial markets, Williamson (2009). This channel also implies that income inequality should increase after expansionary monetary policy shocks, since households that trade in the financial markets have higher income on average than households that are unconnected with the financial markets. An additional channel pushing the response of inequality to monetary policy in the same direction is the portfolio channel. The portfolio channel implies that high income households, with large concentration of financial assets gain more from asset market booms orchestrated by expansionary monetary policy.

There are two additional channels that will tend to move inequality in the opposite direction in response to expansionary monetary policy shifts. The first channel as was noted by Doepke and Schneider (2006) is the so called savings redistribution channel. According to this channel, an unanticipated increase in interest rates or reduction in inflation will benefit savers more than borrowers thus bringing about an increase in consumption inequality to the extent that savers are wealthier than borrowers.

On the other hand, an expansionary policy action that involves a reduction of official policy interest rates or relaxation of credit controls will benefit borrowers more than savers to the extent that low income households can meet the credit standards thereby reducing inequality. Secondly, the income composition channel might lead to a reduction in inequality after an expansionary monetary policy. This is because low-income households receive a large portion of their income from transfers including unemployment benefits, food stamps amongst others than high-income households and given that transfers tend to be countercyclical, this component of income heterogeneity could lead to reduced income inequality after expansionary policy shocks Coibion et al (2012).

Our discussions thus far reveal that the impact of monetary policy on income inequality is at best ambiguous. This is because the effects of policy shifts on top and low income earners depend on the channels through which the policy shift affects inflation, savings, borrowing, changes in asset prices as well as investments. Having said that, a crucial question is whether it is optimal for monetary policy to target income inequality directly. A good place to start providing answers to this question is by defining a target for

income distribution which will be- the reduction of the income gap between the highest and the lowest income earners as well as the maintenance of the living standards of the poor. Given these two income distribution targets; the next important question is whether the current monetary policy instrument will be able to achieve these targets. We argue in favour of the use of monetary policy to target asset price misalignments which have profound implications to the income of high income earners[40] while fiscal and financial sector policies can be used directly to narrow the income distribution.

From the fiscal policy perspective, policy makers can use the progressive income tax scale and the use of transfer payments the so called "automatic stabilizers[41]" in the budget to narrow the income gap between those at the highest and lowest ends of the income spectrum as well as help the poor to achieve a minimum standard of living. The use of fiscal policy to target income inequality does have an advantage over monetary policy in the sense that increased government spending leads to an immediate increase in aggregate demand. Bastagli, Coady and Gupta (2012) showed that fiscal policy can influence income distribution directly through its effect on current disposable income and indirectly through its effect on future earnings capacities. This was corroborated by a United Nations report on trade and development (2012) that concluded that fiscal policy provides the main instruments for influencing income distribution.

From the financial policy perspective, well functioning financial systems are critical in channelling funds to the most productive uses and in allocating risks to those who are well suited to bear them, hence improving opportunities and income distribution as well as reducing poverty. Consequently, improving access and developing inclusive financial system should be a major focus of all economies at all levels of development. However, financial market imperfections limit access to finance thus, making the benefits of financial development to elude agents from low income households and small firms; thereby leaving much of the populations in absolute poverty. Demirguc-Kunt and Levine (2009) have argued that implementing financial sector policies that are targeted at reducing financial market

[40] The effect of asset price changes on the income distribution is examined in detail in the next chapter.

[41] The U.S government can be able to directly affect the distribution of income through the use of discretionary fiscal policy and automatic stabilizers. Automatic stabilizers are structural features of government spending and taxation that smooth fluctuations in disposable income and hence consumption over the business cycle, Dolls et al (2012). In other words, automatic stabilizers are those elements of fiscal policy that reduce tax burdens and increase public spending without discretionary government action they provide income replacement immediately when unemployment starts to rise. Consequently, these stabilizers will increase budget deficits during times of recessions and decrease budget deficits during times of booms.

imperfections to expand individual opportunities will create positive incentive effects and reduce persistent inequality more than redistributive policies. We will analyse in greater details the reaction of income inequality to financial sector development in the final chapter of this thesis.

2.4 Literature review on monetary policy, income inequality and financial crises

The aim of this section is to provide a review of previous findings on monetary policy, income inequality and financial crisis. In the past, income distribution and monetary policy have been considered separately. However, the implementation of the Federal Reserve's unconventional monetary policy stance at the peak of the financial crisis has re-ignited the debate about the effects of monetary policy on the distribution of income and consumption across households. There is increasing evidence that monetary policy has distributional implications for income and wealth distribution. Coibion et al (2012), using standard deviations of log of Gini and the ratio of 90th percentile/10th percentile as measures of income inequality revealed that, in the United States, contractionary monetary policy systematically increases inequality in labour earnings and total income as well as expenditures and consumption inequality. According to them, monetary policy does not only explain fluctuation but also the rising trend in income inequality since the 1990s.

Wong (2014) showed that monetary policy creates intergenerational inequality; he provided evidence that contractionary monetary policy increases inequality between young and old households in the U.S. In their own contribution, Brunnermeier and Sannikov (2012) argued that monetary policy can be used as a potent policy in reducing inequality after an adverse shock. The Bank of England (2012) in their analysis of the distributional consequences of unconventional monetary policy revealed that 40% of the wealth increase resulting from its asset purchase program benefited the top 5% wealthiest U.K households. In a related study but in a different jurisdiction, Saiki and Frost (2014) analyzed the effect of a decade of unconventional monetary policy in income inequality in Japan. They found that unconventional monetary policy led to an increase in income inequality, particularly after 2008 when quantitative easing became more aggressive. According to them, this increase in inequality is largely driven in part through the portfolio transmission channel (where high income households, with large concentration of financial securities gain more from asset market booms orchestrated by expansionary monetary policy).

In addition, increasing inequality, whether generated by monetary policy, financial policy or by other factors, is of paramount concern to central banks' policies. Kumhof et al (2013) posits that increasing income inequality, combined with rising household debt, can trigger financial crises. Financial crises pose great challenge to central banks, because such crises can distort their transmission mechanisms as well as price and financial stability. Although the adverse effects of financial crises on economic growth and poverty are well documented Birdsall (2005); and Organisation for Economic Co-operation and Development (2008), the fact that financial crises tend to worsen income distribution is less frequently considered. Income inequality literature suggests that income inequalities in most advanced countries have surged since the 1980s. The increase in income inequality is closely correlated with the increase in the incidence of financial crises over the same period, Stiglitz et al, (2009) and Rajan, (2010).

Authors such as Cornia et al, (2004) and Woo, (2005) have shown that there may be a strong link between the rise in income inequality and the increasing frequency of domestic financial crises in some advanced economies. Kumhof and Ranciere, (2010) provided support for this view when they showed that income inequality can be traced to have played a role in the two major economic crises in the U.S namely; the Great Depression of 1929 and the Great Recession of 2007. According to them there were two remarkable similarities between the periods leading up to the two crises- sharp increase in income inequality, asset prices and household debt-to-income ratios.

The inequality-financial crisis nexus can be categorized into two broad strands of literature namely- literatures that focused on whether increasing income inequality leads to financial crises, that is, does causality go from inequality to crises or vice versa and those that focused on how financial crises interact with the relationship between inequality and the business cycle, that is, do crises decrease/increase inequality. We will start our analysis by looking at recent literatures that tried to explain how income inequality can lead to financial fragility which could precipitate into a full blown crisis. Increasing inequality in the U.S has been subjected under greater scrutiny since the 2007/08 crisis.

The rising income gap between the rich and the poor has been suggested as one of the primary determinants of the global financial crisis. According to Stiglitiz et al, (2009), Fitoussi and Saraceno (2010), and Rajan (2010), the global financial crisis that started in the sub-prime mortgage market in the U.S has its roots in a structural change in income

distribution that had been going on for the past three decades. Inequality can contribute to financial fragility through several interrelated channels; for instance, increasing income and wealth inequality will reduce the purchasing power of households at the middle and lower spectrums of the income distribution.

The consequence of this reduction in purchasing power from a macro-economic perspective is redistribution away from households with higher propensity to consume to households with a lower propensity to consume United Nations Development Programme (2011). The redistribution of income from the lowest earning 80 percent of income earners to the highest earning 20 percent over the past four decades meant that money was transferred from those who would spend it to meet basic needs to those who had more than they could easily spend. This scenario created a tendency toward reduction in the levels of aggregate effective demand Stiglitz et al (2009). To hem in the negative consequences of rising inequality, policy makers in most advanced economies pursued policies that made the financial system vulnerable to instability.

According to Rajan (2010), policies such as loose monetary policy and legislations that manifested in easy credit for poor households and complex financial instruments coupled with the search for high-return investments by high income earners, who have benefited from the increase in inequality, led to the development of bubbles within the financial assets and real estate market. Galbraith et al (2007) opines that the declining real incomes and standards of living provided strong incentives for workers to borrow money against their homes in order to maintain their standards of living. In other words government felt that the only way to maintain high levels of consumption in the presence of stagnating income was for poor households to borrow, the so called ‘financing consumerism’.

The economic hardship amongst the low income households provided an easy way for mortgage purveyors to entice people to borrow money against their homes, initially at low interest rates in order to meet up with their maturing debt obligations. Consequently, household debt in the US grew from 67 percent to about 92 percent of GDP between 1997 and 2005. Reich (2010) showed that most of the sub-prime mortgage loans taken out between 2000 and 2007 were mainly by people who were refinancing their homes rather than for buying new homes. Rajan (2010) argued that easy credit became America’s substitute for decent wages. The implication of this was the creation of an economic environment filled with excessive liquidity. According to Reich (2010), the growth in

household credit and mortgage debt mirrors that of the late 1920s. Reich (2010) noted that the period between 1913 and 1928 saw the ratio of private credit to the total national economy at an all time high (nearly double) and total mortgage debt was almost three times higher in 1929 than in 1920, exactly the same scenario that was seen before the great recession.

Overvaluation of net wealth and high asset prices created a false impression that high levels of both corporate and household debts were sustainable. Researchers have argued that the political response to income inequality helped in fuelling credit bubbles within the financial sector which precipitated to the real estate market, creating bubble whose eventual collapse led to mounting toxic loans in bank's balance sheets and massive disruption of economic activities. Kumhof and Ranciere (2010) model provided a good description of the inequality-financial crisis nexus. According to them, the financial crisis of 2007-08 was the result of a shock to the relative bargaining powers over income of two groups of households namely investors and workers. Investors accounted for 5 percent of the population with increasing bargaining power while workers accounted for 95% of the population with low bargaining power in their model. They noted that investors used part of their increasing income to buy financial assets which are backed by loans to workers.

Their action allowed workers to limit the drop in consumption caused by loss of income, however, the increasing worker's debt-to-income ratios brought about financial fragility that led to a financial crisis. A similar proposition was advanced by authors such as Reich (2010) and Rajan (2010) that analyzed the link between household debt, financial crisis and income inequality, their work emphasized the role that credit demand or credit supply- see Fitoussi and Saraceno, (2010) played during the periods leading to the crisis. They argued that increased borrowing amongst the poor and middle class to maintain their level of consumption left the financial sector exposed to shocks. From a theoretical point of view, these authors seem to suggest that the widening income gaps between the high income earners and low income groups created wrong incentives which heightened the vulnerability of the financial system, since the massive borrowing by low income households led to an unsustainable path that made default and financial crisis possible.

We will now look at the second strand of inequality literature that seeks to explore the link between financial crises and increase/decrease in inequality. There is no reason within the framework of orthodox economics to expect that an external macro-economic

shock will have distributional effects. However, both empirical and theoretical studies have shown that there could be a relationship between financial shocks and income inequality, in what follows is a review of previous findings on the subject matter. Earlier empirical literature that attempted to provide answers to this question has largely focused on the relationship between currency crises and inequality in emerging economies. Most of the literatures on this subject theme show that inequality has tended to increase after major crises.

For instance Kaminsky and Reinhart (1999), using data on currency crises between 1970s and 1990s found that inequality increased substantially after crises, they showed that this increase was more in emerging than advanced countries particularly Latin America. Galbraith and Jiaging (1999), using data set of crises complied by Kaminsky and Reinhart (1999) that defined financial crisis as a weighted average of exchange rate and reserve changes provided support for the above study by showing that financial crises tend to raise inequality; however, this rise occurs the most in highly deregulated labour markets and less in highly regulated ones.

This explained why financial crises have had worse effects on Latin American workforces than on Asians and more effects on Asians than more advanced countries like the U.S. that has better insulators against financial shocks and stable wage structures. Similarly, Lustig (2000) who used data on Latin American financial crises between 1980 and 1989 found that both poverty and inequality proxied by GINI coefficient witnessed a significant increase in 40 crisis episodes. In addition, Baldacci et al (2004) that used a panel regression approach on some emerging countries in the 1990s found that currency crises resulted in an increase of income inequality. Like Lustig (2000) they used the Gini coefficients as a measure of income inequality however, they added the share of income by deciles to test the robustness of their findings. In contrast, when survey data as opposed to time series data was employed, an opposite pattern emerged.

For instance, Baldacci et al (2004) found using survey data for Mexico during and after the tequila crisis of 1994-95 that the income gap between the top and lower deciles of the income distribution reduced. They interpreted their result as reflecting larger income losses to the highest income groups compared to the lowest groups. Their findings were corroborated by Lopez and Salinas (2000) that looked at a sample of 44 countries between 1960 and 2000 and concluded that banking crises are associated with smaller GINI

coefficients. Honohan (2005) in his own study analyzed the relationship between banking crisis and inequality during the 1990s crises using data from some African countries as well as Indonesia, Mexico and Russia and found a similar reduction in income dispersion between the top and low income earners after banking crisis.

Recent studies produce conflicting evidence with regards to the notion that crises penalize the income of those at the top income spectrum more than those at the low income spectrum. For instance, Roine et al (2009), in their panel study of 16 mostly advanced countries between 1900 and 2000 using the income share of the Top deciles as a measure of income inequality found that banking crisis have significant negative impact on the income share of the top deciles, as a result, they concluded that crises are likely to reduce inequality. However, Bordo and Meissner (2011), using historical data for up to 16 countries (both advanced and emerging countries) between 1880 and 2000 and employing two measures of inequality namely the share of the total income going to the top 1%[42] and the percentage change in the ratio of unskilled wages to the average level of GDP per capita[43] found that banking and currency crises led to an increase in inequality during the pre-1914 and the post world war II eras, when you control for terms of trade shocks (that is deteriorating terms of trade). However, data on the inter war period reveals that crisis led to an improvement in income inequality showing nominal wage rigidity for the middle income earners.

Agnello and Sousa (2011) in their study of how banking crises affect income inequality for both OECD and Non-OECD countries found that inequality increases rapidly at the onset of banking crises and reduces after the crises for OECD countries. For these countries, income inequality improves after the crisis while the reverse is the case for Non-OECD countries. The seemingly lack of consensus as is seen from the literature review could be as a result of the use of different chronologies of crises, different measures of income inequality as well as different panels of countries.

2.5 The Taylor rule specification

In this section, we tested to see whether monetary policy takes into account changes in income inequality when calibrating their policy stance. If the income inequality variable is significant, then it means that monetary policy observe changes in inequality when setting

[42] This proxy is used as a measure of inequality in the post world war 11 period
[43] This proxy is used as a measure of inequality in the pre world war II

their policy stance. To achieve this object, we incorporated a measure of inequality in a linear Taylor rule framework. In what follows is a brief discussion of the Taylor rule which we used as our benchmark model.

The monetary authority's policy rule or reaction function comprise of its response to deviations in macroeconomic variables with the purpose of achieving its ultimate policy objectives. The Taylor rule is used to describe the behaviour as well as how central banks set their policy rate in achieving the objective of price stability and maximum output. The rule assumes that central banks use past or current values of inflation and output gap to set the interest rate. Taylor (1993), proposed a rule that characterize the monetary policy in the US over the period 1987-1992;

$$r_t^* = r + \pi_t + \beta(\pi_t - \pi^*) + \gamma(y_t - y_t^*) \qquad (2.0)$$

Where

$r_t^*$is the target short term nominal interest rate, r is the long run equilibrium real interest rate, π_t is the inflation rate, π^* is the target inflation rate, and y_t is the measure of the output gap. The rule takes the nominal short term interest rate r_t^* as the monetary policy instrument and predicts that it should increase if inflation (π_t) increases above its target range (π^*). β and γ indicates the sensitivity of interest rate policy to deviations in inflation and output gap respectively from their targets. In equilibrium, the deviation of inflation and output from their target values is zero and therefore, the desired interest rate is the sum of equilibrium real rate plus the target value of inflation.

However, Clarida et al (1998) made important modifications to the Taylor rule by suggesting the use of a forward-looking version of the rule where policy makers target expected inflation and output gap instead of past or actual values of these variables. The forward looking Taylor rule allows the Central Bank to take relevant variables into account when forming its inflation forecasts. These views were supported by Sauer and Sturm (2007) who highlighted the importance of considering a forward looking Taylor rule in the analysis of the ECB monetary policy. Equally, Johnson (2002) argues in favour of the inclusion of forward-looking indicators in monetary response function. Kent and Lowe (1997) opined that the forward looking behaviour is in line with inflation targeting central

banks. In line with Clarida et al (1998) we assumed that the Central bank has a target for the nominal short term interest rate r_t^* and this target is based on the state of the economy.

In the baseline model equation (2.0) the target interest rate is seen as a function of both expected inflation and output.

$$r_t^* = \bar{r} + \beta(E[\pi_{t+n}/\Omega_t] - \pi^*) + \gamma(E[y_t/\Omega_t] - y_t^*) \quad (2.1)$$

Where $\bar{r}$ the target nominal interest rate, π_{t+n} is the rate of inflation between periods t and $t+n$, y_t is real output and π^* and y_t^* are the desired points for inflation and output respectively. E is the expectation operator and Ω_t is the information available to the central bank at the time it sets interest rates. To account for the possibility of lack of direct information about current values of either output or the price level, they considered an implied target rate for the ex ante real interest rate, $rr_t = r_t - E[\pi_{t+n}|\Omega]$, rearranging equation 2.1 gives;

$$rr_t^* = \overline{rr} + (\beta - 1)(E[\pi_{t+n}|\Omega_t] - \pi^*) + \gamma(E[y_t|\Omega_t] - y_t^*) \quad (2.2)$$

Where $\overline{rr}$ is the long–run equilibrium real rate of interest which is determined by purely real factors; equation (2.2) stipulates that the target real rate will adjust relative to its natural rate in response to deviations of either expected inflation or output from their respective targets. According to the "Taylor principle" for monetary policy to be stabilizing the coefficient on the inflation gap (β) should exceed unity and the coefficient on the output gap (γ) should be positive. A coefficient greater than unity on the inflation gap means that the central bank increases the real rate in response to an expected rise in inflation, which exerts a stabilizing effect on inflation; on the other hand, $\beta < 1$ indicates an accommodative behaviour of interest rates to inflation, which may generate self-fulfilling bursts of inflation and output, Bernanke and Woodford (1997) and Clarida et al (1998). An estimated magnitude of the parameter β therefore, offers an important benchmark for evaluating a central bank's policy rule. A positive coefficient on output gap means that in situations in which output is below its potential a decrease in the interest rate will have a stabilizing effect on the economy Clarida et al (2000).

The specification equation (2.2) resembles the original Taylor rule; however if either lagged inflation or output gap provides enough information for inflation then the equation reduces to a simple Taylor rule. Clarida et al (1998) have highlighted the virtues of the forward looking reaction function arguing that explicitly incorporating expected inflation in the central bank's reaction function makes it easy to separate the link between the estimated coefficients and central bank objectives which is usually not very clear in the simple Taylor specification. Furthermore, by allowing policy makers to respond to forecasts of inflation and output gap the model incorporates a realistic feature of policy making namely that central banks look at board array of information when calibrating monetary policy stance.

Nevertheless, a simple rule like equation (2.2) has some flaws because of its inability to capture the tendency of central banks to smooth changes in interest[44] rates. These characteristics have often led to criticism that policy reacts too little or too late to macroeconomic developments thus suggesting that monetary authorities have an additional objective of minimizing interest rate volatility in addition to stabilizing inflation and output. To capture the interest rate smoothing assumption Clarida et al (1998) assumes that in each period, the actual interest rate partially adjusts towards the target value.

Including the partial adjustment mechanism in the central banks' reaction function reflects to a large extent optimal behaviour on the part of central banks whose primary focus is on inflation and output stabilization Goodfriend, (1991), Svensson (1997) and Sack and Wieland (2000). The findings from our literature review suggest four major arguments that might help to explain why the observed degree of interest rate smoothing may be optimal. These arguments presented in turn below include: Forward-looking behaviour of market participants, uncertainty about key macro-economic parameters, fear of disrupting financial markets and loss of credibility.

Forward looking expectations: Monetary policy rules with forward looking expectations that are estimated in form of equation (2.2) are usually not as effective as rules with partial adjustment mechanism in stabilizing output and inflation for a given level of interest rate volatility. Forward looking market participants normally expect a small initial policy shift to be followed by additional shifts in the same direction. When monetary

[44] Interest rate smoothing refers to the tendency of central banks to change short-term interest rates in sequences of small steps in the same direction and a reversal of that direction is done only infrequently, Sack and Wieland (2000).

authorities exhibit high degree of partial adjustments, it increases the effectiveness of policy on current output and inflation without significant interest rate changes Woodford (2003).

Data and parameter uncertainty: Central bankers face high level of uncertainty when making interest rate decisions because the data upon which these decisions are based specifically, estimates of potential output gap and the natural rate of unemployment may be revised years later. Sack and Wieland (1999) discussed the impact of data uncertainty on interest rate setting. Furthermore, the uncertainty about the exact state of the economy and about the key parameters of the economic structure that affects the transmission of monetary policy calls for caution in setting the policy rate. Soderstrom (2002) in their study discussed the implications of this parameter uncertainty on policy rate. According to them, when parameters are uncertain, contractionary policy stance which might otherwise be expected to offset inflationary pressure and output deviations fairly quickly are more likely to have unintended consequences on output and inflation. Optimal policy behaviour in such a situation may be to implement a gradual response of the interest rate instrument[45] that would return output and inflation more slowly to their respective targeted values.

Fear of disrupting financial markets: The adverse reaction of financial markets to regular changes in the direction of interest rates has been pointed out as one of the main reasons behind interest rate smoothing. Given that deposit money banks offer flexible interest rates on deposits and receive fixed interest payments for loans, high interest rate volatility may lead to bankruptcies since banks' liabilities may be higher than its available assets. Hence the gradual adjustment of rates provides banks an opportunity to adjust their assets and liabilities portfolios in response to interest rate changes Cukierman (1991).

Loss of credibility: Goodhart (1999) suggests that policymakers may use interest rate smoothing as a means of protecting their reputation. Central banks might lose credibility as a result of large sudden interest rate reversals. The inability of market participants to assess whether a change in policy reflects reaction to latest macro-economic developments or just the correction of an earlier policy mistake might prompt policymakers to smooth interest

[45] Economists such as Ball (1997) and Rudebusch (2001) have argued against the policy inertia hypothesis of interest rate smoothing. According to them, smoothing might be present in the data as a result of some omitted variables which monetary policy reacts to but which are not captured in the estimated policy reaction function. Rudebusch suggests that interest rate smoothing will arise if these omitted variables are auto-correlated. Other researchers have argued that the practice of smoothing interest rates might reflect an objective of lowering interest rate volatility in addition to the Federal Reserve's mandate of minimizing deviations of output from its potential level and inflation from its target.

rates in order to reduce the need for reversals and reduce the chances of being exposed to criticism. In other to capture these factors it is assumed that the actual rate partially adjusts[46] to the target as follows;

$$r_t = (1-\rho)r_t^* + \rho r_{t-1} + v_t \quad (2.3)$$

where the parameter $\rho\epsilon[0,1]$ captures the degree of interest rate smoothing and v_t. is an exogenous random shock to the interest rate which is assumed to be iid. The exogenous random shock to the interest rate v_t could reflect a pure random component to policy or could be introduced because of the policy maker's inability to perfectly forecast idiosyncratic reserve demand and as a result fails to immediately supply reserves to offset the shock. Under such a condition, the interest rate tends to jump in response to unexpected movements in reserve demand that are orthogonal to movements in inflation and output Clarida et al (1998). Defining $\alpha \equiv \overline{r} - \beta\pi^*$ and $x_t \equiv y_t - y_t^*$ and rewriting equation (2.2) as;

$$r_t^* = \alpha + \beta E[\pi_{t+n}|\Omega_t] + \gamma E[x_t|\Omega_t] \quad (2.4)$$

We get the target model. Combining the target model equation (2.4) with the partial adjustment mechanism equation (2.3) yields;

$$r_t = (1-\rho)\alpha + \beta E[\pi_{t+n}|\Omega_t] + \gamma E[x_t|\Omega_t] + \rho r_{t-1} + v_t \quad (2.5)$$

Replacing the unobserved forecast variables from the policy rule with realized variables so as to estimate the model we obtain a new policy rule;

$$r_t = (1-\rho)\alpha + (1-\rho)\beta\pi_{t+n} + (1-\rho)\gamma x_t + \rho r_{t-1} + \varepsilon_t \quad (2.6)$$

[46] As was noted by Clarida et al (2000) introducing the partial adjustment into the reaction function means that the condition β>1 does not automatically guarantee that the real rate goes up when inflation rises, only that it 'eventually' goes up. However, the expected increase may reflect immediately in real long term yields. On the other hand, the short term-real rate will rise immediately if inflation is expected to increase in the future.

Where the error term $\varepsilon_t = -(1-\rho)\{\beta(\pi_{t+n} - E[\pi_{t+n}|\Omega_t])\} + v_t$ the error term is a linear combination of the forecast errors of inflation and output and the exogenous disturbance v_t, the set of orthogonality conditions implied by equation (2.6) is;

$$E[r_1 - (1-\rho)\alpha - (1-\rho)\beta\pi_{t+n} - (1-\rho)\gamma\hat{y}_t - \rho r_{t-1}|z_t]=0 \qquad (2.7)$$

Where z_t is a vector of variables that are inside the policymaker's information set at the time it sets the interest rate i.e. $(z_t \in \Omega_t)$ that are orthogonal to ε_t. Potential elements of z_t comprise of any lagged variables that help forecast inflation and output as well as any contemporaneous variables that are not correlated with the current interest rate shockv_t.

2.6 Data description and summary statistics

The data we used for this analysis are quarterly time series spanning the period 1967:q1-2011:q4. All our data apart from the average income share of the top 1 percent, one year- ahead inflation expectation forecasts and the 90/10 income differentials were sourced from FRED (Federal Reserve Economic Data) database from Federal Reserve Bank of St Louis. We employed effective Federal Funds rate percentage per annum as our proxy for monetary policy. The Federal Funds rate is used by the Federal Reserve as the operating target in its conduct of monetary policy. The Fed specifically targets the Federal Funds rate which is the rate at which central bank balances, are lent for one day. This rate serves as both the policy rate (the rate decided by the Federal Open Market Committee) and the official operating target. The 3 months Treasury bill which is a short term debt security issued by the government was used as an alternative stance of monetary policy. The baseline inflation measure we used is the annualized log of consumer price index growth rate. Measured as

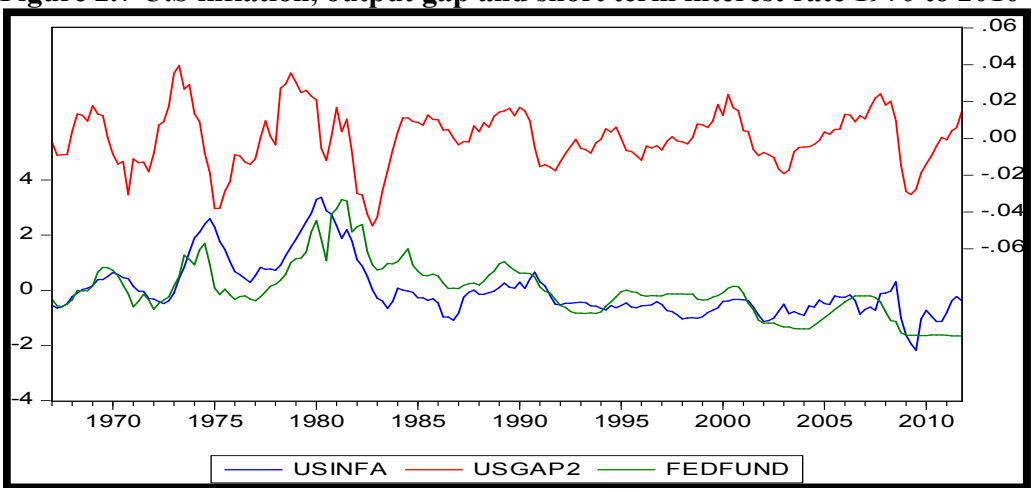
$$100 \times ln\left({(x_t)}/{(x_{t-1})}\right)^{47} \qquad (2.8)$$

[47] $\ln(x_t) = Natural\ Log x_t$ is the value of series x at time period t.

We used annualized data because it facilitates the comparison of growth rates of various time periods. In other words, this kind of data adjustment allows for easy comparison of percent changes, irrespective of the time period and is very common in economic analysis. For the output gap, the difference between actual and potential output, is calculated via Hodrick-Prescott de-trended log of real GDP. The output gap measures how far the economy is from its full employment or productive potential.

Figure 2.7 below is a plot of U.S inflation, output gap and short term interest rate. The U.S inflation rate and short term interest rate displays great similarities. The plot shows that both the inflation series and the interest rate series moved in tandem with each other since the 1970s up until the 2000s, although the magnitude of the increases and decreases were much higher in the inflation series. The plot seems to support the Barro and Gordon, (1983) "inflation bias" hypothesis which claim that the high inflation of the 1970s was due to the lack of proper incentives on the part of policymakers who chose to accept high inflation in order to prevent a recession.

Figure 2.7 U.S inflation, output gap and short term interest rate 1970 to 2010



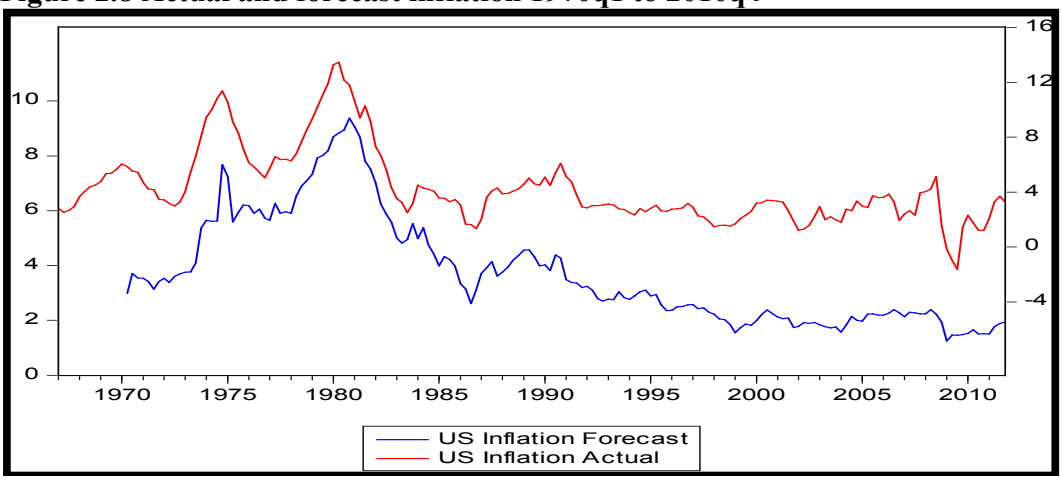
Data sourced from the Federal Reserve banks of Philadelphia and St Louis

The output gap in figure (2.7) shows significant divergence with inflation and short term interest rate, while both interest rate and inflation series were increasing during the mid 1970s, the output gap defined as the difference between actual and potential GDP was decreasing. A potential explanation of the "output gap conundrum" was that policy makers relied on deeply flawed estimates of the output gap, Orphanides (2002, p.7). According to him, "…the error in the real-time assessment of the natural rate of unemployment meant that

for much of the 1970s policy decisions were based on the incorrect belief that the economy was operating below its full employment potential, while the opposite was true."

In a bid to rein in the resultant inflation the Fed reversed its policies, raising interest rates to some 20 percent, a number that was considered usurious for interest rate sensitive industries. This had a negative impact on the U.S productivity levels. Finally, the decline in the output gap indicates a weaker U.S economy during the global financial crisis since it is declining after its peak in the early 2000s. For the expected inflation we used the expectations for one-year-ahead annual average inflation forecasts sourced from the Federal Reserve Bank of Philadelphia.

Figure 2.8 Actual and forecast inflation 1970q1 to 2010q4



Data sourced from the Federal Reserve banks of Philadelphia and St Louis

Figure 2.8 is the plot of actual and forecast inflation data. The plot shows that actual inflation has been more volatile than forecast inflation series. Both the actual and forecast inflation rate has tracked each other in that both series increases and decreases at almost the same time, however, the magnitude of the increase and decrease has been higher in the actual inflation series. A closer look at the plot reveals a drop in the volatility of actual inflation in the 1990s which saw both series almost in near perfect synchrony. An interesting feature of the two series that is worth mentioning is that there was no remarkable divergence in both series, that is they tend to move together.

Following Sarel (1997) and Ibarra and Trupkin (2011) and Danne and Schnabl (2008) we used the logarithm of inflation rate so as to avoid the distortion of our regression results by extreme observations. Figures A2.1a and A2.1b in the appendix of this chapter

presents the histograms of the distribution of inflation rate and its logarithmic transformation respectively, as can be seen from these figures, the rate of inflation has an asymmetric distribution (positive skew). Using this variable will place an enormous weight on the few observations with highest inflation rate while the logarithm of inflation has a more balanced distribution, in fact by using the log of inflation rate; we obtained an almost symmetric inflation distribution which is comparable to a normal distribution. Finally, Ghosh and Phillips (1998) provided documented evidence that suggests that the log function provides a reasonable characterization of the inflation-growth nexus.

Measures of income and consumption inequality

Given that inequality is a difficult concept to measure, we used three measures of income inequality in this chapter namely, the Gini coefficient, the 90/10 income differentials and the income share going to the top 1 percent households.

Gini coefficient: The Gini coefficient is by far the most popular measure of income inequality. This measure is derived from the Lorenz curve framework[48]. We used continuously compounded growth rate in the calculation of the Gini index measured as: $\left(\left(\frac{x(t)}{x(t-1)}\right)-1\right)$[49] $\times 100$. Although the Gini[50] index has been the most popular method for operationalising income inequality in economics, sociology and public health literature, however, the index does not contain information about the absolute national or personal incomes, De Maio (2007). The index does not take into account the differential efficiency of use of household income and frequently ignores wealth except as it contributes to income. A major limitation of Gini coefficient is its inability of differentiating different kinds of inequalities, Cowell (1995).

[48] The Lorenz curve shows the percentage of total income earned by cumulative percentage of the population, De Maio (2007). The logic behind the Lorenz curve is that in a perfectly equal society, the "poorest" 25 percent of the population would earn 25 percent of the total income, the "poorest" 50 percent of the population would earn 50 percent of the total income and the Lorenz curve would follow the path of the 45^0 line of equality. As inequality increases, the Lorenz curve will deviate from the line of equality; the "poorest" 25 percent of the population may earn 20 percent of the total income and so on, De Maio (2007). An important property of the Lorenz framework is that it can be used to develop a single summary statistic of the income distribution, the GINI coefficient.

[49] $\ln\left(x(t)\right) = Natural\ Log x(t)$ is the value of series x at time period t.

[50] The Gini coefficient is equivalent to the size of the area between the Lorenz curve and the 45^o line of equality divided by the total area under the 45^0 line of equality. The Gini coefficient used in this study is presented as a percentage. A Gini coefficient of 1 implies that the Lorenz curve follows the line of equality. As the Lorenz curve deviates from the line of equality, the higher will be the resulting value of the Gini coefficient.

As was noted by Ellison (2002) and Lambert (1980), researchers working with the Gini coefficient need to be aware that it is most sensitive to inequalities in the middle part of the income spectrum thus this measure of income inequality is not "neutral or value free". In addition, Lorenz curves may intersect, reflecting differing patterns of income distribution, but nevertheless resulting in similar Gini coefficient values, thus, making comparisons of Gini coefficient values difficult and complicated, Atkinson (1975), and Cowell (1995). Furthermore, in some situations where there may be valid reasons to emphasize inequalities in the top or bottom of the income spectrum this summary measure may not be appropriate. Consequently, the present chapter employs an alternative measure of income inequality the share of total income accruing to the top 1 percent, (income is defined as market or gross income including capital gains). This measure provides a more nuanced understanding of the distribution of income particularly at the top of the income distribution.

Dispersion ratio[51] *90/10 income differential:* this is defined as the percentage wage differential between the worker at the 90h percentile of income distribution and the worker at the 10^{th} percentile. We used continuously compounded growth rate measured as:

$$100 \times ln\left(\left.(x_t)\right/_{(x_{t-1})}\right) \tag{2.9}$$

This proxy is a measure of the range of the income distribution. As inequality increases, the difference between households at the 90th and 10th percentiles of the income distribution will also be growing. One of the limitations of the use of 90/10 wage differential as a measure of income inequality is that this ratio can be very vulnerable to extreme values and outliers. In addition it has no axiomatic basis: that is, it is not derived from principles about equity.

Proportion of income received by the top 1 percent: The proportion of income received by the richest or poorest $nth\%$ of the population is amongst the most intuitive measures of income inequality. Its intuitive appeal makes it an appropriate choice of income inequality measure for many audiences. Unlike the Gini index, this measure allows you to

[51]The dispersion ratio measure the distance between two groups in the distribution of income. The most frequently used are the deciles and quintiles. A decile is a group containing 10 percent of the total population; a quintile is a group containing 20 percent of the population.

emphasize inequalities in any part of the income spectrum. However, this measure has its own limitations, in that it offers a very limited insight into the income distribution; the share/proportion of income received by the richest 1 percent of the population for instance does not inform us about how equally income is shared by the richest 1 percent[52]. In addition, this measure does not reveal anything about the nature of the income distribution among the rest of the population. As important as theses limitations are, proportion measures has been used extensively in income inequality literatures.

In line with Bordo and Meissner (2011) we employed the income share accruing to the top I percent of the earning population (measured as log annualized growth rate) to overcome the limitations of the other two measures of income inequality; however, before we discuss about this variable, it is important to put the figures into perspective by understanding exactly what the figure means. The average annual income earned by the top 1 percent of the population is $717,000, compared to the average income of the rest of the population, which is around $51,000, Dunn (2012). Dunn posits that the real disparity between the classes is not in income, but in net value. He opined that the 1 percent earning population are worth about $8.4 million or 70 times the worth of the lower classes[53].

Wolff (2012) in his own contribution estimates the net worth of the top 1 percent to be around $6,616,000 or more while the bottom 90 percent has a net worth of less than $890,000. From this perspective, it is no surprise that the bulk of income inequality can be attributed to this class of income earners. Consequently, we used this variable as our main measure of inequality in this thesis. The data for this measure of inequality was sourced from 'Top Incomes Database', Alvaredo, Atkinson, Piketty and Saez (2007 updated 2014). Our reason for using this variable as the main measure of income inequality is because the growth in income inequality for the past 30 years has been largely driven by trends at the very top of the income distribution. This is supported by some of the empirical literature on the distribution of income and wealth that tried to explain long-run changes in the income inequality data, Piketty and Saez (2003); and Piketty (2010). These studies came to the

[52] This limitation can be resolved through the use of quantile regressions that are used to examine the entire income distribution. Quantile regression was used in chapter three of this thesis to evaluate the response of income to asset prices. This estimation technique aids our understanding of how households at different ends of the income spectrum react to changes in financial and non-financial assets.

[53] According to the Dunn (2012), corporate American executives make 62 times more money than an average worker in bonuses alone. He argued that 'incentive pay' rose by 30 percent from years before the recession of 2007.

conclusion that the changes in income distribution for most of the countries studied has been driven by a sharp increase in top income share. We used the following as our lists of instruments for the GMM estimations: lags 1 of Civilian unemployment rate sourced from the Federal Reserve Economic Database; M1 which is a measure of money stock: in addition to the lags 1 of all the regressors. All the variables used in this study are stationary variables given that we transformed them to growth rates. We conducted a formal test of stationarity of the variables using the Augmented Dickey-Fuller test with trend and intercept included in the test equation. The result of the ADF test is reported in Table 2.2.

Table 2.2 Augmented Dickey-Fuller Test with trend and intercept

Parameters	$t-Statistic$	Probability
π	-3.21	0.02
π^f	4.27	0.00
y	-5.411	0.00
tp	-4.26	0.00
g	-3.91	0.00
wg	-6.08	0.00
3_tb	-5.88	0.00
l	-8.24	0.00
h	-3.51	0.00
ue	-3.25	0.00
r	-3.93	0.01

Notes:
π denotes the inflation rate, π^f denotes the log of one-year-ahead inflation, y denotes the Hodrick-Prescott detrended real GDP, tp is the growth rate of the income share going to the top 1 percent income earners, g denotes the growth rate of GINI index of inequality, wg denotes the growth rate of the percent wage differential between the worker at the 90th percentile of income distribution and the worker at the 10th percentile (wage gap), 3_tb denotes the three months treasury bill, l denotes the growth rate of average annual consumption expenditures of housholds within the lowest 20 income quintiles, h denotes the growth rate of average annual consumption expenditures of households within the highest 20 income quintiles, and ue denotes the unemployment rate, r denotes the effective federal funds rate. Lag length 5 based on AIC.

Table 2.3 is the descriptive statistics of our variables.

Table 2.3 Descriptive Statistics for the Variables1967:q1-2011:q4

	r	π	y	3_tp	g	wg	tb	ue	π^f
Mean	6.14	4.33	0.01	555269	0.43	9.97	5.52	6.10	1.20
Maximum	17.78	13.47	0.04	1003791	0.47	11.67	15.05	10.7	2.24
minimum	0.12	-1.63	-0.10	321122	0.37	8.53	0.06	3.40	0.23
Std. Dev.	3.51	2.75	0.02	227200	0.03	0.90	2.98	1.62	0.50

Notes:
r denotes effective federal funds rate, π is the inflation rate, y denotes the Hodrick-Prescott detrended real GDP, tp is the growth rate of the income share going to the top 1 percent income earners. g denotes GINI index of inequality, wg denotes the percent wage differential between the worker at the 90th percentile of income distribution and the worker at the 10th percentile (wage gap). 3_tb denotes the three months Treasury bill and ue denotes the unemployment rate while π^f denotes the log of one year ahead inflation expectation forecast.

The descriptive statistics shows the mean, maximum, minimum and standard deviations of each of the variables used in the estimation. The correlation matrix reveals a high level of positive correlation amongst the three measures of income inequality namely, the income share of the top 1 percent, GINI index of inequality and the 90/10 wage differential, defined as the income difference between the worker at the 90th percentile of income distribution and the worker at the 10th percentile.

Table 2.4 Correlation Matrix1967:q1-2011:q4

	r	π	y	tp	g	wg	3_tb	ue	π^f
r	1.00	0.74	0.24	-0.59	-0.59	-0.60	0.99	0.07	0.81
π	0.74	1.00	0.15	-0.57	-0.64	-0.67	0.71	0.01	0.85
y	0.24	0.15	1.00	0.10	-0.01	-0.04	0.22	-0.58	0.08
tp	-0.59	-0.57	0.10	1.00	0.94	0.91	-0.60	-0.23	-0.84
g	-0.59	-0.64	-0.01	0.94	1.00	0.96	-0.60	-0.08	-0.87
wg	-0.60	-0.67	-0.04	0.91	0.96	1.00	-0.61	-0.01	-0.85
3_tb	0.99	0.71	0.22	-0.60	-0.60	-0.61	1.00	0.09	0.82
ue	0.07	0.10	-0.58	-0.23	-0.08	-0.01	0.09	1.00	0.30
π^f	0.81	0.85	0.08	-0.84	-0.87	-0.85	0.82	0.30	1.00

Notes:
r denotes effective federal funds rate, π is the annualized inflation rate, y denotes the Hodrick-Prescott detrended real GDP, tp is the growth rate of the income share going to the top 1 percent income earners. g denotes GINI index of inequality, wg denotes the percent wage differential between the worker at the 90th percentile of income distribution and the worker at the 10th percentile (wage gap). 3_tb denotes the three months treasury bill and uedenotes the unemployment rate and π^f denotes the log of one-year-ahead inflation expectation forecast.

2.6.1 Presentation and interpretation of results:

Table 2.5 OLS estimates of benchmark and augmented Taylor Rule 1967q1-2011q4

Parameters	Column 1 benchmark result	Column 2 tp	Column 3 g	Column 4 wg
$\propto$	-0.27 [-1.50]	-0.28 [-1.24]	-0.22 [-0.95]	-0.21 [0.92]
ρ	0.84*** [26.12]	0.83*** [26.75]	0.83*** [25.35]	0.84*** [26.13]
$\beta_1\pi^f$	1.56*** [4.16]	1.52*** [3.40]	1.51*** [3.20]	1.51*** [3.26]
$\beta_2 y_t$	0.44*** [6.36]	0.40*** [4.52]	0.42*** [4.87]	0.42*** [4.73]
$\beta_3 tp$		0.02** [1.83]		
$\beta_4 g$			-0.06 [-0.89]	
$\beta_5 wg$				-0.05 [-0.95]
$Adj\ R^2$	0.94	0.94	0.94	0.94
RR_T	0.72	0.24	0.49	0.46

Notes:

$\propto, \rho, \beta_1\pi^f, \beta_2 y_t, \beta_3 tp, \beta_4 g, \beta_5 wg$ represent the parameters in the 4 models, where $\propto$ is the constant, ρ is the smoothing parameter, $\beta_1\pi^f$ is the Log of one year ahead inflation expectation forecasts, $\beta_2 y_t$ is the estimated weight on output gap, $\beta_3 tp$ is the estimated weight on the average growth rate of income share going to the top 1 percent income earners, $\beta_4 g$ is the estimated weight on growth rate of GINI index of inequality and $\beta_5 wg$ is the estimated weight on the percent wage differential between the worker at the 90th percentile of income distribution and the worker at the 10th percentile (wage gap). . The parameter estimates are obtained by OLS estimation using HAC standard errors & covariance (Bartlett Kernel, Newey-West fixed bandwidth = 5, 0000). The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $AdjR^2$ is the adjusted R^2, RR_T denotes the t-statistic for the Ramsey Reset diagnostic test. Column 1 contains the OLS estimates of the policy coefficients from the forward looking Taylor Rule given below

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi^f + \beta_2 y_t\} + \varepsilon_t \quad \text{(a)}$$

Column 2 contains the OLS estimates of the policy coefficients from the augmented forward looking Taylor Rule augmented with the average income of the top 1 percent given below

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi^f + \beta_2 y_t + \beta_3 tp_t\} + \varepsilon_t \quad \text{(b)}$$

Column 3 contains the OLS estimates of the policy coefficients from the augmented forward looking Taylor Rule augmented with the GINI index of income inequality given below

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi^f + \beta_2 y_t + \beta_4 g_t\} + \varepsilon_t \quad \text{(c)}$$

Column 3 contains the OLS estimates of the policy coefficients from the augmented forward looking Taylor Rule augmented with the GINI index of income inequality given below

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi^f + \beta_2 y_t + \beta_5 wg_t\} + \varepsilon_t \quad \text{(d)}$$

Table 2.5 is the results from the benchmark forward looking Taylor rule and the augmented Taylor rule. This is an interest rate rule that specifies a target for the policy rate as a function of deviations of inflation from its target and some measure of slack in economic activities such as the output gap or level of unemployment. The 'Taylor principle" which is an integral part of the rule stipulates that the Federal Funds rate should be increased when inflation is above its target rate. The stabilization criterion implies that the nominal funds rate should rise more than one-for-one with an increase in inflation above its target. We model the forward-looking nature of the policy rule by relating the current value of the federal funds rate to the one-year-ahead average expected inflation rate and the contemporaneous output gap.

The results presented in table 2.5 above suggest several conclusions. First, the policy response coefficients in the estimated Taylor rule, namely, the smoothing parameter ρ, the one year ahead inflation expectation forecasts $\beta\pi^f$, and the output gap βy_t in all the models are all positively signed and statistically significant. The major points to note are; that the estimated long run inflation coefficients $\beta\pi^f$ are well above unity, which suggests that Federal Reserve responded strongly to expected inflation. In addition, the estimated output gap βy_t response coefficients in all the models are generally well below unity, suggesting the presence of a relatively weak response to the output gap.

Finally, the estimated partial adjustment coefficients ρ, are well above zero, indicating the presence of interest rate smoothing; having said that, we move to interpret the results from each of the models separately. The empirical result from the benchmark model (table 2.5, column 1) satisfies the dynamic stability criterion since the estimated inflation coefficient is greater than one. Specifically, the result shows that a one unit increase in inflation will cause monetary policy makers to increase interest rate by approximately (1.56) basis points other things being equal. This implies that the real rate increases in response to an expected rise in inflation thus exerting a stabilizing effect on inflation.

In addition the output gap coefficient is positive and statistically significant at the 1 percent level. Its estimate implies that, holding expected inflation constant, one percent increase in the level of output gap induces the Federal Reserve to increase interest rates by (0.44) 44 basis points. This result is in line with those reported by Judd and Rudebusch (1998) who employed quarterly U.S data. The result seems to suggest that the Federal Reserve has put more weight on price stability than output stabilization during our sample

period. The estimate of the interest rate smoothing parameter is close to 1 at 0.88 which indicates a high level of persistence in short-term interest rate. The result supports the notion that the U.S Federal Reserve smoothes the adjustment of interest rates towards their target values.

Table 2.5 column 2 reports the estimated parameters of the augmented Taylor Rule, with the share of income going to the top 1 percent βtp_t as a measure of income inequality. The results from this model is consistent with Clarida's et al (2000) and Taylor (1999) in that monetary policy is found to be stable during our sample period ($\beta\pi^f > 1$) and statistically significant. The policy rate is estimated to increase by about (1.55) basis points for every 1 percent increase in inflation holding other variables constant. A reaction of over a hundred basis point for a I percent increase in inflation expectations over one year.

The coefficient for the output gap is positive and statistically significant and is below unity $\beta y_t < 1$. This suggests that the Fed adjusts its policy rate if there is a deviation of output from potential; however, the Fed's response to output deviation is relatively weak when compared to its response to the deviations of inflation from its desired level. Specifically, the result reveals an increase of about (0.46) 46 basis points in the policy rate for every 1 percent increase in output holding all the other variables within the model constant and the result is statistically significant at the 1 percent levels.

The result from the top 1 percent augmented Taylor Rule implies a stable monetary policy with the inflation coefficient greater than 1. The estimated coefficient of the top 1 percent income group βtp_t is positive and statistically significant, suggesting a restrictive policy stance in the face of increases in the share of income going to the top 1 percent and monetary easing in the presence of a decline in the incomes of this group. One interpretation of this result is that during the sample period, controlling for inflation and output gap, the Fed was increasing the Federal funds rate as the income of the top 1 percent increases. The result from this model imply that a 1 percent increase in the income of the top 1 percent results in an increase of (0.04) i.e. 4 basis point in the policy rate.

Looking at the GINI βg and the _90_10 wage gap βwg augmented model in table 2.5 columns 3 and 4, we can observe evidence of a stable monetary policy given that the inflation coefficients in both models are greater than one and statistically significant at the 1 percent levels. The coefficients on the output gap in both models are consistent with previous results (significant, below unity and positive) indicating an increase in Federal

funds rate in response to deviations of output from its potential. The coefficients on both Gini and the _90_10 wage gap are both statistically insignificant. This seems to suggest that the Fed does not take variations in these two measures of income inequality into account in its reaction function.

The evidence of no reaction in the Gini and 90/10 augmented models could be as a result of the limitations of Gini coefficient and the 90/10 wage differentials as measures of income inequality. Given that the Gini coefficient measure relative, not absolute wealth, some authors have argued that changes in income inequality, measured by Gini coefficients can be due to structural changes in society such as growing and aging population, extended family households dividing into nuclear families, immigration and emigration as well as income mobility amongst others Kwok (2010), and the Fed does not react to such changes. As well as the inability of this summary measure in identifying where the observed income inequality is occurring, or that the reaction to the top 1 percent income inequality measure is an indirect reaction to the stock market given the high correlation between this variable and the S&P500. Finally, the Ramsey Reset test which is used to test for specification errors indicates that all the OLS models were correctly specified. We turn to look at the potential reaction of monetary policy to income inequality using the GMM estimation method.

The results for the GMM estimate of benchmark and augmented Taylor rule is reported in table 2.6 below. The reaction function that we modelled is of this form:

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta\pi_{t+1} + \beta y_t/z_t\} + \varepsilon_t \qquad (2.10)$$

Where z_t represents all the variables in the Fed's information set available at time t when the interest rate is chosen (instruments). In order to control for the simultaneity bias in the relationship between monetary policy and the regressors, we instrument for the contemporaneous values of output gap and income inequality. The benchmark reaction function given by equation (2.10) is estimated using the GMM and the instruments employed in the estimation include a constant, first lags of output gap, measure of income inequality, unemployment rate and M1 as well as the second lag of expected inflation. Since the number of instrument is greater than the number of the parameters in the model[$\propto, \rho, \beta\pi_{t+1}, y_t$], we test for the validity of the over-identifying restrictions using Hansen's $J - statistic$. Clarida et al (2000) posits that a failure to reject orthogonality implies that the

Fed considers lagged variables in its reaction function, only to the extent that they forecast future inflation and output.

Table 2.6 GMM estimates of benchmark and augmented Taylor Rule 1967q1-2011q4

Parameters	Column 1 benchmark	Column 2 tp	Column 3 g	Column 4 wg
$\propto$	0.12 [0.77]	0.08 [0.87]	0.19 [1.31]	0.21 [1.51]
ρ	0.86*** [31.76]	0.88*** [38.41]	0.89*** [35.51]	0.89*** [36.36]
$\beta_1\pi_{t+1}$	1.23*** [3.55]	1.09** [2.90]	0.92*** [2.02]	0.94** [2.01]
$\beta_2 y_t$	0.32* [2.40]	0.46*** [3.41]	0.44** [2.79]	0.40*** [2.39]
$\beta_3 tp_t$		0.06*** [2.47]		
$\beta_4 g_t$			0.01 [0.73]	
$\beta_5 wg_t$				-0.04 [0.48]
$Adj\ R^2$	0.94	0.94	0.93	0.93
$pro.(j-stat)$	0.30	0.71	0.78	0.97

Notes:

$\propto$, ρ, $\beta_1\pi_{t+1}$, $\beta_2 y_t$, $\beta_3 tp_t$, $\beta_4 g_t$, $\beta_5 wg_t$, represent the parameters in the 4 models, where $\propto$ is the constant, ρ is the smoothing parameter, $\beta_1\pi_{t+1}$ is the actual future Inflation i.e one period ahead inflation, $\beta_2 y_t$ is the estimated weight on output gap, $\beta_3 tp_t$ is the estimated weight on the average growth rate of income share going to the top 1 percent income earners, $\beta_4 g_t$ is the estimated weight on growth rate of GINI index of inequality and $\beta_5 wg$ is the estimated weight on the percent wage differential between the worker at the 90th percentile of income distribution and the worker at the 10th percentile (wage gap). The parameter estimates are obtained by GMM estimation using HAC [Bartlett Kernel, Newey-West fixed bandwidth=50000] as the estimation weighting matrix. The instruments used in the models are a constant, lag 2 of Federal Funds rate, lag 1of inflation, unemployment rate, income of the top 1 percent, Gini and 90/10 wage differential and M1. $pro.(j-stat)$ denotes the probability of the test statistic for over-identifying restrictions i.e. the probability of observing the value of the J-statistic, if the null hypothesis is true. The J-statistic tests the null hypothesis that the instruments are orthogonal to the error term of the regression. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $Adj\ R^2$ is the adjusted R^2, Column 1 contains the GMM estimates of the policy coefficients from the bench mark forward looking Taylor Rule given below

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi_{t+1} + \beta_2 y_t/z_t\} + \varepsilon_t \quad \text{(e)}$$

Column 2 contains the GMM estimates of the policy coefficients from the augmented forward looking Taylor Rule augmented with the average income of the top 1 percent given below

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi_{t+1} + \beta_2 y_t + \beta_3 tp_t/z_t\} + \varepsilon_t \quad \text{(f)}$$

Column 3 contains the GMM estimates of the policy coefficients from the augmented forward looking Taylor Rule augmented with the GINI index of income inequality given below

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi_{t+1} + \beta_2 y_t + \beta_4 g_t/z_t\} + \varepsilon_t \quad \text{(g)}$$

Column 3 contains the GMM estimates of the policy coefficients from the augmented forward looking Taylor Rule augmented with the GINI index of income inequality given below

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi_{t+1} + \beta_2 y_t + \beta_5 wg_t/z_t\} + \varepsilon_t \quad \text{(h)}$$

z_t represents all the variables in the Fed's information set available at time t when the interest rate is chosen (instruments). The instruments used in these models are a constant and lags of the endogenous variables.

The GMM estimation results in table 2.6 above, column 2 reveals that the benchmark specification satisfies the dynamic stability criterion given that the estimated inflation coefficient $\beta\pi_{t+1}$ is greater than one (1.23). Specifically, the result seems to suggest that holding output gap constant that a 1 percent increase in inflation will induce the Fed to raise interest rate by over a 100 basis point. Taylor (1999) argues that if the estimated inflation coefficient was smaller than the stability threshold of one, then this would entail a positively sloped aggregate demand, with output decreasing in response to an inflation shock. In addition, the estimated inflation coefficient is statistically significant at the one percent levels. The response of Federal Funds rate to inflation is larger in the OLS model which uses one-year-ahead inflation expectation forecasts. However, both the OLS and GMM models are consistent in revealing a stable monetary policy.

The output gap βy_tcoefficient is positive (0.32) and also significant indicating that holding expected inflation constant, a one percent increase in the level of output gap will induce the Fed to increase interest rates by 32 basis points. Therefore, during the period under consideration, the Federal Reserve has put more weight on price stability than output stabilization. The estimated coefficient on the interest rate smoothing parameter is close to 1 (0.86) indicating a high level of persistence in short term interest rates. Finally, the $J-statistic$ shows that the over-identifying restrictions of the benchmark model are not rejected.

As was pointed out in the previous sections, monetary policy can change the shape of the income distribution via five channels namely, income composition channel, (the difference between wages and capital income), financial segmentation channel, (the ability of some financial market participants to benefit more from policy shocks than others), portfolio / asset price channel, (the notion that high income households, who tend to hold more financial and non-financial assets benefit more from asset price booms created by expansionary monetary policy), the savings redistribution channel, (the impact of unanticipated inflation on nominal contracts) and earnings heterogeneity channel (the tendency of low income earners to be more sensitive to the business cycle). Our literature search in section 2.4 suggests that changes in monetary policy stance have important distributional implications in the U.S and elsewhere. In addition, Fowler et al (2005) employing the seigniorage tax rate as a measure of monetary policy and, using both

simulation and VAR estimation techniques reveal that monetary policy systematically responds over the business cycle to deviations in income inequality with a lag.

Most of the studies we surveyed were interested in analyzing the effect/ contribution of monetary policy to widening income inequality. To contribute to this debate, we tested the response of monetary policy to income inequality within a standard monetary policy framework. Therefore, we considered three alternatives to our benchmark specification, by allowing three different measures of income inequality to enter in the Taylor rule. The augmented reaction function that we considered is of the form:

$$r_t = \propto_0 + \rho r_{t-1} + (1-\rho)\{\pi_{t+1} + \beta y_t + \beta' X_t + \varepsilon_t\} \quad (2.11)$$

Where $X_t = [x_{it} \dots x_{jt}]'$, and $\beta = [\beta_I \dots \beta_j]'$, denote the vector of $j - additional$ explanatory variables, and the relevant coefficient vector respectively. In this estimation, X_t contains contemporaneous measures of income inequality, namely the Gini index, the 90/10 wage gap and average income share going to the top 1 percent.

First, we allow annual income share of the top 1 percent to enter the reaction function. The results are presented in table 2.6, column 2. The top 1 percent coefficient is positive and highly significant. Monetary policy tightens in response to increases in the income of the top 1 percent. Specifically, a one percent increase in the income of the top 1 percent increases interest rates by 0.06 basis points. A straight forward interpretation of this result implies that the Fed will increase interest rate if income inequality is increasing and reduce the policy rate if it is reducing. Another important question that arises from this finding is whether the Federal Reserve follows a 'symmetric or an 'asymmetric' policy towards income inequality during the period under review. The current study provides empirical answer to this question.

Secondly, we included the Gini index another measure of income inequality into the reaction function. The estimated coefficient is positive; however, the response of expected inflation does not meet the dynamic stability threshold and is not significant suggesting an unstable monetary policy. In addition, we included the 90/10 wage differential into the model and the model again failed the stability tests and is not significant, thus, confirming our earlier findings from the OLS estimation method. Finally, the probabilities of the $J - statistic$ in all the models reveal that the models as well as our set of instruments are

valid. This implies that the models met the orthogonality condition, indicating that the Federal Reserve considers lagged variables in their reaction function only to the extent that they help in forecasting future inflation and output.

Why would Fed react to the top one percent measure of inequality? It is important to bear in mind that this reaction could be an indirect reaction coming from the Fed's reaction to asset prices particularly stock prices as we have pointed out in section 2.3. Another possible explanation of this reaction to top income earners could be because of the big changes in the share of top income in America's total income. Pervious empirical research on income inequality suggests that these changes had significant impact on overall measures of income distribution. For instance, Atkinson, Piketty and Saez (2009) provided documented evidence which shows that the 14 percentage point increase in the share of the top percentile group in the United States between 1976 and 2006 produced an increase of 8.4 percent in the overall Gini Coefficient for pre-tax incomes. Most of the increases in top incomes in the U.S during the economic expansion up until 2007 were generated primarily by income from employment; stock market and performance related pay which disproportionately benefitted top executives and finance professionals in the 1980s and 2000s, Bakija et al (2012).

The study of Atkinson et al (2011) as well as reports by OECD throws more light on why the Fed may be concerned with the changes in the incomes of the top 1 percent. The incomes of this group of earners have a sizeable influence on measures of income growth of different population groups. According to Atkinson et al (2011), in the United States real household income increased by 1.2 percent on average per year in the ten years leading to the 2007 financial crisis, excluding the top 1 percent the average income of the bottom 99% grew by 0.6 percent indicating that the top 1 percent captured 58 percent of the real income gain.

A 2011 report by Organisation for Economic Co-operation and Development OECD "*Divided we stand: Why Inequality keep Rising"* highlighted that the increases in household income inequality have been largely driven by changes in the distribution of wages and salaries, which account for about 75 percent of household incomes among working age adults. According to this report, with the exception of France, Japan and Spain, the wages of the 10 percent best paid workers have risen relative to those of the 10 percent lowest paid; which was due to the growing earnings shares at the top and declining shares at the bottom.

In addition, another OECD report in 2008 "*Growing Unequal"*?, showed that inequality in the distribution of market incomes-gross wages, income from self-employment, capital income and returns from savings increased in almost all OECD countries between mid 1980s and 2000s; as we alluded elsewhere in this thesis, top income earners are more likely to have access to such returns from market income given that they have better credit ratings, and savings and are therefore more likely to invest. Therefore, a reaction of Fed to the income of this group is not surprising given that increase in the share of capital income were due predominantly to movement in the upper part of the distribution. Reducing the income of the top 1 percent via reaction to asset prices could narrow the income disparity between the top and bottom income earners.

Furthermore, widening income inequality is not without importance for Federal Reserves' policies. For instance, Ostry and Al (2014) in their study found that increasing levels of inequality is correlated with slower and very fragile growth. In addition, authors such as Rajan (2010) pointed out that rising income inequality with excessive household debt, can lead to financial crises. Finally, rising income inequality is a threat to social cohesion; therefore, monetary authorities could be concerned with growing inequality if a pervasive perception of unfairness leads to political instability, thereby undermining economic growth and overall welfare.

Although there is still widespread disagreement among academics and economists on the exact causes of inequality, the post recession recovery however, provides an anecdotal evidence of the monetary policy/income inequality relationship via the asset prices or portfolio channel[54]. The Fed's aggressive policies[55] aimed at propping up the economy have resulted to an unintended consequence-increase in inequality. A 2007 Bank of England's report posit that the Bank's policies of quantitative easing-similar to the Fed's has benefited the wealthy more than the poor, Bank of England Quarterly Bulletin (2012).

According to this report, the program had boosted the value of stocks and bonds by about 26 percent or $970 billion, and about 40 percent of those gains went to the richest 5

[54] For more on the distribution of wealth in the post-crisis period in the U.S amongst households see, Fry and Taylor (2013), "An Uneven Recovery, 2009-2011.

[55] The Fed's primary monetary policy tool is its ability to influence the level of interest rates. At the onset of the 2007 financial crisis, the Federal Reserve policy makers pushed short term interest rates down nearly to zero. However, the Fed had to embark on more policy stimulus to turn the recession around. Given that the Fed could not push short-term interest rates down further it used the unconventional monetary policy tool of asset purchases the so called Quantitative easing to bring longer-term interest rates such as mortgage rates down.

percent of British households. Although the report maintains that the benefits of the monetary easing have also trickled down and that most households in the U.K would have been worse off without the Bank's asset purchases. This report is instructive for the Unites States because the Fed's monetary easing has helped to re-inflate the stock market in 2009 and 2010 helping the wealthy to recover much of their wealth as stocks doubled in value while the rest of the households which depend on houses and jobs for their wealth are still stuck in recession.

Monetary easing in the post-recession era has benefited asset prices and, the top 1 percent owns an outsized share of assets-especially stocks. Although, low interest rates also penalize savers, and the top income earners as a group have the largest savings pool in American, but the benefits of monetary easing far outweighs the costs of low savings rate. This is because, the top income earners have only 13 percent of their investible assets in cash, and the rest in stocks, bonds, alternative investments and mutual funds-all of which benefits from monetary easing, Frank (2012).

From the foregoing, it seems plausible to argue that the asset price channel of monetary policy transmission can explain in part the link between monetary policy and income inequality measured by the income of the top income earners. Empirical literatures on monetary policy and asset prices suggest that expansionary monetary policy will lead to a rise in asset prices[56] (particularly stock prices). Given that stock ownership is concentrated within the high income brackets a booming stock market will contribute to the increase in the income of those households that have access to the stock market via capital gains and stock options more than those that do not have such access.

[56] The present value model provides an insight on the effects of a monetary policy shifts on stock prices. This model stipulates that the stock price (S_t) is the present value of the future expected dividends (D_{t+j}). Under the assumption of constant discount rate (r) with no rational stock price bubbles we can obtain the present value model as: $S_t = E_t\left[\sum_{j=i}^{K}\left(\frac{1}{1+R}\right)^j D_{t+j}\right]$ Where E_t is the conditional expectation operator based on information available to market participants at time t, R is the rate of return used by market participants to discount future dividends, j is the investors time horizon. A change in monetary policy can affect stock returns by changing the discount rate used by market participants. This is because the discount factors used by financial market participants is assumed to be linked to market rates of interest which in turn is influenced by the actions of the central bank. In addition, monetary policy changes can have an indirect effect on a company's stock values by changing expected future cash flows; therefore, stock prices will increase when there is a monetary policy easing because firms' expects higher future cash flows as a result of increase in overall levels of economic activities.

Another explanation that is consistent with the above interpretation is that the top income earners are mainly highly salaried workers, Bakija (2012), that have a larger share of their wealth coming from wage income, capital income and entrepreneurial income (see figure 2.7 income composition of top 1% from 1917-2010). Thus these groups of individuals benefit more disproportionately in an environment of increasing asset prices than other households at the lower end of the income spectrum.

Consequently, to the extent that financial asset prices particularly equity prices decreases following a restrictive monetary policy stance, lower stock prices will reduce the capital gains income from financial assets. This will reduce the income of those rich households with ownership of these assets thus narrowing the income gap between the rich and the poor. This finding is also consistent with the findings from previous studies that used stock market measures to augment the Taylor rule and show that the Fed rate increases when stock valuations increase, see-Rigobon and Sack (2003), Borio and White (2004), and Ioannidis and Kontonikas (2003). The idea is that higher rates (restrictive policy stance) would eventually cause stock prices to fall and subsequently top 1 percent income to decline.

2.6.2 Robustness test for income inequality (measured using top 1 percent income)

The adjustment of the short term interest rates by the Fed influences several economic variables including unemployment, consumer confidence and inflation amongst others. The Federal Reserve has at different occasions cited unemployment levels as one of the key factors influencing monetary policy. Recently, in December (2010),[57] the Fed announced that the decision to keep interest rates near zero was to target unemployment. According to Barnichon and Figura (2010) fluctuations in the unemployment rate are influenced by three main factors namely: changes in labour demand, changes in labour supply due to movements in and out of the labour force, and changes in the rate at which jobs that are available in the labour market are matched to those actively searching for work, the so called "matching efficiency".

[57] The December 14 2010 Monetary policy release suggests that the FOMC decided to continue expanding its holdings of securities as announced in November (2010); via the reinvestment of principal payments from its securities holdings and to maintain the target range for the federal funds rate at 0 to ¼ percent. Principally, because of high levels of unemployment rate, available at www.federalreserve.gov/newsevents/press/monetary/20101214a.htm

In addition, past empirical studies such as Taylor (1993,1999) and Clarida et al (1998) have suggested that changes in economic conditions, as reflected in the unemployment rate could induce the Federal Reserve to change the Federal funds rate. Given the role that the Federal funds rate plays in influencing economic activity such as unemployment as well as the relationship between unemployment and income inequality, it is important to determine if indeed the reaction of monetary policy to income inequality is robust in the presence of unemployment rate.

To this end, we test the robustness of our findings by using an alternative measure for monetary policy- the three month Treasury bill as well as unemployment rate as a measure of economic activity instead of the frequently used output gap. Table 2.7a presents the result from the GMM estimation model. The result from this model is consistent with Taylor (1999) in the sense that monetary policy is found to be stable during this period. The coefficient on unemployment rate is negative as expected; however, it is not statistically significant. In addition, the response of monetary policy to income inequality is significant at the 5 percent levels. The result seems to suggest an increase of 0.05 basis points in the federal funds rate for a one percent rise in the income of the top 1 percent, confirming our previous findings that the Fed observes changes in income inequality measured using the income of the top 1 percent.

Table 2.7a GMM estimates of the augmented Taylor Rule 1967q1-2011q4: robustness check using 3 months Treasury bill and unemployment rate

Parameters	$\propto$	ρ	$\beta_1\pi_{t+1}$	$\beta_2 ue_t$	$\beta_3 tp_t$	$pro.(j-stat)$	$Adj\ R^2$
	0.26 [0.87]	0.89*** [28.07]	1.20*** [2.87]	-0.40 [-1.23]	0.05** [2.32]	0.24	0.94

Notes:

$\alpha, \rho, \beta_1\pi_{t+1}, \beta_2 ue_t, \beta_3 tp_t$ represent the parameters in the model, where $\propto$ is the constant, ρ is the smoothing parameter, $\beta_1\pi_{t+1}$ is the estimated weight on actual future inflation i.e. one period ahead inflation, $\beta_2 ue_t$ is the estimated weight on unemployment, $\beta_3 tp_t$ is the estimated weight on the income share going to the top 1 percent income earners, The parameter estimates are obtained by GMM estimation using HAC [Bartlett Kernel, Newey-West fixed bandwidth=50000] as the estimation weighting matrix. z contains the lagged values of the endogenous variables (the instruments). 3_tb_t denotes three months treasury bill the proxy for monetary policy. The instruments used in the models are a constant, lags 2 of three months Treasury bill, lag 1of inflation, unemployment rate, income of the top 1 percent and M1. $pro.(j-stat)$ denotes the probability of the test statistic for over-identifying restrictions i.e. the probability of observing the value of the J-statistic, if the null hypothesis is true. The J-statistic tests the null hypothesis that the instruments are orthogonal to the error term of the regression. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $Adj\ R^2$ is the adjusted R^2.

$$3\_tb_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi_{t+1} + \beta_2 ue_t + \beta_3 tp_t/z_t\} + \varepsilon_t \quad \text{(i)}$$

Table 2.7b presents the result from the model that used Fed fund as a measure of the policy instrument and unemployment rate as a measure of economic activity. The aim of this analysis is to see if the reaction of monetary policy to income inequality will still be significant. The model using the Fed fund as a measure of monetary policy and unemployment rate as a measure of economic activity confirm our earlier findings.

Table 2.7b GMM estimates of the augmented Taylor Rule 1967q1-2011q4: robustness check using Fed funds and unemployment rate

Parameters	$\propto$	ρ	$\beta_1\pi_{t+1}$	$\beta_2 ue_t$	$\beta_3 tp_t$	$pro.(j-stat)$	$Adj\ R^2$
	-0.01 [-0.02]	0.89*** [31.36]	1.37*** [3.52]	-0.08 [-0.22]	0.07** [4.24]	0.145	0.93

Notes:

$\propto$, ρ, $\beta_1\pi_{t+1}$, $\beta_2 ue_t$, $\beta_3 tp_t$ represent the parameters in the model, where $\propto$ is the constant, ρ is the smoothing parameter, $\beta_1\pi_{t+1}$is the estimated weight on one period ahead inflation, $\beta_2 ue_t$ is the estimated weight on unemployment, $\beta_3 tp_t$ is the estimated weight on the income share going to the top 1 percent income earners, The parameter estimates are obtained by GMM estimation using HAC [Bartlett Kernel, Newey-West fixed bandwidth=50000] as the estimation weighting matrix. z contains the lagged values of the endogenous variables (the instruments). The instruments used in the models are a constant, lag 2 of federal funds rate, lag 1of inflation, unemployment rate, average income of the top 1 percent and M1. $pro.(j-stat)$ denotes the probability of the test statistic for over-identifying restrictions i.e. the probability of observing the value of the J-statistic, if the null hypothesis is true. The J-statistic tests the null hypothesis that the instruments are orthogonal to the error term of the regression. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $Adj\ R^2$ is the adjusted R^2.

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi_{t+1} + \beta_2 ue_t + \beta_3 tp_t/z_t\} + \varepsilon_t \qquad \text{(j)}$$

Table 2.7b shows that the Taylor inflation stability threshold was met. A one unit increase in inflation will give rise to over a 100 percent increase in federal funds rate (1.37). The response of federal funds rate to inflation seems a bit stronger than the response of the 3 months Treasury bill (1.20). The sign of the estimated coefficient of unemployment rate in the federal funds rate model is consistent with that of the 3 month Treasury bill model in Table 2.7a. In both models the measure of unemployment rate is negative and is not statistically significant. With regards to the measure of inequality, it is positive and statistically significant supporting our earlier findings

Like we have mentioned elsewhere in this chapter, accommodative policy stance that results in increase in financial asset prices does have a major role to play in the observed income gap between the top income earners and the rest. Our literature search shows that about 60 percent of the top income earners are mangers, executives, financial professionals and supervisors and these groups of professionals can account for 70 percent of the increase in the share of national income going to the top 1 percent, Bakija and Heim (2009). A large

portion of their compensation comes in the form of stock options which implies that their income might be heavily influenced by financial market assets, particularly stock prices since their compensation is strongly tied to the stock market Philippon and Reshef (2009). The implication of the financial asset prices narrative is that monetary policy in a bid to react to stock prices misalignment from their economic fundamentals via restrictive monetary policy stance will affect the income of the top income earners thus narrowing the income distribution.

Ronie, Vlachos and Waldenstrom (2008) provided support to the role of financial asset prices in influencing the income shares going to the top income earners. Their study found a positive statistically significant relationship between top income shares and stock market capitalization. Bakija and Heim (2009) in their cross-country study spanning from 1979 to 2005 also found that stock price movement played a significant role in explaining the changes in the top income shares for the top 0.1 percent. We will investigate the causal relationship between income inequality and financial assets narrative in chapter 3 of this thesis.

2.6.3. Testing for monetary policy asymmetric reaction to income inequality

The estimations as performed in section 2.6.1 suggest that monetary policy observe changes in the income share of the top 1 percent. In principle, a positive β_3 coefficient (income of top 1 percent), indicates both interest rate cuts in times of sustained income decreases and rates hikes in times of sustained income increases. Using a state dependent dummy variable we want to see whether the interest rate setting of Fed differs during periods of sustained increase and decrease in the income of top 1 percent income earners. That is if the relationship between monetary policy measured using the Federal Funds rate and income inequality measured using the average income of the top 1 percent differs, depending on whether the income of the richest 1 percent is below or above the three years moving average which we used as the threshold value. The analysis follows the methodology of Hoffmann (2009)[58] that tested for asymmetric monetary policy reaction with respect to asset markets and Danne and Schnabl (2008) that tested possible asymmetric

[58]Hoffmann (2009) study suggested that the Fed lowered interest rates after the dot-com bubble-burst but did not raise them during the boom years during the Greenspan tenure as Fed chairman.

monetary policy behaviour with respect to exchange rate changes in appreciation and depreciation phases in Japan[59].

In line with the above studies, we test for asymmetric monetary policy decisions with respect to top 1 percent income earners using a forward looking Taylor rule. To capture this phenomenon, we introduced an asymmetric interaction term to isolate the Federal Reserve's monetary policy responses in low income growth periods. Consequently, we defined a dummy variable D_t and some threshold value x^* that takes the value of 1 when the income of the top 1 percent wage earners is below the 3 years moving average (the threshold value) and 0 otherwise.

$$D_t = \begin{cases} 0 \; if \; x_t < x^* \\ 1 if x_t \geq x^* \end{cases} \tag{2.12}$$

To identify an asymmetric behaviour in interest rate decisions with respect to periods of low income growth the interaction term is multiplied with the income share of the top 1 percent income earners. This yields the following specification:

$$r_t = \beta_1\alpha_0 + \beta_2\rho r_{t-1} + (1-\rho)[\beta_3\pi_{t+1} + \beta_4 y_t + (\varphi + \eta D_t)(tp_t)/z] + \varepsilon \tag{2.13}$$

Where $\beta_1\alpha_0$ is the constant in the equation, $\beta_2\rho r_{t-1}$, represents the smoothing parameter, $\beta_3\pi_{t+1}$ denotes the long run implied coefficient of expected inflation, $\beta_4 y_t$ long run implied coefficient of the contemporaneous output gap, tp_t denotes the variable top 1 percent income share, ηD_t represents the periods of sustained decline in income. The coefficient η captures the interest rate responses in low income growth phases. If η is significant and positive it indicates that the Fed reacted differently in low income growth phases (with interest rate cuts) compared to high income growth phases. The size of the η coefficient (economic effects) indicates the interest rate effect which is additionally triggered by the income declines.

[59]Danna and Schnabl (2008) asserts that the fear of appreciation against the dollar forced the Bank of Japan (BoJ) to lower interest rates in appreciation periods in the 1990s to support growth. However, the BoJ did not increase interest rates in depreciation periods to the same extent to keep Japanese economy competitive. Therefore, the Bank of Japan systematically lowered interest rate until they reached the zero bound.

The coefficient φ represents the coefficient for periods of high income growth, i.e the difference to η. The total economic effect of periods of sustained income decreases is captured by the sum of the coefficients $\eta \; and \; \varphi$, Danne and Schnabl (2008) and Hoffmann (2009). To test if this total effect is significant, we used the Wald test for joint significance of $\eta \; and \; \varphi$. finally, z_t is the instruments used in the GMM model which includes lags 1 of the endogenous variables and unemployment rate. The error term ε is assumed to be normally distributed. The results from table 2.8 below (both the GMM and OLS) estimation methods seem to suggest the presence of asymmetry in the response of monetary policy to the income of the top 1 percent income earners.

The η coefficients (which captures the interest rate responses in low income growth phases) on both the GMM and OLS results are both significant at the 1 percent levels. Evidence of monetary policy asymmetry can also be seen from the magnitude of the Fed's response to income inequality when the average income of the top 1 percent is below the 3 years moving average η (periods of low income growth). This is because although monetary policy tightens during periods of prolonged income increases, the Fed did not increase interest rates high enough to curb the increase in income as they would cut rates in the event of a decline in income.

Table 2.8 GMM and OLS estimates of state dependent model 1967q1-2011q4

Parameters	Column 1 GMM	Column 2 OLS
$\beta_1\alpha_0$	0.10 [0.67]	-0.29 [-1.38]
$\beta_2\rho_t$	0.89*** [37.60]	0.84*** [26.07]
$\beta_3\pi_{t+1}$	1.03*** [2.52]	1.52*** [3.19]
$\beta_4 y_t$	0.58*** [3.47]	0.10*** [5.89]
φ	0.04** [2.09]	0.03* [1.92]
η	0.18*** [2.74]	0.08** [2.19]
$Adj\ R^2$	0.94	0.94
$pro.(j-stat)$	0.76	
RR_T		0.58

Notes:

$\beta_1\alpha_0$ is the constant in the equation, $\beta_2\rho_t$, represents the estimated weight of the smoothing parameter, $\beta_3\pi_{t+1}$ denotes the estimated long run implied coefficient of expected inflation, $\beta_4 y_t$ estimated long rum coefficient of the contemporaneous out gap, φ denotes the estimated coefficient on periods of sustained income growth, $(\eta D)^* tp$ represents the estimated coefficient on periods of sustained decline in income and z is the instruments used in the GMM model which includes lags 1 of the endogenous variables and unemployment rate. The parameter estimates are obtained by OLS and GMM estimation using HAC standard errors & covariance (Bartlett Kernel, Newey-West fixed bandwidth = 5, 0000) as the estimation weighting matrix. $pro.(j-stat)$ denotes the probability of the test statistic for over-identifying restrictions. $Adj\ R^2$is the adjusted R^2 .RR_T denotes the t-statistic for the Ramsey Reset diagnostic test. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The inflation used in the OLS model is the one year ahead inflation expectation forecast $\beta\pi^f$

$$r_t = \beta_1\alpha_0 + \beta_2\rho r_{t-1} + (1-\rho)[\beta_3\pi_{t+1} + \beta_4 y_t + (\varphi + \eta D_t)(tp_t)/z] + \varepsilon \quad \text{(k)}$$

The result presented in table 2.8 column 1 (GMM) reveals an increase of about (0.18) 18 basis point in the policy rate for every 1 percent decrease in income of the top one percent, however, the Fed's response to income inequality when the average income of the top 1 percent is above the 3 years moving average (periods of high income growth), φ coefficient reveals an increase of only about (0.04) 4 basis point for a 1 percent increase in income. The Fed's response to periods of sustained income gains seems relatively weak when compared to its response to the periods of prolonged income declines. In addition, the strength of the significance levels can also be used to judge the strength of Fed's response. While the response of Fed during periods of income declines is significant at the 1 percent levels, its response during periods of income growth is significant at 5 percent levels. Both the magnitude of the estimated coefficients and strength of the levels of significance are confirmed by OLS model (table 2.8 columns 2).

To test the hypothesis that the Fed has put more weight on their reaction to income inequality during periods of sustained decreases in income of the top 1 percent than during periods of sustained increases we performed an Wald test for the null hypothesis that the value of the coefficient η in equation 2.12 is equal to the value of the coefficient on φ. The null hypothesis is $\eta = \varphi$. That is equal reaction of Fed to sustained increases versus declines in the top 1 percent income.

Table 2.8.1a Wald test for coefficient magnitude

Test Statistic	Value	probability
$t - statistic$	1.99	0.05
$F - statistic$	3.97	0.05
$Chi - square$	3.97	0.05

Notes: Null Hypothesis: $C(\eta) = C(\varphi)$. Model standard error=0.007

Based on the Wald Test result (table 2.8.1a), the null hypothesis was rejected at 5 percent levels. According to the Wald test, the Fed's reaction to a decline in the income of the top 1 percent is not equal to their reaction during periods of sustained income growth indicating support for asymmetric reaction. We also used the Wald test to determine the joint significance of the two coefficients $\eta \; and \; \varphi$ i.e. the total economic effect in low income growth phases, the null hypothesis is $\eta = 0, \varphi = 0$.

Table 2.8.1b Wald test for joint significance of $\eta \; and \; \varphi$

Test Statistic	Value	probability
$F - statistic$	5.64***	0.00
$Chi - square$	11.27***	0.00

Notes: Null Hypothesis: $\eta = 0, \varphi = 0$

The result in table 2.8.1b shows that $\eta \; and \; \varphi$ are jointly significant at the 1 percent levels. The interaction term provides strong evidence that the Fed responded asymmetrically to income declines in periods of low income growth. This implies that the Federal Reserve's monetary policy contributed to some extent to the high income disparity between the high and low income earners. The Fed lowered interest rates during the low income growth periods more than they increased it during the income boom periods.

This sort of asymmetry seems identical to the Fed's reaction to equity prices, Ravn (2011) and Hall (2011)[60]. According to Issing (2009) 'the "pre-crisis" consensus' or the "Jackson Hole consensus" with regards to monetary policy and asset prices is that central banks should not lean against asset price movements; because of the difficulties involved in doing so. Instead, they should stand ready to cut the interest rate in response to decreases in asset prices. In other words, monetary policy should react to asset market bursts and not to booms in asset prices, Stark (2011). As we pointed out in the previous sections of this chapter, the holding of financial assets particularly stocks is highly concentrated within the top income class. Therefore, the implicit partial insurance (cut in interest rate during periods of decreases in stock prices) against stock price drop might lead to moral hazard problems by covering part of the downside risk faced by investors in the stock market which are mainly top income earners. This seems like a destabilizing policy.

To confirm the internal stability of our findings, we estimated a forward looking Taylor rule, cutting off the 1970s to mid 1980s that is periods of aggressive ant-inflationary stance as well as the post financial crisis era (i.e. the sample stopped in 2007 Q2 onset of the crisis) . The results and discussions from these models are presented in the next section.

2.7 Sub-sample stability test: 1984q1 to 2007q2

The late 1970s and early 1980s witnessed a major shift in the emphasis of macroeconomic policy toward combating inflation as opposed to maintaining full employment. This was accompanied by tight monetary policies in the U.S which saw interest rate increased to unprecedented heights. Monetary policy during this period[61] gave rise to higher real and nominal rates of interest. These rates of interest as was argued by Niggle (1989) brought about a major shift in the functional distribution of income toward

[60] The study of Ravn (2011) reveals that a 5% drop in the S &P 500 index increased the possibility of a subsequent 25 basis point interest rate cut by 33% during the period under review (1998-2008). In addition, Hall (2011) using an augmented Taylor rule model with lagged stock price deflation found that stock price deflation led to a highly significant cut in interest rate. Her study also showed that the inclusion of stock price deflation led to an improvement in the fit of the Taylor rule. Finally, Hoffmann (2009) also found asymmetric monetary policy reaction to stock prices during the Greenspan/Bernanke period (1987-2008). According to her, the Fed lowered interest rates, when asset markets bursts, but did not raise them when they boomed during the Greenspan era.

[61] The monetary policy stance in the U.S during the late 1970s was in disarray. In 1974 and 1980 inflation peaked above 10 percent leaving many central bankers questioning the potency of monetary policy in reducing inflation. Economist such as Okun (1979) suggested that the Federal Reserve would need to reduce employment and output by 10 percent for one year for each permanent percentage point reduction of inflation that it wished to achieve.

capital at the expense of labour income. According to Niggle (1989), financial capital's share of income increased at the expense of industrial and labour incomes. Given that the ownership of interest bearing financial assets is concentrated within the high income earners, this shift in the functional distribution of income has contributed to the shifts in personal distribution of income. These periods (1979 to 1984) of aggressive anti-inflationary policy stance urshed in the so called 'great moderation' era which saw inflation reduced from 12 percent per annum to around 3 percent per annum, Kontonikas and Kostakis (2013). However, workers particularly low skilled workers borne a heavy cost due to increased unemployment as policy interest rates were increased, Ball (1993).

After the volatility of the 1970s and early 1980s, the great moderation was seen as a welcome end to inflation volatility. A prominent feature of this period was persistently low inflation without compromising unemployment and economic growth. This period saw also massive financial deregulation which encouraged financial institutions to take on more risk. Another prominent feature of the great moderation period was increasing asset prices especially house and equity prices accompanied with rising income inequality. Some researchers have argued that the increase in stock prices coupled with the so called financialization of the 1980s were major forces behind the high income gap between the rich and the poor.

The above events provide a major motivation for us to test the structural stability of the earlier findings by splitting the sample from 1984 to 2007 that marked the periods of the great moderation characterized by low inflation, strong economic growth, low macroeconomic risk and high income inequality. The sub-sample analysis considers the potential reaction of monetary policy to the income of the top 1 percent during the 'great moderation' era until the on-set of the global financial crisis in the second quarter of 2007.

Table 2.9 columns 1 and 2 present the results from the GMM and the OLS estimations. Evidence from the sub-sample analysis implies a stable monetary policy regime during the period under investigation. The results from the GMM model suggests that the Fed during the great moderation periods and before the start of the 2007 great recession did observe changes in our measure of income inequality in setting the policy rate. . This result reveals that a one unit increase in the income of these groups of income earners will result in a 4 basis points increase in Fed funds rate.

Table 2.9 GMM and OLS estimates of sub-sample stability 1984q1-2007q2

Parameters	Column 1 GMM	Column 2 OLS
α_0	0.13 [0.68]	-0.04 [-1.38]
ρ_t	0.86*** [25.92]	0.78*** [17.05]
$\beta_1\pi_{t+1}$	1.05** [2.19]	1.21*** [3.41]
$\beta_2 y_t$	0.56*** [3.47]	0.44*** [6.27]
$\beta_3 tp_t$	0.04** [5.18]	0.01* [1.83]
$Adj\ R^2$	0.97	0.94
$pro.(j-stat)$	0.89	
RR_T		0.58

Notes:

α_0 is the constant in the equation, ρr_{t-1}, represents the estimated weight of the smoothing parameter, $\beta_1\pi_{t+1}$ denotes the estimated long run implied coefficient of expected inflation, $\beta_2 y_t$ estimated long rum coefficient of the contemporaneous out gap, $\beta_3 tp$denotes the estimated coefficient on the income of the top 1 percent, ε_t is the error term and z is the instruments used in the GMM model which includes lags 1 of the endogenous variables and unemployment rate. The parameter estimates are obtained by OLS and GMM estimation using HAC standard errors & covariance (Bartlett Kernel, Newey-West fixed bandwidth = 5, 0000) as the estimation weighting matrix. $pro.(j-stat)$denotes the probability of the test statistic for over-identifying restrictions. $Adj\ R^2$is the adjusted R^2 .RR_T denotes the t-statistic for the Ramsey Reset diagnostic test. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The inflation used in the OLS model is the one year ahead inflation expectation forecast $\beta\pi^f$

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi_{t+1} + \beta_2 y_t + \beta_3 tp_t/z_t\} + \varepsilon_t \quad \text{(l)}$$

While the OLS model table 2.9 column 2 shows a minimal increase of about 1 basis point in Fed funds rate in response to an increase in income inequality. The dynamic stability criterion in both models were not compromised in that $\beta_1\pi_{t+1} > 1$ and statistically significant and the coefficients of the output gaps in both models were positive $\beta_2 y_t > 0$ indicating that the Federal funds rate increases if the Federal reserve observes an increase in output i.e. excess demand.

To sum up, the results from the models that used the income of the top 1 percent as a measure of income inequality within a forward looking monetary policy rule, seems to suggest a positive relationship between the monetary policy rate and the income of the top 1 percent measure of income inequality. In addition, we observed evidence of asymmetric policy response to the income of the top 1 percent wage earners in the U.S. These results seem to suggest that monetary policy regime between 1967 and 2011 have accommodated increases in the income of the top 1 percent income earners.

2.8 Consumption inequality and monetary policy

Earlier empirical studies that have looked at consumption based measures of inequality suggests major divergence from income based measures. For instance, Cutler and Katz (1991) in their work found that consumption inequality increased less sharply than income inequality between 1960-61 and 1988. Slesnick (2001) in his own contribution found that consumption inequality has been somewhat constant between 1970 and 1995. Blundell et al (2008) maintained that the divergence in income and consumption inequality can be partly explained by the nature and durability of shocks to labour market earnings. According to them, households may temper the effects of an adverse economic shock on consumption by borrowing and saving more or by delaying the decision to replace durable goods. The fact that economic agents can borrow and save to smooth their living standards can explain the reason behind the small disparities in consumption when compared to that of income.

Blundel et al (2008) highlighted four insurance mechanisms between income received in the labour market and consumption which may help to reduce the impact of an adverse economic shock on consumption to include number of work hours, family labour supply, taxes and transfers as well as the ability of households/individuals to borrow and save. These insurance mechanisms are discussed in turn below:

- *Number of work Hours*: Give that an hourly wage that an individual receive has a direct link to the number of hours worked; economic agents might decide to increase their income in the face of a negative income shock by increasing the number of hours they work.
- *Family labour supply*: the number of eligible/potential earners in a household is another mechanism that households could use to increase their income and maintain their consumption levels. Decisions concerning who and how many of the potential earners can work as well as the number of work hours that each earner can commit will be made jointly. Therefore, if income is falling, households with two eligible workers for instance might decide to not only take up employment but also increase the number of hours and over time they work.
- *Taxes and Transfers*: Many governments particularly in Europe (countries such as Sweden or Netherlands) use their tax and transfer systems to counteract high

inequality in income before taxes and public transfers. Households can use transfers such as unemployment benefits, child and family allowances, social retirement e.t.c. to augment failing income. Blundell and Pistaferri (2003) showed that national programs like food stamps (Supplemental Nutrition Assistance Program SNAP) in the United States were effective in easing the effects of income shocks on consumption.

Given that one of the key mechanisms between earnings and spendable/disposal income is taxes and transfers, a well designed social security system can help families to reduce consumption inequality and shield themselves from fluctuations in income. According to Blundel et al (2008) low-income households would temper the effects of an adverse income shock on consumption by using one or a combination of the above mentioned insurance mechanism. He maintained that the rise in income inequality has been more pronounced than the rise in consumption inequality because of the increased borrowing for the purpose of consumption.

This narrative was corroborated by Kumhof and Ranciere (2010) in their study which showed that the rise in aggregate household leverage has been due to an increase in leverage for the bottom 95% of the income distribution. To account for the potential reaction of monetary policy on dispersion in household consumption we estimated a similar model of forward looking Taylor rule but this time we used average annual consumption expenditure of different income quintiles starting from 1984 to 2011. Specifically we used the growth rates of average quarterly expenditures of the highest and lowest 20 percent income quintiles spanning from 1984 to 2011 as our measure of consumption inequality.

Table 2.10 is the descriptive statistics for the variables in the consumption inequality models. The data for this analysis was sourced from the Bureau of Labour Statistics Consumer Expenditure Survey. The table reports the average, maximum, minimum and standard deviations of the Federal funds rate, inflation, output gap, average annual consumption of the lowest and highest 20 income quantiles as well as unemployment rate.

Table 2.10 Descriptive Statistics for the consumption inequality 1984 to 2011

	r	π	y	l_t	h_t	ue
Mean	4.43	2.86	0.00	2.60	3.02	6.02
Maximum	9.73	6.09	0.02	180.70	8.60	9.90
minimum	0.07	-1.63	-0.03	-163.72	-2.89	3.90
Std. Dev.	2.60	1.22	0.01	436	2.76	1.49

Notes:
r denotes effective federal funds rate, π is the annualized inflation rate, y denotes the Hodrick-Prescott detrended real GDP, l_t denotes the average annual consumption expenditures of households within the lowest 20 income quintiles, $h_t$denotes the average annual consumption expenditures of households within the highest 20 income quintiles and uedenotes the unemployment rate.

Table 2.10.1 below reports the correlation matrix of all the variables included in this part of our analysis. The table reveals a positive correlation between Federal funds rate, inflation, output gap and average consumption expenditures of households at the highest 20 percent income quintiles.

Table 2.10.1 Correlation matrix for the consumption inequality 1984 to 2011

	r	π	y	l_t	h_t	ue
r	1.00	0.55	0.50	-0.03	0.54	-0.49
π	0.55	1.00	0.51	0.11	0.42	-0.29
y	0.50	0.51	1.00	-0.03	0.36	-0.50
l_t	-0.03	0.11	-0.03	1.00	-0.16	0.00
h_t	0.54	0.42	0.36	-0.16	1.00	-0.45
ue	-0.49	-0.29	-0.50	0.00	-0.45	1.00

Notes:
r denotes effective federal funds rate, π is the annualized inflation rate, y denotes the Hodrick-Prescott detrended real GDP, l_t denotes the average annual consumption expenditures of households within the lowest 20 income quintiles, h_t denotes the average annual consumption expenditures of households within the highest 20 income quintiles and uedenotes the unemployment rate.

A negative correlation was observed between the Federal funds rate, output gap, and the income of the lowest 20 percent income quintiles. The table also shows a negative relationship between the incomes of the lowest and highest 20 percent income quintiles at approximately 16 percent

The results from both models in table 2.10.2 show that the responses of monetary policy on the consumption expenditures of households within the lowest and highest 20 percent income quintiles are statistically insignificant. Furthermore, the results from both models showed that the Taylor stability criteria were not met and inflation had a negative sign and is not significant in model 1. The output gaps in both models were positive and statistical significant. The probabilities of the $J-statistics$ in both models show that the lists of instruments used in the estimations met the orthogonality conditions.

It seems to be the case that including a measure of consumption inequality in the fed's reaction function, results in coefficients on inflation that no longer consistently imply a stable monetary policy. The evidence of no reaction of monetary policy to consumption inequality seems consistent with the narrative that households can employ one or more combination of any of the previously discussed insurance mechanisms to temper the effects of adverse economic shocks on consumption. In addition, given that monetary policy in the U.S have a dual mandate of price stabilization and sustainable long term economic growth, it seems plausible to argue that inequality in consumption that does not result in a decline in aggregate demand or consumption might not attract the Fed's attention.

2.10.3 GMM estimates of consumption inequality 1984 to 2011

Parameters	h_t Column 1	l_t Column 2
α	0.49 [1.48]	0.40 [1.47]
ρ	0.94*** [18.56]	0.97*** [16.46]
$\beta_1\pi_{t+1}$	-3.83*** [-1.01]	-5.21 [-0.78]
$\beta_2 y_t$	0.65* [1.78]	1.42** [1.91]
$\beta_3 l_t$	0.33 [1.61]	
$\beta_4 h_t$		0.003 [0.27]
$pro.(j-stat)$	0.59	0.17
$Adj\ R^2$	0.96	0.96

Notes:
$\propto \rho\beta_1\pi_{t+1}\beta_2 y$represent the parameters in the models, where $\propto$ is the constant, ρ is the smoothing parameter,$\beta_1\pi_{t+1}$ denotes the estimated long run implied coefficient of expected inflation, $\beta_2 y_t$ estimated long rum coefficient of the contemporaneous out gap,$\beta_3 l_t$ denotes the average annual consumption expenditures of households within the lowest 20 income quintiles,$\beta_4 h_t$ denotes the average annual consumption expenditures of households within the highest 20 income quintiles. The parameter estimates are obtained by GMM estimation using HAC [Bartlett Kernel, Newey-West fixed bandwidth=50000] as the estimation weighting matrix. The instruments used in the models are a constant, lag 2 of federal funds rate, lag 1of inflation, unemployment rate, average income of the top 1 percent and M1. $pro.(j-stat)$ denotes the probability of the test statistic for over-identifying restrictions i.e. the probability of observing the value of the J-statistic, if the null hypothesis is true. The J-statistic tests the null hypothesis that the instruments are orthogonal to the error term of the regression. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $Adj\ R^2$ is the adjusted R^2.

$$r_t = \alpha_0 + \rho r_{t-1} + (1-\rho)\{\beta_1\pi_{t+1} + \beta_2 y_t + \beta_3 l_t + \beta_4 h_t/z_t\} + \varepsilon_t \qquad \text{(m)}$$

2.9 Conclusion:

Our main contributions to the existing literature on monetary policy and income inequality are two folds; first the study found a significant reaction of monetary policy to income inequality measured using the share of income going to the top 1 percent income earners. We suspect that this reaction may be linked indirectly to the reaction of monetary policy to financial assets. The study found that interest rate tightens when the income of the top 1 percent is increasing and loosens during low income growth phases. Secondly, this chapter found evidence of an asymmetric monetary policy reaction, with stronger response to the top 1 percent variable when it is exhibiting sustained declines. The finding is related to the existing augmented Taylor rule literature that found asymmetric monetary policy reaction to stock market measures (stronger reaction to stock markets when they are down) the so called "Greenspan-Bernanke put".

Officially, income inequality targeting is not an objective of the Fed. However, our estimation results from the forward looking Taylor Rule of the United States in the period 1967 to 2011 seems to suggest that the Fed actually takes into account changes in income inequality in its reaction function. We found that a 1 percent increase in the growth rate of the average income going to the top one percent in our OLS model brings about an increase of 2 basis points in the interest rate in the same period. This reaction is consistent when a different estimation method (GMM) is used. The result from the GMM model reveals that a 1 percent increase in the growth rate of the income of the top 1 percent will lead to an increase of 7 basis points in interest rate.

The result from the state dependent model seems to suggest some sort of asymmetric reaction to the income of the top 1 percent. In the sense that the Fed responds strongly to inequality in periods of sustained decreases in the income of the top 1 percentage, given that the estimated implied long term coefficient η which captures phases of sustained income increases is 0.18 as opposed to the relatively weak response of 0.04 in periods of sustained increase in income. This sort of policy adjustment seems to be destabilizing. The result has important policy implication because understanding of the relationship between monetary policy and income inequality will help monetary authorities in gaining a better insight into how shifts in their policy stance affect income distribution so that a discretionary policy stance does not become an independent cause of macroeconomic instability.

The analysis so far shows that some aspects of monetary policy as conventionally defined- the ultimate goals, intermediate policy targets, policy instruments and operating procedures chosen by the monetary authorities respond to changes in income inequality measured using the income share going to the top 1 percent. The logic seems compelling especially if it is interpreted within the context of past empirical works that augmented the Taylor rule with financial assets. The processes connecting distribution of household income to changes in monetary policy through the transmission mechanism of the level of interest rates are not that simple. Past empirical studies reveal that changes in policy interest rates will change the market values of financial assets, thus affecting capital gains and losses with either positive or negative implications for holders of such assets.

Our literature search reveals that the long-run increase in the income of the top 1 percent earners reflected a strong rise in asset prices, specifically stock prices and home prices during the boom/ great moderation periods; this was partially reversed in the recent financial crisis. The distributional effects of interest rates are different and sometimes complex. If interest rates are kept too low, domestic price inflation will eventually pick up. This erodes the value of deposits and loans. At the same time, low interest rates will lead to an increase in asset prices such as stocks and house prices. This implies a shift in favour of those who are already well positioned within the affected markets (real estate or stock market). Our point of view is that asset prices could be one of the transmission channels of monetary policy to income inequality. Therefore, policies that are targeted towards the reduction of asset price bubbles might help in reducing income inequality.

Finally, changing the trend and pattern of income distribution in a manner that ensures that society as a whole shares in the overall progress of the economy should be a major preoccupation of both monetary and fiscal policy. In addition to achieving their dual mandate of promoting maximum sustainable employment and stable prices, monetary policy makers should also strive to develop appropriate incomes policy that can help in achieving a socially acceptable degree of income inequality. This is an area which requires continuing research.

Chapter 3

The Role of Asset Prices on Income Inequality

(Does the top 1 percent respond to changes in stock prices?)

3.0 Introduction:

The empirical findings from the previous chapter suggests a strong positive and statistically significant relationship between monetary policy and income inequality measured using the income share of the top 1 percent within a Taylor rule framework. We suspect that this reaction to the income of the top 1 percent and a lack of reaction to other measures of income inequality namely the GINI index of inequality and the 90/10 wage differentials used in the last chapter could be an indirect reaction to the stock market. This is because of the close correlation between the income of the top 1 percent and the S&P500 index. The chapter also found an asymmetric monetary policy reaction with respect to the income of the top 1 percent[62]. Such asymmetric policy reaction can be linked to that of the stock market[63]. The two findings from the previous empirical chapter provide a major motivation for the present chapter.

The present chapter seeks to determine whether there is some sort of endogeneity in financial market development and the income of the top 1 percent. Specifically, we want to determine if the developments within the stock markets have any causal effect on the income of the top 1 percent income earners and the direction of this effect if any. The focus on top 1 percent income earners allows us to evaluate a special subset of questions regarding the extent to which asset prices is particularly pro-rich. Some authors have evaluated some aspects of this effect in the past.

For instance Sawhney and Dipietro (2006) found that increases in stock market wealth have a positive and significant effect on income inequality across the 73 countries

[62]The findings implied that the Fed reacted differently in low income growth phases (with interest rate cuts) compared to high income growth phases.

[63] See, Hoffman (2012) who found that the Fed's policy differed depending on the chairman. Her study found that the Fed policy during the Greenspan era lowered interest rates when the stock prices fell but did not raise it during the boom period. Ravn (2011) also found that the reaction of the Federal Reserve was asymmetric between 1998 and 2008. According to him, a 5% drop in the S&P 500 index is shown to increase the probability of a 25 basis point interest rate cut by one third, while no significant reaction to stock price increases was identified.

they studied. Their work showed that increases in stock market wealth led to an increase in the income of the top quintile while it reduced the share of income of the bottom quintile. In a recent study Roine et al (2009) were interested in studying the long-run determinants of inequality, they found that financial development measured as the relative share of the banking and stock market sectors increased the income share of the top percentile.

Our first objective in this chapter is to use Pair wise Granger (1969)[64] causality tests to explore unidirectional causality, bidirectional causality or absence of directional causality between stock returns and changes in the income shares of the top 1 and bottom 90 percent. The essence of this test is to determine if changes in stock prices is useful in forecasting changes in the income share of the top 1 percent and vice versa. A finding of unidirectional causality from stock returns to top 1 percent income earners may imply that the reaction of monetary policy to the top 1 percent variable as was established in the previous empirical chapter could be a reaction to the financial market as opposed to a direct reaction to changes in the income of this group of individuals. The current paper is the first study that has studied the causal effect of stock prices and the income of the top 1 and bottom 90 percent and therefore, brings a huge insight into the issue, as well as filling the gap in the literature on top income earners which has so far focused on the contribution of the top 1 percent income earners to overall income inequality. The results of our analysis hold practical implications to policy makers and regulators alike who are interested in narrowing the gap between the top income earners and the rest.

Secondly, we analyze the relationship between asset prices and income inequality. We study this question empirically by looking at how the income of top 1 percent of the earning population responds to changes in both financial and non financial assets. We used the Generalized Method of Moments (GMM) to study the reaction of inequality to changes in asset prices. To achieve our second objective, we specified a parsimonious model for the income of the top 1 percent as a function of six factors (6 covariates): financial assets (stock returns), non financial assets (returns on house prices), bond yields, macro-economic factors (unemployment rate and inflation), and education premium. Our task here is to provide empirical evidence on which of the two variables (asset prices and education premium) provides better explanatory power to changes in income of the top 1 percent.

Examining whether changes in both financial and non-financial assets affects everyone in the top and bottom of the income distribution the same way, or if there are remarkable differences on how these variables affect individuals within the top and bottom

[64] For an application of Granger Causality Tests see Huang and Kracaw (1984), Swanson (1987) and Cochran and Mansur (1991).

income percentiles, will be an important contribution in understanding what is driving the changes in the income share of the rich in the United States. Our central concern is to determine empirically whether stock prices can explain variations in the income of top 1 percent, bottom 90 percent and lowest fifth percent households. We achieve this by specifying 3 GMM models with the income of the top 1 percent, the income of the bottom 90 percent and the share of aggregate income of the lowest fifth percent households as our measures of income inequality (the dependent variables).

Previous studies on income inequality link the increasing income inequality to labour market, Fortin and Lemieux (1997), demographic changes, McCall and Percheski (2010), technological changes, Autor et al (2003), politics and social policy, Domhoff (2012) and Iverson and Wren (1998), education/skill premium, Mankiw (2013) and Goldin and Katz (2008) amongst other factors. However, these changes alone cannot fully explain the growing concentration of income at the very top of the income distribution. Our central hypothesis is that developments within the asset markets particularly stock markets can explain the dynamics behind the growth in the income of top income earners in the United States.

Consequently, this chapter empirically examines the relationship between income inequality and stock prices, house prices, bond yields, unemployment rate and inflation. While some of these variables are not direct measures of typically suggested causes of changes in income distribution, studying their relation to inequality seems an important step towards understanding how wealth[65] affects the distribution of income. This is because the distribution of stocks and homes has important implications for who benefits from asset prices appreciation and who is hurt by its depreciation. The present paper departs from earlier work in that we study the relationship between our three measures of income inequality and the covariates using a dynamic GMM model. To our knowledge, this is the first study that has undertaken a detailed analysis of the relationship between the incomes of the top 1 percent, bottom 90 percent and lowest fifty percent household income on one hand and stock and house prices using this estimation method.

The rest of this chapter is organised as follows: section 3.1 develops a financialization perspective of income/ wealth distribution and mechanisms to show the way

[65] Stocks (equities) have long been acknowledged as an important form in which people hold wealth. Fry and Taylor (2013), using data from the U.S. Census Bureau showed that among households with net worth of $500,000 or more, 65% of their wealth comes from financial holdings, such as stocks, bonds and 401(k) accounts and only 17% comes from their home. Ludvigson and Steindel (1999) in their own contribution estimated that the household sector's equity holding increased to nearly 100 percent between mid 1994 and 1997, representing a gain of over five trillion.

in which financialization might affect the distribution of income between the top income earners and the rest and also elaborates on the different theories of rising top income share. In section 3.2 we present a review of past literatures on asset prices and income inequality. Section 3.3 is the data analysis section as well as the causal effect of stock prices on top 1 percent income earners. In section 3.4 we present a detailed analysis of the estimation method used in this study as well as the presentation and interpretation of results. In section 3.5 we test the robustness of our findings by including a measure of skill/education premium. The idea is to test whether the stock price-income inequality increasing hypothesis will continue to be significant if we control for education premium in the model while section 3.6 is the summary of findings and conclusion.

3.1 Concept of financialization and income inequality

According to an accumulating body of research in economics and income inequality literatures, the significant increase in wage inequality is one of the main drivers of the increased upward distribution of household income to the top income earners. Wage inequality is defined as the increasing wage gaps between higher and lower paid workers; this has been on the increase since the late 1970s both in the UK and U.S., Schmitt (1995) and Machin (1996). Those at the bottom of the income distribution have been experiencing large falls in their earnings since the late 1980s. The proximate causes of rising wage inequality have been attributed to the growing inequality of capital income as well as the increasing share of income going to capital rather than wages and compensation, Mishel and Bivens (2011).

These developments fall within the ambit of the concept known as financialization. Authors such as Epstein and Jayadev (2005), Skot (2008), Foster and Magdoff (2009), and Duenhaupt (2010), amongst others have all acknowledged the role of financialization[66] of the economy, the performance of financial markets and the alignment of top executive compensation to stock price movements via share options to the widening income gap between the top and low income earners. These studies emphasized the tremendous growth

[66] Epstein (2005) defines financialization as "the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies". Others see it as a situation in which profits are made through financial channels rather than through trade and commodity production. Epstein and Jaydev (2005) define it as a situation in which industrial corporations channel a large part of their resources to financial activities at the expense of their main activity. Financialization as a concept can be seen as a phase of capitalist development in which rent extraction and profit making occurs primarily through financial channels rather than through trade and commodity production. In other words, financialization can be seen as the changing role of the financial sector for the real sector as well as the changes within the financial sector itself.

in capital income, decline in the share of labour income as well as the stagnation of real wages as important determinants of inequality in most industrialized economies.

Financialization covers a wide range of phenomena including the deregulation of the financial sector, the increasing importance of finance and financial markets for firms and households, Orhangazi (2008), the increase in both corporate and household leverage, the proliferation of new and complex financial instruments, Krippner, (2005), the boom and bust cycle in asset markets, the shareholder value orientation and changes in corporate governance, Stockhammer (2010), as well as the rapid rise of incomes in the financial sector amongst others. In this section, we explore how some of these changes have affected the income of the top income earners in the U.S.

The effect of financialization on income inequality can be understood within the context of financial assets[67] because they contribute to an individual's stock of wealth. Financial assets held by households form an important part of overall income and an important source of revenue either through their sale or refinancing. Keister (2002), argues that changes in the rules and practices[68] governing financial markets can have a significant impact on the distribution and disposition of wealth/income in the society. Much of the 1980s in the United States were marked by prosperity and strong economic growth that came in the form of financial activity and speculation in the financial market. Coming at the expense of the three decades-long process of financialization is the real sector of the economy which employs millions of middle-class Americans while most of the wealthiest individuals were employed by large investment firms in the financial sector, Mishel and Sabdish (2012), Bakija, Cole and Heim (2012).

The repeal of the Glass-Steagall Act[69] in 1999 was the culmination of financialization and pursuit of neo-liberalism in America. Another development that

[67] Financial assets are assets that derive their value because of a contractual claim and can be readily converted into cash. Financial assets include stocks, bonds, certificate of deposit amongst others. Firms in the financial services industry usually prefer to use financial assets to measure an individual's wealth because this reflects what the individual currently has to invest..

[68] The financialization of the U.S economy that started in the 1980s brought a lot of changes in both the regulation and operations of financial firms. The financialization got to the peak in the 1990s which led to the deregulation of the financial services industry. The deregulation initiatives of the 1990s culminated to the repeal of the Glass-Steagall Act in 1999 that provided the environment that aided financial firms to make huge amount of profits in the face of little regulation, Arnum (2011). According to Johnson (2012), financial profits for most U.S businesses went up to a little over 40 percent nearly twice the post-world war II average.

[69] The Glass-Steagall Act is the Banking Act of 1933 that separated banking according to the types of banking business- commercial and investment banking. The Act also amended the Federal Reserve Act to institute the system of federal deposit insurance and created the Federal Deposit Insurance Corporation (FDIC) owned by the Federal Reserve System, Conference of State Bank Supervisors (CSBS): Banking 101.
The primary purpose of the 1933 Act was to make banking safer by prohibiting speculation in securities. Specifically, the Act prohibited commercial banks from owning securities brokerage firms. Most banks at that

occurred as a result of the advent of the broad phenomenon called financialization was the pre-dominance of the shareholder value orientation[70] in American corporations, Orhangazi (2008). The shareholder value concept led to a new corporate governance strategy that emphasized the alignment of shareholder and manager's interests, Stockhammer (2010) and Orhangazi (2008). This phenomenon also led to a focus on short-term profits and gave organizations an incentive to cut labour cost, while rewarding top executives that focused solely on maximizing the value of their stock (rising stock prices) with generous compensation packages, Khurana (2002).

The new focus on stock prices as the most important metric of appraising management's performance led to a major change in the investment priorities of American corporations and in turn gave rise to the stock market boom of the 1980s. The historic stock market boom of the 1980s and 1990s worsened income inequality via a shift in the allocation of national income from labour to capital, Kristal (2010). The growth in capital income in the 1980s up until the late 2000s was much more concentrated amongst high income households since the ownership of financial assets is concentrated within this group of household.

According to the financialization thesis, its impact was seen in three interrelated aspects namely; the elevation of the significance of the financial sector, the transfer of income from the real sector to the financial sector and increases in income inequality via the effect of financialization on wages and financial assets, Stockhammer (2010) and Orhangazi (2008). The financialization literature maintains that the rapid developments within the financial sector brought significant changes in macro-economic patterns and income distribution in the U.S. These developments led to a relaxation of credit standards and increased the influence of the financial sector over the non-financial sector. In this chapter

time had to abandon the securities business and focused on banking because they were only permitted to receive not more than 10 percent of their income from the securities markets, which they considered to be too small, Conference of State Bank Supervisors (2013). President Clinton on November 12, 1999 signed into law the Gramm-Leach Bliley Act which repealed the Glass-Steagall Act of 1933. The emergence of Gramm-Leach Bliley Act of 1999 allowed banks to engage in securities trading and insurance underwriting, increasing the wealth of financial services companies Mamum et al (2005). According to the report of U.S Department of Treasury, the top five banks in third quarter of 2007 held approximately 97.2 percent of total derivatives contracts in the U.S, (U.S Department of Treasury 2007), the report highlights the new focus of banks-derivative trading as opposed to core banking functions.

[70]The proponents of the shareholder value argued that firms in America in the 1970s witnessed stagnation in profits because they were overly bureaucratic and inefficient and had placed too much emphasis on satisfying multiple groups of stakeholders including employees, creditors, suppliers, consumers alongside owners (shareholders) instead of focusing on the bottom line (profit), corporate strategy and investment, Davis (2009).

our focus is on the effect of financialization in promoting income inequality through the asset price channel. We did not study other aspects of financialization in this chapter.

The notion of financialization has been frequently employed in analyzing the increasing wage gap between the high and low income earners. Its theoretical appeal lies in its ability to connect the increasing income differentials between these two groups of income earners to the growth of finance in recent years. In a general term, financialization can give insight into the structural transformation of capitalist[71] economies during the last three decades with its resultant economic and social implications, Lapavitsas (2011). Epstein (2001) defined financialization as the increasing importance of financial markets, motives, institutions and financial elites in the operation of the economy as well as its regulatory institutions, both at the national and international level, from this perspective, one can argue that one of the impacts of financialization at the macroeconomic level is the dominance of the financial sector. This dominance was marked by rapidly rising debt to household ratios, corporate debt to equity ratios, increase in stock and house prices, increase in wage and compensation of finance and finance-related occupation, as well as the increase in the use of stock-option as a means of compensation for top executives in both the financial and non-financial sectors of the economy amongst others.

These developments led to the strong economic growth of the 1980s; however, they also increased financial fragility. Another factor that exacerbated the macroeconomic concerns of the impact of financialization on the economy is concerns about income distribution. The period of financialization of the U.S economy experienced a disconnection of wages from productivity growth, this, raised serious concerns with regards to the stagnation of wages and growing income and wealth inequality, Mishel et al (2007). Conventional economic theory has also played a critical role in promoting financialization and growing income dispersion.

One area where economic theory has been particularly important is the application of Jensen and Meckling (1976) 'agency theory'. This theory was formulated to tackle the lacklustre performance of most U.S firms during the stagflation of the 1970s, a period of poor stock market performance, Dobbin and Jung (2010). The agency theory came as a solution to the agency problem whereby the challenge was to get the firm's managers to maximize profits on behalf of shareholders. Proponents of this theory argued that the

[71] A capitalist economy is an economic system based on private ownership of capital; some of the core elements of a capitalist economic system include free market operation in which the invisible hand of pricing mechanism coordinates supply and demand in markets in a way that is to the best interest of the society, Scott (2007).

economic malaise of the 1970s was a result of executive obsession with corporate stability over profitability. The theory therefore, challenged the way that firms were being managed, maintaining that the interest of principals (shareholders) and their agents (executives) were misaligned, Whitley (1986) and Useem (1984).

According to Agency theorists, executives were serving their own interest rather than those of owners, given that they were more focused on maximizing corporate size by building large diversified empires that could shield them from downturns in any particular industry rather than profitability. To solve the corporate governance problem, the theorists prescribed changes in corporate governance and strategy. Jensen and Meckling (1976) argued that one of the ways of aligning the interest of managers with those of the shareholders would be by making managers to focus on increasing the value of their firms through increase in stock prices. Stock options[72] were used to guarantee that managers focused on increasing their firm values. Another prescription of the theory was the use of debt in financing new projects; this was aimed at putting an end to the executive practice of spending profits to buy new businesses, Davis et al (1994). The use of debt in financing new endeavours meant that profits were returned to shareholders through share buybacks and stock options were structured to reward executives for short-term price gains without penalizing them for losses, Dobbin and Jung (2010).

Some elements of this theory had important distributional consequences. For instance, the short-term pay-for performance systems favoured CEOs, money managers and security analysts because it increased their income. As was noted by Lounsbury (2007), some components of the agency theory aligned CEO interests with fund manager interests, because fund manager bonuses were based on short-term increase in stock value. In addition, borrowing to finance new projects and the use of profits to buy back stock meant that companies could raise stock price and boost CEO and fund manager's compensation. The increase in stock prices will also favour high income earners via capital gains. Hall and Liebman (1998) noted that the spread of stock options in the 1980s increased executive compensation and caused total compensation to be closely aligned with firm performance.

[72] Stock option is a call option on the common stock of a company that enables executives to buy a certain number of shares at a specified future date, typically three years at the market price of the stock at the date of issue, Karmel (2004). The objective of compensating managers with stock option is to give them an incentive to behave in ways that will boost the company's stock price. A recipient of a stock option will gain if the company's stock market price rises above the call price; the employee could exercise the option, pay the exercise price and would be issued with ordinary shares in the company. The original objective of stock option was to align CEO and shareholder interests; however, options even more closely aligned executive and fund manager interest, given that fund managers earned bonuses based on increases in the value of the portfolios under their management just as CEOs made more money based on increases in the value of the firms they managed.

Dobbin and Jung (2010) showed that median CEO compensation of big American firms rose seven times from 1984 to 2004, to over $3,500,000 much of these increases came in the form of stock option grants and bonuses.

Another area in which economic theory lent support to financialization is on the importance of financial markets expansion on economic efficiency. Proponents of the importance of financial sector argue that economic growth in any modern economy hinges on an efficient financial sector that mobilizes both domestic and foreign savings for productive investments. Therefore, expanding the scope of financial markets and the range of financial assets will increase efficiency and improve the ex-ante allocation of resources within an economy; this in turn will help economic agents in assembling portfolios that provide better risk/reward ratio. In other words increasing the number and range of financial assets will help businesses to hedge risk. Conventional economic theory suggests that the financial system as a whole plays a super important role in promoting economic growth and efficiency.

However, it did not suggest ways of mitigating the distributional consequences of the dominance of the financial sector over other sectors of the economy. While financialization of the 1980s brought with it strong economic growth, income growth was stagnant for middle income earners in the 2001-07 period and as is common, declined in the recessions at the end and beginning of the decade. While those at the top of the income distribution witnessed strong income growth during these periods, many in the middle and at the bottom have struggled. The financialization thesis have argued that many of the factors (e.g. rising CEO pay, prevalence of shareholder value orientation, high interest rates that prevailed in the 1980s due to Federal Reserve policy amongst others) that led to the stagnation of wages and increase in income inequality can be linked to a new economic configuration that has been explicitly promoted by financial sector interests, Wolff et al (2007).

Documented evidence with regard to the composition of wage share between managerial and workers wages suggests that there has been a shift in the wage share from workers to managers. Mishel and Sabadish (2012) showed that CEO pay has increased from thirty-eight times average worker pay in 1979 to two hundred and sixty-two times worker pay in 2005. According to them the wages of higher paid workers in the top half of the wage distribution increased much faster than those in the bottom half of the wage distribution. Using a measure of CEO compensation that includes the value of stock options granted to senior executives, the CEO-to-worker compensation ratio was 18.3-to-1 in 1965; it increased

to an all time high of 411.3-to-1 in 2000 before dropping to 209.4-to-1 in 2011, Mishel and Sabadish (2012).

The wages and compensation of CEOs as well as workers in the financial sector reveal much about the rise in income inequality. Mishel and Sabadish (2012) showed that the rise in the income of top 1 percent income earners was largely driven by households headed by someone who was either an executive or was employed in the financial sector. According to them, these group of workers accounted for 58 percent of the expansion of income for the top 1 percent and 67 percent of the increase in income for the top 0.1 percent from 1979 to 2005. In addition, CEO compensation increased by more than 725 percent from 1978 to 2011 while compensation of workers recorded only 5.7 percent over the same period. For this reason, high stock prices and the adoption of pay for performance increased the pay of some workers (executives, managers and supervisors), indirectly; financialization of (pay) contributed to redistribution of income upwards.

The question is: to what extent can changes in the prices of financial and non financial assets, particularly equities explain the super concentration of income in the top spectrum of the income distribution? We attempt to provide answer to this question by looking at different theories from related literature on the causes of rising top income share in the U.S in the next section and modelling the influence of asset prices on the conditional income distribution.

3.1.1 Theories and causes of rising top income share in the U.S

The rising top income shares that has been going on for the past three decades in the U.S has been attributed to many factors. Researchers such as Piketty and Saez (2003, updated 2010), have shown that salary income[73] and business income account for the majority of the incomes of top income earners in the U.S. According to them, 63 percent of the increase in the share of national income (including capital gains) going to the top 0.1 percent of the income distribution between 1971-1980 and 2001-2010 came from both salary income and business income.

Globalization defined as the free movement of goods, services and capital across borders has also been pointed at as one of the explanations for rising income inequality, Heshmati (2004). Globalization brings with it rapid changes in trade relations, financial

[73] Salary is defined for the purposes of income tax as every payment made by an employer to his employee for service rendered; this would be chargeable to tax as income from salaries while business income is income received from the sale of products or services. It is any income that is realized as a result of business activity, Mahesh and Shukla (2006).

flows and mobility of labour across the world. Several scholars have studied the wage links between globalization and inequality; for instance Ethier (2002) in his study of the impact of globalization on the skill premium, unemployment and countries social policies arrived at the conclusion that skill-biased technical change has played a major role in the rise of skill premium more than globalization. In this regard, it is assumed that the advancement of technology compliments the skills of highly-skilled workers and substitutes the skills of low-skill workers, Garicano and Hubbard (2007). Other researchers such as Miller (2001) and Krugman (2008) provided evidence in support of the globalization thesis.

Their research showed that a significant increase in the wage differential between skilled and low skilled workers in the U.S during the late 1970s can be attributed to rapid globalization. According to this narrative, most of the increase in wage inequality is as a result of structural change in production process that involves the outsourcing of low skilled-intensive production process to low-income countries. This implies that low-skilled workers in the U.S will now have to compete with abundant low-skilled workers from the rest of the world while the demand for the labour of highly-skilled workers in the U.S is on the increase, since highly-skilled workers are scarcer in the rest of the world than in the U.S. This situation will arguably depress the wages for lower-skilled workers.

A second narrative that is closely related to the globalization narrative is the economic theory of 'superstar' suggested by Rosen (1981). According to him, reward for high flying performers in any field of endeavour increases over time relative to reward for others because of globalization and advancement in technology which enables them to sell/offer their skills to a wider market over time. In other words, the concentration of output among a few individuals is generally marked with skewness in the associated distribution of income and significant large rewards at the top. The basic insight of this theory is that sellers of a particular service e.g. entertainers, financial-traders in an investment bank e.t.c. are not perfect substitutes; therefore, consumers of such services will prefer to patronize the extraordinarily talented individual than another person that is almost as good. In the case of investment banks, they will be willing to pay a substantial premia for the services of few exceptional financial traders.

Another explanation of rising income inequality is the major shifts in economic structure in recent decades as well as the declining share of national income going to wages. The growing importance of financial services sector is a key contributor to the decade long decline in the share of national income accruing to wages. A study by Reed and Himmelwelt (2012) showed that the share of national income going to wages in most developed

economies has fallen from 59 to 53 percent over the last thirty years, whereas the proportion going to profits has increased from 25 to 29 percent. One of the major reasons has been a significant reduction in the number of manufacturing industries that spend a high proportion of turnover on wages and the expansion of financial services industries that have a far higher profit margin. Philippon and Reshef (2009) and Mishel and Sabadish (2012) provided documented evidence on the role of financial sector pay and executive compensation in explaining the concentration of income at the very top of the income distribution.

According to Philippon and Reshef (2009) financial sector workers have been capturing rents that account for between 30 and 50 percent of the difference between financial sector wages and wages in non-financial sector jobs. The discussions so far seem to suggest the existence of 'superstars' in the financial sector and top managerial[74] cadre as one of the major contributors to the extreme wage inequality. Therefore, theories about executive compensation[75] and financial market asset prices could be important contributing factors to rising top income shares. We tested the financial asset price hypothesis empirically using causal inference analysis and quantile regression. In addition, we checked the stability of our findings by including a proxy for skilled and low skilled wage differential in the quantile regression model.

3.2 Literature review on income inequality and asset prices

Das and Mohapatra (2002) in their panel study of 11 emerging economies investigated the distributional consequences of stock market liberalization over the periods 1986 to 1995 and found that the gains from stock market liberalization appears to have benefited the top income earners more than the rest. Specifically, they observed a pattern that seems to indicate that income share growth accrued almost wholly to the top quintile of the income distribution at the expense of the middle class which they defined as the three middle quintiles of the income distribution. They provided evidence that showed that the income of those individuals at the lowest quintiles of the income distribution remained effectively unchanged in the event of the liberalization. The research of Das and Mohapatra

[74] Gabaix and Lander (2008) applied the superstar theory in explaining the significant increase in CEO pay over the last two decades. According to their study, ECOs differ in their managerial ability and are matched to firms in accordance to their ability in a competitive manner. If the managerial impact of CEO's ability increases with the value of the firm under his management, then the best CEO manages the best firm. They found in their calibration that small differences in ability can result in large differences in wages.

[75] There is a long debate on the effect of executive compensation in explaining rise in top income share. Kaplan and Rauh (2013) have argued that executives of publicly traded firms represent too small of a share of top income earners in the U.S to be able to explain much of the rise in top income shares.

(2002) corroborated the findings of Bekaert et al (2000) which found an increase in the mean income of the top income quintiles post liberalization.

Sawhney and Dipietro (2006) tested the relationship between stock market valuations proxied by stock market capitalization and four different measures of income inequality (GINI, share of income of bottom quintile, top quintile and the ratio of bottom and top quintile). Their study found that the stock market wealth has a positive and significant effect on income inequality across the countries. Specifically, an increase in stock market capitalization increases the Gini coefficient, income share of the upper quintile and lowers the share of the bottom quintile. Similarly, Ronie et al (2009) in their study of the long run determinants of inequality using panel of 16 countries and focusing on the rich (P99-100), the upper middle class (P90-99) and the rest of the population (P0-90), found that periods of high economic growth disproportionately increases the top percentile income share at the expense of the rest of the top deciles and that financial development also favours the super rich more than the others.

Nguyen (2012) studied the effect of income inequality measured by the share of national income going to the wealthiest 10 percent of the U.S population in explaining stock returns in the U.S from 1927 to 2012. His study explored income inequality under the asset pricing model. He employed the Fama-French three-factor model[76] to obtain the inequality beta coefficient as well as the inequality risk premium. His study found a significant relationship between income inequality and the rate of market participation which in turn influences the rate of returns on stocks. In addition, Zhang (2012) in a panel study of 154 countries from 1950 to 2008 showed that a rise in the GINI coefficient of 0.01 percentage point is associated with up to 2 percent reduction in stock price to dividend ratio. She concluded that an increase in income inequality increases the rate of return in the stock market due to a lower overall price level. Furthermore, Zhang's study found a connection between income inequality and the stock market via the interest rate channel. According to Zhang (2012) the risk-free rate measured using interest rate on T-bill was found to increase by 0.18 percent for a unit increase in income inequality measured using the GINI coefficient.

Recent theoretical studies on income/wealth inequality and stock returns provide evidence of a positive correlation between measures of stock market development and

[76] The Fama and French three factor model is a model that expands on the Capital Asset Pricing Model (CAPM) by adding size and value factors in addition to the market risk factor in CAPM. This empirical model considers the fact that the value and small capitalized stocks outperform markets on a regular basis; therefore, the inclusion of these two additional factors adjusts for the outperformance tendency which is thought to make it a more superior tool for evaluating manager performance, Fama and French (1993).

income of the top income earners. For instance, Favilukis (2012) using equilibrium model showed that stock returns are positively correlated with changes in inequality because stock market participants are on the average rich households who benefit disproportionately from a stock market boom. Solving for a heterogeneous agent incomplete market model where workers are subject to uninsurable labour market shocks[77] and are able to invest in a risk-free asset as well as the aggregate stock market if they are willing to pay a participation cost[78], with an ad hoc borrowing constraint that prevents wealth from falling below some level, showed that a positive stock market return, increases inequality because it benefits households that are already wealthy. According to him, allowing for a simultaneous change in wage inequality, loosening of borrowing constraints and drop in stock market participation costs allows the model to qualitatively match the pattern of changes in inequality, stock market participation and asset prices observed in the data.

Favilukis (2012) showed that a reduction in participation costs results in an increase in stock market participation and a fall in equity premium. On the other hand, an increase in labour income inequality induces households to save more, which in turn causes wealth inequality to fall. While loosening of borrowing constraints will have the opposite effect, i.e. a reduction in saving. The combination of increased precautionary saving because of an increase in labour market income risk and a decrease in precautionary savings due to the easing of borrowing standards results in a 0.015 increase of the Gini wealth coefficient in the model; which is smaller to the 0.056 rise over this period in the data.

According to Favilukis (2012) allowing for these three exogenous changes namely increase in wage inequality, a loosening of borrowing constraints and a drop in stock market participation costs simultaneously, allows the model to qualitatively match the pattern of changes in inequality. The study concluded that the changes in the pattern of stock returns were a major contributor to the increase in wealth inequality between 1983 and 2007.

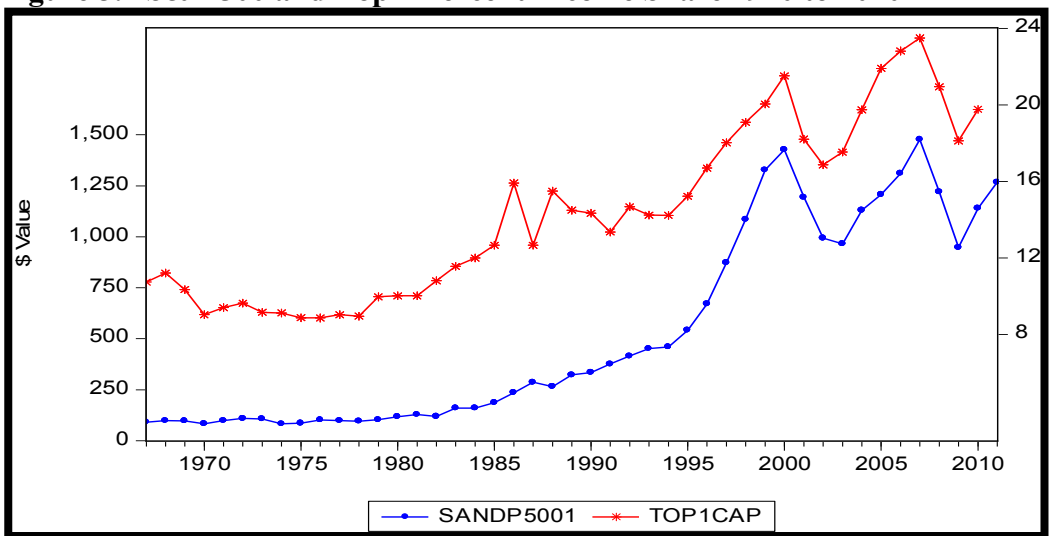
Recently, particularly after the great recession of 2007-2008 a new theory is starting to emerge the so called "asset bubble theory of income inequality". The theory suggests that the rise in income inequality over the past 4 decades could be the product of a series of asset price bubbles within the financial and real estate markets Fox (2009). According to this theory, the share of income accruing to households at the top end of the income distribution

[77] In the model, the realization by risk averse households that their uninsurable labour income has become more risky will cause poorer households to respond by saving a higher fraction of their income. This is particularly true for low income households who are usually more afraid of large negative labour income shocks because they have no buffer stock of wealth to use as insurance.

[78] According to him, allowing households to invest in equity and charging a participation cost is a direct departure from standard incomplete markets models. However, this departure is very important for considering inequality and heterogeneity.

increases whenever there is a boom in the financial markets and decreases when the boom gets bust. However, the increase even becomes much stronger with the next bubble. Piketty (2010) reported that some of the transitory changes in the income shares going to the top 1 percent reflect the volatile nature of income from capital gains. Capital gains ranged from about 3 percent to 5 percent of market income between 1979 and 1984; however, there was a spike in 1986 of over 10%. This spike could be attributed to investor's rush to realize profits from asset price increases in anticipation of the capital gains tax increase scheduled to come into force in 1987 Congressional Budget Office (2011). The run-up in stock market prices from 1995 through 2000 further helped to fuel the increase in the share of income going to those households within the top echelon of the income distribution.

Figure 3.1 S&P 500 and Top 1 Percent Income Share 1970 to 2010



Data sourced from Federal Reserve Bank of St Louis (2009) and Alvaredo, Atkinson, Piketty and Saez (2010) updated

Figure 3.1 above shows that the S&P 500 and the income share of the top 1 percent income earners have followed similar trend since the 1980s, although the top 1 percent income share series reveals an upward spike in the mid 80s which was followed almost immediately by a downward trend. Apart from these periods, the two series have moved in tandem with each other since the late 1990s. Removing capital gains from the income of the top 1 percent smoothes out some of the jumps in their income but does not change the trend.

How does income inequality fuel asset price bubbles? One can argue that the role that income inequality played during the pre-crisis period was the channelling of funds to the financial and real estate market. Given that more wealth yields to a diminishing marginal propensity to consume and a correspondingly higher propensity to either invest, save or speculate Dynan et al (2004); the speculative activities could lead to a vicious cycle of price

increases that may not be supported by changes in economic fundamentals while the diminishing propensity to consume is likely to result in a lower consumer demand at least within the upper class.

This view is supported by Kumhof and Ranciere, (2010) who argued that the income/wealth inequality provided large and expanding funds to the wealthy that looked for the most profitable investment opportunities. According to Kumhof and Ranciere, (2010) capital was channelled to high-return, high risk investments within the financial sector because the profit in the real economy was low. The high demands for risky high interest paying financial instruments saw lots of funds been channelled into different forms of complex securitized instruments and real estate which created the conditions for asset bubbles to develop. A similar pattern was witnessed before the Great Depression, Reich (2010) showed that wealthy Americans in the 1920s created equity and real estate bubbles which saw the Dow Jones Stock index rose from 63.9% in the mid-1921 to a peak of 381.2% eight years later before it collapsed.

Furthermore, stagnating middle class income meant increased demand for credit, most of which were used to buy financial and real assets thus fuelling the bubble. Easy access to credit allowed first time home buyers to gain entry into the mortgage market thus generating high demands for private real estates, as demands kept increasing, prices kept skyrocketing. To summarize, the income inequality/asset price bubbles hypothesis suggests that the increase in wealth of the richest households and the cheap cost of consumable funds for the middle to low income households played a role in increasing the demand for investment assets. On the part of the top income households, their increasing income prompted the need to invest in high-risky, high-reward investments while the increase in debt-to-income ratios for the low income households in the period preceding the crisis was associated with mortgage debt.

While these studies provided both empirical and theoretical evidence on the relation between stock returns and income inequality, the issue of causality between the two variables remains unexplored. The regression models used in previous empirical studies have been based on implicit assumptions that some unspecified causal relations exist between stock returns and changes in income inequality, particularly inequality measured using the income of the top income deciles. However, the existence of such relations between the two variables and the directions of causality has not been thoroughly established.

Changes in the stock market and the income of the top 1 percent may be related because of some underlying economic variables that systematically affect the two variables leading to convergence of some sort of expectations among participants within the stock market which are usually the top income earners. For instance, it could be that innovations in the stock market affect income of the top 1 percent via capital gains income and dividends or it could be that changes in income of the top 1 percent affect stock prices. This logic is in line with the "stock" oriented and "flow" oriented models of exchange rates[79], see- Dornbusch and Fischer (1980) and Branson (1983). One of the central objectives of this chapter is to investigate causal relations between stock returns and income of the top 1 percent income earners. The findings from this study will help in bridging the gap in income inequality and asset prices literature.

3.3 Data description, and summary statistics

This section describes the variables that we used in our empirical analysis as well as the descriptive statistics and correlation matrix. We start by providing the description and sources of each of the variables that we used. All the variables were measured on a quarterly basis from 1967 to 2011 and were all transformed to growth rates.

Measures of income

Top 1 percent income: This variable is defined as a measure of the share of total income (excluding capital gains) accruing to the top 1 percent of tax units[80]. The top 1 percent is defined relative to all families in the US population. Top income shares are estimated as income accruing to a given top group such as top 1 percent divided by total personal income in the US economy. This variable is one of the most widely used in recent income inequality literatures, Sherman and Stone (2010), Dunn (2012) and Saez (2013) amongst others.

The real disparity between the top 1 percent and the rest could be seen in their net worth. According to Dunn (2012), the top 1 percent[81] income earners are worth about $8.4 million, or 70 times the worth of the lower classes. The top 1 percent control 43 percent of the wealth in America while the next 4 percent control an additional 29 percent, Sherman

[79] The "flow" oriented models of exchange rates posit that changes in exchange rates affect income/output and therefore stock prices, e.g. Dornbusch and Fischer (1980) while "stock" oriented models e.g. Branson (1983), argues that innovations in the stock market affect exchange rates via the capital account.

[80] Tax units refer to either a married couple living together with dependent or a single adult with dependents, Alvaredo, Atkinson Piketty and Saez (2003).

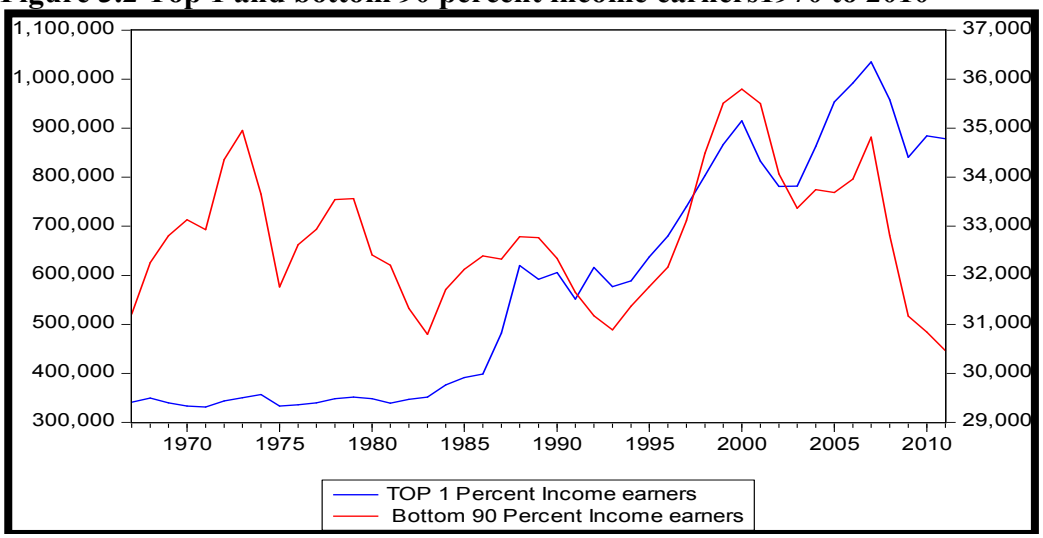
[81] Within this group of individuals is a smaller and wealthier subset of people, 1 percent of the top 1%, or .01 percent of the entire nation. These groups have incomes of over $27 million or approximately 540 times the national average income.

and Stone (2010). This variable was sourced from Alvaredo, Atkinson, Piketty and Saez (2009, updated to 2013).

Bottom 90 percent income: This variable is defined as a measure of the share of total income (excluding capital gains) accruing to the bottom 90 percent of tax units. Tax units estimated as sum of married men, divorced and widowed men and women, and single men and women aged 20 and over. Population and tax units' estimates are based on census and current population surveys. This variable was sourced from Alvaredo, Atkinson Piketty and Saez (2009, updated to 2013).

Figure 3.2 presents the pre-tax income share of the top 1 percent and bottom 90 percent income earners in the U.S from 1970 to 2010. The overall pattern of the top 1 percent income share over the 1970s is a downward trend while the bottom 90 percent witnessed some level of volatility in their income during the same period. After decades of stability, the top 1 percent income share has increased substantially since the early 1980 while the earnings of the bottom 90 percent income earners have failed to keep pace during the same time period. Although, the income of the bottom 90 percent saw large income gains between 1995 to early 2000s, the top 1 percent income earners have done even better. The plot showed a disproportionate surge in top incomes in the mid 1980s which continued till the onset of the 2007-08 financial crisis.

Figure 3.2 Top 1 and bottom 90 percent income earners1970 to 2010



Data sourced from Alvaredo, Atkinson, Piketty and Saez (2009, updated to 2013).

Income received by lowest fifth percent of households: this variable is defined as the share of aggregate income received by the lowest fifth percent of household. The data are based on the Current Population Survey (CPS), Annual Social and Economic Supplements

(ASEC) sample of 68,000 addresses. The survey reports the share of aggregate income received by each fifth and top 5 percent of households all race. We used the lowest fifth percent as our third measure of income.

Standard & Poor's 500 composite market index: This variable is used as one of the explanatory variables. This is used as a proxy for financial assets and was sourced from the Federal Reserve Bank of St Louis database. The S&P 500 has been used by other studies as a measure of the U.S financial market, Volscho and Kelly (2012), Hockett and Dillon (2013). We transformed it to the growth rate. As was noted before, one of the major arguments for the concentration of income in the top of the income distribution has been linked to the stock market boom of the late 1980s. Wolf (2012) reported a substantial increase in S&P 500 of about 171 percent between 1989 and 2001. According to him, from 2004 to 2007 the stock market rebounded after a brief recession and the S&P 500 rose by 19 percent in real terms while real wages stagnated. *Bond yield:* This is proxied using Moody's Aaa corporate bond yield sourced from the Federal Reserve Bank of St Louis. This variable is used to proxy financial income.

House prices: We used the median sales price for new homes sold in the United States as our proxy for non-financial asset. This variable was sourced from U.S Census bureau. Recent studies on the relationship between house prices and income inequality have identified several channels through which inequality can affect house prices. For instance Dewilde and Lancee (2012) noted that higher investment in property by wealthy households could lead to changes in housing market dynamics and property prices. In addition, such households can derive additional income from their investments in properties in the form of rents and capital gains that comes from the sale of the properties. Smith et al (2008) opined that homeownership that was prevalent in the U.S during the period leading to the great recession was used by low income households as a form of investment that allows for capital gains, which can finance other consumption. This variable was sourced from the Federal Reserve Bank of St Louis

Unemployment rate: Persistent high levels of unemployment and income inequality have continued to threaten the U.S economy four years after the Great Recession was officially declared to have ended. While unemployment literatures have focused more on its relationship with inflation and monetary policy[82], the income inequality literatures are concerned on its relationship with economic growth and efficiency[83]. The 1990s however saw the emergence of large literatures on income inequality and unemployment with

[82]See the classic work of Phillips (1958), Samuelson and Solow (1960), and Lucas (1976).
[83] See the pioneering work of Kuznets (1955), Okun (1975) and others.

conflicting results. Unemployment rate is used in this study to capture the effect of macroeconomic conditions on income across the nine equally spaced quantiles. This variable was sourced from Federal Reserve Bank of St Louis

Inflation: The relationship between inflation and income inequality remains inconclusive in the literature, though many studies find that inflation on the average worsens inequality, Romer and Romer (1999), Easterly and Fischer (2000), and Huangfu and Zhang (2012) who found that changes in inflation negatively affects low wage earners more than high wage earners. To analyze the impact of inflation on income we included this variable in the model. Inflation is measured as the growth rate of consumer price index.

Education/college premium: Education plays a critical role in labour markets and income inequality. Plethora of empirical studies from different countries supports the notion that well-educated individuals earn higher incomes, witness less unemployment and are employed in professional and prestigious occupations than their less-educated counterparts, Psacharopoluos (1985, 1994). Recent studies have argued that the widening income differential between the top income earners and low income earners is as a result of skill bias or education premium. In line with Goldin and Katz (2009), we used the growth rate in the income of individuals with four years or more of college education to capture the economic return to a year of college education that is skilled workers.

We used changes in the income of individuals with four years or more of college education to analyze the effect of highly educated[84] workers (skilled workers) across the entire income distribution. Our motivation for using this variable is because the earnings of the more educated is higher than that of the less educated- consequently, it seems plausible to use this variable to capture changes in the income of skilled workers. Following Goldin and Katz (2009), we defined college premium as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education.

Our data reveals that the college premium began to collapse in the mid 1990s. Earnings of the more educated (workers with 4 years or more of college education) reduced relative to that of the less educated (workers with only 1 to 3 years of college education). The education premium started to pick in early 2000s. The premium to a college education returned to an upward trajectory in the early 2000s and has sustained this upward trend till

[84] According to Goldin and Katz (2009), there seems to be a change in the concept of highly educated worker. The authors highlighted the differences in the definition of highly educated worker in 1915 and now. According to them a college graduate or someone with a post-graduate degree is considered highly educated in today's world while in 1915 a high school graduate would have been deemed well educated.

now. Table 3.1 is the descriptive statistics of the variables used in the study. The table shows the mean income of top 1 percent income earners at $591595, the bottom 90 percent at $33388 and that of the lowest fifth percent income earners at $3806. The maximum income of the top 1 percent income earners during the period under review stood at $106, 3046.00 this is $1026443 higher than that of their bottom 90 percent counterpart.

Table 3.1 Descriptive statistics income inequality and asset prices 1967Q1 to 2011Q4

	b_90_inc	st	$lfinc$	tp	ue	hp	π	by	sw	$colpre$
Mean	33388	535	3806	591595	6.16	116388	1.08	-0.01	35327	2540
Median	33314	318	3800	583447	5.80	118334	0.91	-0.03	39809	2391
Maximum	36603	1497	4316	1063046	10.70	255933	3.87	0.57	47383	8131
Minimum	30961	69	3185	336113	3.40	22333	-2.32	-0.69	14027	-3724
Std.Dev	1452	482	320	241383	1.66	70299	0.78	0.25	9727	2776

Notes

b_90_inc is the income share of the bottom 90 percent income earners, st denotes S&P 500 price index, $lfinc$ denotes the share of aggregate income going to the lowest fifth percent households, tp denotes top 1 percent income share, ue denotes the unemployment rate, hp denotes the median sales price for new houses sold in the United States, π denotes the growth rate of consumer price index, by is the Moody's Aaa corporate bond yield, sw denotes the income of skilled workers and $colpre$ denotes the college premium, defined as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education.

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Table 3.2 Correlation matrix for income inequality and asset prices 1967Q1 to 2011Q4

	b_90_inc	st	$lfinc$	tp	ue	hp	π	by	sw	$colpre$
b_90_inc	1.00	0.37	-0.04	0.29	-0.69	0.12	0.09	0.17	-0.03	-0.14
st	0.37	1.00	-0.89	0.97	-0.19	0.92	-047	-0.13	0.75	0.23
$lfinc$	-0.04	-0.89	1.00	-0.93	0.02	-0.95	0.61	0.26	-0.87	-0.28
tp	0.29	0.97	-0.93	1.00	-0.19	0.96	-0.50	-0.16	0.82	0.26
ue	-0.69	-0.19	0.12	-0.19	1.00	0.003	-0.02	-0.24	0.17	0.38
hp	0.12	0.92	-0.95	0.96	0.003	1.00	-0.49	-0.19	0.89	0.38
π	0.09	-0.47	0.61	-0.50	-0.02	-0.49	1.00	0.44	-0.48	-0.05
by	0.17	-0.13	0.26	-0.16	-0.24	-0.19	0.44	1.00	-0.27	-0.12
sw	-0.03	0.75	-0.87	0.82	0.17	0.89	-0.48	-0.27	1.00	0.36
$colpre$	-0.14	0.23	-0.28	0.26	0.38	0.38	-0.05	-0.12	0.36	1.00

Notes:

b_90_inc is the income share of the bottom 90 percent income earners, st denotes S&P 500 price index, $lfinc$ denotes the share of aggregate income going to the lowest fifth percent households, tp denotes top 1 percent income share, ue denotes the unemployment rate, hp denotes the median sales price for new houses sold in the United States, π denotes the growth rate of consumer price index, by is the Moody's Aaa corporate bond yield, sw denotes the income of skilled workers and $colpre$ denotes the college premium, defined as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education.

Table 3.2 above, is the correlation matrix; a closer analysis of the table reveals a high negative correlation (-0.69) between the income of the bottom 90 percent and unemployment. This finding indicates that increasing unemployment will lead to a reduction in the income of this group of population. Another interesting observation from the correlation matrix is the positive relationship between stock prices and the income of the top 1 percent at 0.97 and a negative relationship between stock prices and the income of the lowest fifth percent of income earner; indicating that stock price appreciation will result to increase in the income of the top 1 percent and a reduction in the income of the lowest fifth percent income earners..

The correlation matrix reveals a negative relationship between inflation and the top 1 percent income earners. This implies that increasing inflation will result to decreases in this variable. On the other hand, inflation was found to have a positive relationship with the incomes of the lowest fifth percent earning population, and the strength of this relationship is high at 0.61 percent. In addition, unemployment was found to have an inverse relationship with the income of the bottom 90 percent and top 1 percent of the population; indicating that increasing unemployment will lead to a decrease in the incomes of these two groups. However, the impact of unemployment is felt more for low income earners as shown by the magnitude of the correlation coefficient at 69 percent compared to 19 percent for top income earners.

3.3.1 Causal effect of stock price on top 1 percent income earners

Like we alluded in chapter two of this thesis, the average annual income of the top 1 percent of the population is $717,000, compared to the average income of the rest of the population, which is around $51,000. The real disparity between the classes is in net worth[85] or value. In addition to accumulating wealth through saving of current income, those individuals who own assets (mainly workers at the top of the distribution) may witness an increase or decrease in their wealth or income due to rising or falling asset prices. Consequently, being able to assess the directionality of the income of the top 1 percent of U.S earning population and asset prices particularly stock prices will be an important milestone in understanding the corporative nature of the two variables.

Research shows that one of the major factors driving the widening income gap between the top income earners and the rest is the unequal growth in earnings accruing to those at the top. Based on data from Alvaredo, Atkinson, Piketty and Saez (2009 updated

[85]Net worth is defined as the difference in value between total assets and total liabilities or debt.

2013), the average annual earnings of the top 1 percent rose from 11.3 to 23.9 percent between 1913 and 1928. The income share going to this group of income earners fell from 24 percent in 1928 to about 8.9 percent in 1975 and 1976. This downward trend was however, reversed during the 1980s, with the concentration of income within the top increasing to about 135 percent between 1981 and 2007, Volscho and Kelly (2012). In this section, we are interested in determining whether the higher earnings observed for the top 1 percent income earners are caused by their higher investments in stock markets or whether the recent increases in the stock market is as a result of their investment in the market. In other words, we want to examine if stock returns Granger causes changes in the income of the top 1 percent or vice versa. We also estimated the causal relationship between stock returns and bottom 90 percent. The knowledge of causal relations between the stock market and the income of both the top 1and bottom 90 percent will potentially increase the information set available to policy makers on the widening income disparity between these two groups.

Runes (1962) defined causality as a relationship between events, processes or entities in a time series such that the occurrence of one event will invariably lead to the occurrence of the other. This definition seems to suggest that one of the processes has the efficacy to produce or alter the other. In time series analysis, inference about cause-effect relationships hinges on the concept of Granger causality, Granger (1969)[86]. This concept is defined in terms of 'predictability' and exploits the direction of the flow of time to achieve a causal ordering of dependent variables, Eichler (2007). According to Granger (2001), if a signal X_1 Granger-causes a signal X_2, then it implies that the past values of X_1 contains information that helps predict X_2 beyond the information contained in past values of X_2 alone.

3.3.2 Presentation and interpretation of results from the causality models

The Granger causality test is used to measure the precedence and information content of variables. Following Lutkepohl (1993), Lee and Yang (2006) that introduced Granger causality in bivariate case; we estimated a bivariate Granger causality on our variables for income inequality and stock returns. The bivariate linear autoregressive model we estimated is of the following functional form:

[86] The mathematical formulation of Granger Causality is based on linear regression modelling of stochastic processes.

$$s_t = \alpha_1 + \sum_{j=1}^{p} \beta_1 s_{(t-j)} + \sum_{j=1}^{p} \gamma_1 tp_{(t-j)} + \varepsilon_{1t} \quad (3.1)$$

$$tp_t = \alpha_2 + \sum_{j=1}^{p} \beta_2 tp_{(t-j)} + \sum_{j=1}^{p} \gamma_2 s_{(t-j)} + \varepsilon_{2t} \quad (3.2)$$

$$s_t = \alpha_1 + \sum_{j=1}^{P} \beta_1 s_{(t-j)} + \sum_{j=1}^{p} \gamma_1 b\_90\_inc_{(t-j)} \varepsilon_{1t} \quad (3.3)$$

$$b\_90\_inc_t = \alpha_2 + \sum_{j=1}^{p} \beta_2 b\_90\_inc_t + \sum_{j=1}^{p} \gamma_2 s_{(t-j)} + \varepsilon_{2t} \quad (3.4)$$

Where

s_t= is the continuously compounded annualized rate of change of S&P 500;

tp_t= is the continuously compounded annualized rate of change of the income share of the top 1 percent;

$b\_90\_inc_t$= is the continuously compounded annualized rate of change of the bottom 90 percent;

p= is the maximum number of lagged observations in the model (the model order);

$\alpha, \beta, and\ \gamma$= The alphas, betas and gammas are the parameters to be estimated i.e. the contributions of each lagged observation to the predicted values of s_t and $tp_t, b\_90\_inc_t$, and $\varepsilon_{1t}, and\ \varepsilon_{2t,}$ are residuals (prediction errors) for each time series.

Equations 3.1 to 3.4 are the unrestricted or bivariate models. According to Ajayi et al (1998), if the gammas are equal to zero in equations 3.1 to 3.4 then a restricted or univariate version of the respective equation is obtained. Following the estimation of equations 3.1 to 3.4, if the estimated lagged coefficient vector γ_1 in equation (3.1) is statistically significant while the estimated lagged coefficient vector γ_2 in equation (3.2) is not statistically significant then the results suggest unidirectional causality within the Granger framework, from the stock returns to changes in the income of the top 1 percent income earners.

If, on the other hand, the estimated lagged coefficient γ_2 in equation (3.2) is statistically significant while the estimated coefficient vector γ_1 in equation (3.1) is not statistically significant then unidirectional causality exists from changes in the income of the top 1 percent to stock returns. If both vectors of lagged coefficients are statistically significant in equations (3.1) and (3.2), then the data provides evidence of bidirectional causality. The absence of directional causality is indicated if the set of parameters γ_s are statistically insignificant. The same explanation applies to equations (3.3) and (3.4) for the bottom 90 percent. Before we performed the Granger causality test we tested for the presence of unit-roots using the Augmented Dickey-Fuller tests. The table reveals that all

the variables used in this study were found to be stationary (see table A3.1 in the appendix of this chapter)[87].

Prior to the pair-wise Granger causality tests we performed a lag order selection to determine the best lag length for the analysis. The entire lag selection criteria[88] were unanimous in selecting lag 2 as the optimal lag length (see table A3.2 in the appendix). We then tested co-integration between the variables using Johansen Co-integration Test[89]. Both Trace test and Max-eigenvalue test indicates 2 co-integrating equations at the 0.05 levels. Based on the estimated equations, Granger causality tests are performed and the F-statistics and probabilities are reported in table 3.3 below.

Table 3.3 Pair-wise Granger causality tests for top 1 percent, bottom 90 percent and stock prices 1967 Q1 to 2011Q4

Null Hypothesis	$F-Statistic$	*Prob.*
tp *does not Granger cause* st @ lag 1	0.31	0.581
st *does not Granger cause* tp @lag 1	11.19	0.001
tp *does not Granger cause* st @ lag 2	1.89	0.154
st *does not Granger cause* tp @ lag 2	6.22	0.003
st *does not Granger cause* $b_{90_{inc}}$@ lag 1	0.17	0.682
$b_{90_{inc}}$*does not Granger cause* st@lag 1	0.64	0.423
st *does not Granger cause* b_90_inc@lag 2	1.62	0.201
$b_{90_{inc}}$*does not Granger cause* st@lag 2	0.65	0.522

Notes:
tp denotes the growth rate of the income share of the top 1 percent income earners and st denotes the growth rate of the S&P 500 and b_90_inc is the growth rate of the income share of the bottom 90 percent income earners

The empirical results reveal statistically significant (at one percent level) unidirectional causality from stock returns to changes in the income share of the top 1 percent. On the other hand, unidirectional causality from growth rate of income share of the top 1 percent to stock returns is found to be statistically insignificant. We found no evidence of directional causality between stock returns and income of the bottom 90 percent either way. The absence of a significant causal relation between the two variables seems to suggest that development within the stock market does not have any effect on the income of the bottom 90 percent workers. Therefore, government policies that are geared towards propping up financial markets particularly the stock market will have no associated effect on the bottom 90 percent income earners.

[87] In estimating the Granger causality models, the stationarity of the series involved must first be ascertained in other to avoid spurious regressions.
[88] The lag order selection criteria used were LR: Sequential modified LR test statistic (each test at 5% level), FPE: Final Prediction Error, AIC: Akaike Information Criterion, SC: Schwarz Information Criterion and HQ: Hannan-Quinn Information Criterion.
[89] A major implication of Granger causality is that if two variables say X and Y are co-integrated, then either X must Granger cause Y or vice versa.

The general implication of these findings is that stock market developments and income of the top 1 percent wage earners are well integrated with the direction of causality running from stock returns to top 1 percent income share. One of the practical policy implications of this finding is that monetary policy stance that is directed to asset prices will have a concomitant effect on the income of the top 1 percent income earners. This empirical evidence provides strong support for our speculation in the previous chapter which suggested that the monetary policy reaction to the top one percent income share could be an indirect reaction to the developments within the stock market given that changes in stock returns have causal influence on the income flowing to this cohort. Therefore, including asset prices in the monetary policy reaction function will not only rein in speculative increase in asset prices but will also narrow the earnings gap between the rich and the poor at least to some extent.

3.4 Model description and justification for the use of GMM

One of the important assumptions of regression analysis is that the independent variables are uncorrelated with the error or disturbance term. If this assumption is untenable for any reason, both the OLS and weighted Least Squares LS are biased and inconsistent. This assumption will be violated in situations where some of the independent variables are endogenously determined or where the regressors are measured with error. The conventional approach to use when the right hand variables are correlated with the residuals in the model is to estimate the equation using Instrumental Variables (IV) regression. The intuition behind this estimation method is to find a set of variables, known as instruments that are both correlated with the explanatory variables in the equation and are uncorrelated with the disturbances. There are different approaches to using instruments to eliminate the effect of variable and residual correlation.

We used the Generalized Method of Moments (GMM) to study the role of asset prices particularly equity prices on the income of the top 1 percent income earners. The GMM is used to solve the problem of heteroskedasticity of unknown form by using orthogonality conditions which allow for efficient estimation in the presence of heteroskedasticity, Baum, Schaffer and Stillman (2003) hereafter referred to as Baum et al. The generalized method of moment's estimator was introduced by Hansen (1982) as a generalization of the method of moments first introduced by Pearson (1894).

Given that the central concern of the present study is the role of asset prices on the top 1 percent income earners, households that fall within this income spectrum may get

more money by investing in the stock market and receive higher income through price appreciation/dividend payments. In addition, the massive investments of this group of income earners in the stock markets could also lead to stock price appreciation; consequently, the effect of stock prices on top income earners may be biased upwards (i.e. positive effect of stock prices is overstated). Furthermore, since monetary policy affects the stock market, which in turn affects the income share of the top 1 percent, there could be a problem of endogeneity. We used the GMM estimator to address this potential endogeneity. The GMM estimator is used to correct for bias caused by endogenous explanatory variables. We start with a brief description of the Instrumental Variable (IV) regression which is a special case of GMM.

Adopting the general notation of Baum et al (2003), the equation to be estimated is,

$$y = X\beta + u, \qquad E(uu') = \Omega \tag{3.5}$$

with typical row

$$y_i = X_i\beta + u_i \tag{3.6}$$

The matrix of regressors X is $n \times K$, where n is the number of observations. The error term u is distributed with mean zero and the covariance matrix Ω is $n \times n$. Some of the regressors are assumed to be endogenous, so that $E(X_i u_i) \neq 0$. The set of regressors X_i is partitioned into $[X_1 \ X_2]$, with the K_1 regressors X_1 assumed under the null to be endogenous, and the $(K - K_1)$ remaining regressors X_2 assumed exogenous.

The set of instrumental variables is Z and is $n \times L$; The instrumental variables are assumed to be exogenous, i.e., $E(Z_i u_i) = 0$. Like the regressors, the instruments are partitioned into $[Z_1 \ Z_2]$, where the L_1 instruments Z_1 are excluded instruments, and the remaining $(L - L_1)$ instruments $Z_2 \equiv X_2$ are the included instruments/exogenous regressors:

$$Regressors\ X = [X_1 \ \ X_2] = [X_1 \ Z_2] = [Endogenous \ \ Exogenous] \tag{3.7}$$

$$Instruments\ Z = [Z_1 \ \ Z_2] = [Excluded \ \ \ Included] \tag{3.8}$$

The order condition for identification of the equation is $L \geq K$; there must be at least as many excluded instruments as there are endogenous regressors, Baum et al (2003). If $L = K$, the equation is said to be "exactly identified"; if $L > K$, the equation is "overidentified". If the projection matrix $Z(Z'Z)^{-1}Z'$ is denoted by Pz, the instrumental variable estimator of β is

$$\hat{\beta}_{IV} = (X'Z(Z'Z)^{-1}Z'X)^{-1}X'Z(Z'Z)^{-1}Z'y = (X'PzX)^{-1}X'Pzy \quad (3.9)$$

Under the assumption of conditional homoskedasticity the asymptotic distribution of IV estimator can be written as follows; let

$$QXz = E(X_i'Z_i) \quad (3.10)$$

$$QZZ = E(Z_i'Z_i) \quad (3.11)$$

and let $\hat{u} \equiv y - X\hat{\beta}_{IV}$ (3.12)

According to Baum et al (2003), the IV estimator is asymptotically distributed as $\hat{\beta}_{IV} \sim N\left(\beta, V\left(\hat{\beta}_{IV}\right)\right)$ where

$$V\left(\hat{\beta}_{IV}\right) = \frac{1}{n}\sigma^2(Q'_{XZ}Q_{ZZ}^{-1}Q_{XZ})^{-1} \quad (3.13)$$

Replacing Q_{XZ}, Q_{ZZ} and σ^2 with their sample estimates

$$\bar{Q}_{XZ} = \frac{1}{n}X'Z \quad (3.14)$$

$$\bar{Q}_{ZZ} = \frac{1}{n}Z'Z \quad (3.15)$$

$$\hat{\sigma}^2 = \frac{\hat{u}\,'\hat{u}}{n} \quad (3.16)$$

The asymptotic variance-covariance matrix of the IV estimator is obtained:

$$V(\hat{\beta}_{IV}) = \hat{\sigma}^2(X'Z(Z'Z)^{-1}Z'X)^{-1} = \hat{\sigma}^2(X'P_Z X)^{-1} \quad (3.17)$$

The IV estimator is a special case of a Generalized Method of Moments (GMM) estimator. Within the context of the GMM , we express the assumption that the instruments Z are exogenous as $E(Z_i u_i) = 0$. The L instruments yields a set of L moments,

$$g_i(\hat{\beta}) = Z_i'\hat{u}_i = Z_i'(y_i - X_i\hat{\beta}) \quad (3.18)$$

Where g_i is $L \times 1$ the moment function. The exogeneity of the instruments means that there are L moment conditions, or orthogonality conditions, that the $K-$ dimensional parameters of interest, will satisfy at the true value of β:

$$E(g_i(\beta)) = 0 \quad (3.19)$$

According to Baum et al (2003), each of the L moment equations corresponds to a sample moment and are written as;

$$\bar{g}(\hat{\beta}) = \frac{1}{n}\sum_{i=1}^{n} g_i(\hat{\beta}) = \frac{1}{n}\sum_{i=1}^{n} Z_i'(y_i - X_i\hat{\beta}) = \frac{1}{n}Z'\hat{u} \quad (3.20)$$

The idea behind GMM is to choose an estimator for β that solves $\bar{g}(\hat{\beta}) = 0$. In cases where the equation to be estimated is exactly identified, that is $L = K$, we will have as many equations-the L moment conditions as we do unknowns- the K coefficients in $\hat{\beta}$. In such a situation, it is possible to find a $\hat{\beta}$ that solves $\bar{g}(\beta) = 0$, this GMM estimator is the IV estimator.

In other situations where the equation to be estimated is over-identified, so that $L > K$, in this case, we have more equations than we do unknowns and it will not be possible to find a $\hat{\beta}$ that will set all L sample moment conditions to exactly zero. Therefore, an $L \times L$ weighting matrix W is used to construct a quadratic form in the moment conditions. This gives the GMM objective function:

$$J(\hat{\beta}) = n\bar{g}(\hat{\beta})'W\bar{g}(\hat{\beta}) \quad (3.21)$$

The GMM estimator for β is the $\hat{\beta}$ that minimizes $J(\hat{\beta})$. Solving the K first order conditions;

$$\frac{\partial J(\hat{\beta})}{\partial \hat{\beta}} = 0 \tag{3.22}$$

Produces the GMM estimator:

$$\hat{\beta}_{GMM} = (X'ZWZ'X)^{-1}X'ZWZ'y \tag{3.23}$$

An important issue when specifying a GMM estimator is the choice of weighting matrix. While any sequence of symmetric positive definite weighting matrices $\widehat{W}$ will yield a consistent estimate of β, however, the choice of weighting matrix affects the asymptotic variance of the GMM estimator. What is the optimal choice of weighting matrix? Following Baum et al (2003), denote by S the covariance matrix of the moment conditions g:

$$S = \frac{1}{n}E(Z'uu'Z) = \frac{1}{n}E(Z'\Omega Z) \tag{3.24}$$

where S is an $L \times L$ matrix. The general formula for the distribution of a GMM estimator is

$$V(\hat{\beta}_{GMM}) = \frac{1}{n}(Q'_{XZ}WQ_{XZ})^{-1}(Q'_{XZ}WSWQ_{XZ})(Q'_{XZ}WQ_{XZ})^{-1} \tag{3.25}$$

Baum et al (2003) opines that efficient GMM estimator is the GMM estimator with an optimal weighting matrix W, one which minimizes the asymptotic variance of the estimator. According to them, asymptotically efficient, or optimal GMM estimator of β may be obtained by choosing the weighting matrix so that it converges to the inverse of the long-run covariance matrix S given as $W = S^{-1}$. Substituting the weight into equations 3.23 and 3.25 yields the efficient GMM estimator.

$$\hat{\beta}_{EGMM} = (X'ZS^{-1}Z'X)^{-1}X'ZS^{-1}Z'y \tag{3.26}$$

With asymptotic variance:

$$V(\hat{\beta}_{EGMM}) = \frac{1}{n}(Q'_{XZ}S^{-1}Q_{XZ})^{-1} \quad (3.27)$$

Implementation of efficient GMM estimation requires that we obtain estimates of S^{-1}. The current study used the HAC estimation weighting matrix which is a heteroskedasticity and autocorrelation consistent estimator of the long-run covariance matrix of $\{Z_t u_t(\beta)\}$ based on an initial estimate of β. To obtain an initial consistent estimate of β we employed iterate to convergence weight updating method. This iteration weighting matrix and coefficient estimation is performed until the coefficients converge so that $\hat{\beta}_j = \hat{\beta}_{j-1}$ to a sufficient degree of precision.

To compute the coefficient covariance weighting matrix, we used the Windmeijer standard errors and covariance estimation method that employs a bias-corrected estimator which take into account the variations of the initial parameter estimates. Arellano and Bond (1991) in their Monte Carlo study provided evidence that seems to suggest that the conventional covariance weighting matrix estimators such as Two-stage least squares, HAC-Newey-West and White covariance estimators produce standard errors that are downward biased in small samples. According to Windmeijer (2000 2005), part of this downward bias is as a result of the extra variation caused by the initial weight matrix estimation which is based on consistent estimates of the equation parameters. Windmeijer (2000 2005) developed bias-corrected standard error estimates that take into account the variation of initial parameter estimates.

3.4.1 Model specification and lag Selection for the autoregressive model

The reactions of households to changes in incomes are not instantaneous. The changes are for the most part distributed over time; and positions of equilibrium are approached gradually. The slowness to respond may be due to the time delays in the transmission and analysis of the information upon which agents base their decisions on. Secondly, there could be some costs that may be incurred in the process of reacting to the new circumstances. In the context of the present study, stock market participants will incur some costs (for example brokerage fees or commissions) in a bid to react to stock price appreciations and these costs are likely to be positively related to the speed and the extent of the adjustments. Consequently, it is appropriate to make some provision in the model for such dynamic responses that are distributed over time.

We introduced an element of feedback in the model by including two lagged values of the dependent variable (measure of income inequality) y_{t-1} and y_{t-2} on the right-hand

of the equation as part of the explanatory variables. We did this to capture the persistency in the income of these groups of people, because we expect that the current level of the dependent variable could be heavily determined by its past levels. The inclusion of these lag values are necessary to ensure the stability of the model. The dynamic model we estimated is of this functional form:

$$y_t = \alpha + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \beta_3 st_t + \beta_4 hp_t + \beta_5 ue_t + \beta_6 \pi_t / z_t + \varepsilon_t \quad (3.28)$$
$$\delta = \beta_1 \bar{y}_{t-1} + \beta_2 \bar{y}_{t-2}$$

Replacing $\beta_1 y_{t-1}$ and $\beta_2 y_{t-2}$ with δ in equation (3.28) yields:

$$y_t = \alpha + (1 - \delta) y_{t-k} + \beta_1 st_t + \beta_2 hp_t + \beta_3 ue_t + \beta_4 \pi_t / z_t + \varepsilon_t \quad (3.29)$$

Where k is lags 1 and 2 of the dependent variable, y_t is a measure of income inequality namely the growth rate of the share of aggregate income received by top 1 percent, bottom 90 percent and lowest fifth percent of the earning population. In addition, the lagged dependent variables according to Nerlove (1958) can be seen as a "partial adjustment"[90] for any mean reverting behaviour.

To confirm the partial adjustment theory, we expect β_1 in equation (3.28) to be positive and significant. This would indicate a drift and β_2 to be negative and significant which indicates reversion towards an equilibrium value. That is to say, they are necessary conditions for the attainment of a long-run equilibrium in the dynamic response. The total effect of the lagged income is defined as δ that is $(\beta_1 + \beta_2)$. st_t denotes growth rate of stock prices, hp_t represents the growth rate of house prices, by_t is the corporate bond yield, while ue_t and π_t represents unemployment rate and inflation rate respectively.ε_t is the error term of the model and z_t the instruments provide information about changes in the income inequality variables that is not provided by the endogenous regressors in the model.

Identification in equation (3.28) requires us to have at least the same number of moments and parameters. In other words, for the GMM estimator to be identified, there must be at least as many instrumental variables as there are parameters to estimate. In this case, we have over-identified models. The instruments used are a constant, lagged income

[90] The idea behind the partial adjustment is that, while the dependent variable y may be related to the explanatory variables $X's$ there is inertia in the system and the actual value of y_t is made up of its value in the previous time period y_{t-1} and the current values of the explanatory variables

inequality (y_{t-3}), lagged stock price (st_{t-1}), lagged house prices (hp_{t-1}), lagged bond yield (by_{t-1}), lagged unemployment rate (ue_{t-1}), lagged inflation (π_{t-1}), lagged index of globalization (kof_{t-1}), lagged college premium ($colpre_{t-1}$) measured as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education and a time trend.

We can express equation (3.29) as a partial adjustment model (PAM). To illustrate this model, adopting the notations of Gujarati and Sangeetha (2007), we assume that there is equilibrium or long-run income of households within the top 1 percent, lowest fifth and bottom 90 percent income earners under the given state of the stock, fixed income and housing markets e.t.c. Also assume that this desired level of household income at the selected percentiles y_t^* is a linear function of stock returns x our main variable of interest as follows:

$$y_t^* = \beta_0 + \beta_1 x_t + u_t \tag{3.30}$$

Since the desired level of income is not directly observable, following Nerlove (1958) partial adjustment hypothesis we postulate the income adjustment hypothesis:

$$y_t - y_{t-1} = \delta(y_t^* - y_{t-1}) \tag{3.31}$$

Where δ is the coefficient of adjustment such that $0 < \delta \leq 1$, and $y_t - y_{t-1}$ is actual change and $(y_t^* - y_{t-1})$ is the desired change. Equation (3.31) stipulates that the actual change in the income of households at the selected percentiles in any given time period t is some fraction δ of the desired change for that period. According to Gujarati and Sangeetha (2007), if $\delta = 1$, it means that the actual incomes of those households adjust to their desired incomes instantaneously in the same time period. However, if $\delta = 0$, it implies that nothing changes since actual income at time t is the same as that observed in the previous time period. Typically, δ the coefficient of adjustment is expected to lie between these extremes (1 and 0) since adjustment to the desired income is likely to be incomplete because of technical or institutional inertia or rigidities. The adjustment mechanism equation (3.31) can also be written as:

$$y_t = \delta y_t^* + (1 - \delta) y_{t-1} \tag{3.32}$$

Equation (3.32) implies that the observed income of households at the selected percentiles at time t is a weighted average of the desired income at that time and the income existing in the previous time period, δ and $(1-\delta)$ is the weights. Substituting equation (3.30) into equation (3.32) gives:

$$y_t = \delta(\beta_0 + \beta_1 x_t + u_t) + (1-\delta)y_{t-1}$$
$$= \delta\beta_0 + \delta\beta_1 x_t + (1-\delta)y_{t-1} + \delta u_t \quad (3.33)$$

Equation (3.33) is known as the partial adjustment model. Given that equation (3.30) represents the long-run or equilibrium income of households at the selected percentiles, equation (3.33) can be regarded as the short-run income of these households since in the short-run their existing income may not be necessarily equal to its long-run level. Once we estimate the short-run function equation (3.33) and obtain the estimate of the adjustment coefficient δ (in this case the the sum of y_{t-1} and y_{t-2}) we can derive the long-run function by dividing $\delta\beta_0$ and $\delta\beta_1$ by δ and omitting the lagged y term, which will then yield equation (3.30). The partial adjustment model is an autoregressive model. Following Koyck (1954), we can derive the speed of adjustment λ as $(1-\delta)$ i.e. 1 minus the coefficient of adjustment δ.

To select the lag length for the dynamic model equation (3.28) we specified an Autoregressive model of order $AR(\rho\, max)$; where $(\rho\, max)$ is the maximum lag length considered, given that the time series used in the present study is quarterly time series, our $\rho\, max = 4$ periods. We estimated using OLS an $AR\,(1), AR(2), AR(3) and\, AR(4)$ with deterministic time trends included in each of the models and then selected lags with statistically significant coefficients, in this case the coefficients on y_{t-1} and y_{t-2} were found to be statistically significant.

The econometrics specification equation (3.28) examines the response of income to changes in the covariates- financial and non financial assets as well as unemployment and inflation. There are limited works modelling household income dynamics in economics. Indeed, Sawhill (1988) and Masumura (1996) opined that economists have no model of household income dynamics or poverty. This is because of the limited knowledge of the processes generating families and family income, Gottschalk (1997). Having a standard model for household income dynamics is difficult because of the human capital issues and individual attributes that arise in personal earnings. These difficulties are further

compounded by the continuous evolution of households; therefore, having a model of household income dynamics might have a lot of econometric problems.

Having said that, the empirical approach we used in this study is based on income distribution in macroeconomic models used by, Bertola et al (2005) and, Heathcote et al (2008) that used log of hourly wages for men and women in studying the macroeconomic implications of rising wage inequality and Sarel and Robinson (1997) that examined in a cross-section empirical framework, the relationship between macroeconomic environment and trends in income distribution using the logarithmic average of income per person as the main variable of interest. Given that we are interested in studying the effect of asset prices on the income of households at selected percentiles as well as testing to determine whether asset prices or the so called college premium provide better explanatory powers to changes in the top 1 percent income, we included variables to capture both the asset price and education premium channels of income inequality[91].

The macroeconomic variables considered in the present study are policy variables namely, inflation and unemployment rate as well as financial and non-financial variables namely stock prices, bond yield and house prices and a measure of skill/education premium. All the variables used in this study are stationary variables given that we transformed them to growth rates. We conducted a formal test of stationarity of the variables using the Augmented Dickey-Fuller test with intercept included in the test equation. The result of the ADF test is reported in Table 3.4.

[91] Equation 3.28 is a relatively simple model used to study the distributional consequences of asset prices and education premium on household income. Obviously, we do not in this chapter attempt to deal with all the documented causes of income inequality such as globalization, technological advancement amongst others. What we have done is to include variables that we feel captures the main factors involved.

. **Table 3.4 Augmented Dickey-Fuller Test**

$Variable$	$t-Statistic$	$Prob^*$
tp_t	-5.130842	0.0000
$lfinc_t$	-4.656162	0.0002
$b\_90\_inc_t$	-4.523297	0.0003
st_t	-9.314975	0.0000
ue_t	-3.268955	0.0178
hp_t	-14.79487	0.0000
by_t	-5.905545	0.0000
π_t	-3.679163	0.0263
$colpre_t$	-3.974325	0.0182

Notes:

tp denotes growth rate of top 1 percent income share, $lfinc$ denotes the growth rate of the share of aggregate income going to the lowest fifth percent households, b_90_inc is the growth rate of income share of the bottom 90 percent income earners, st denotes growth rate of S&P 500 price index, ue denotes the unemployment rate, hp denotes the growth rate of median sales price for new houses sold in the United States, by is the Moody's Aaa corporate bond yield, π denotes the growth rate of consumer price index, $colpre$ denotes the growth rate of college premium, defined as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education.

3.4. 2 Presentation and interpretation of results

We analyzed the effects of asset prices particularly stock prices on the income of the top 1 percent, lowest fifth percent and bottom 90 percent income earners in the U.S from 1970 to 2011. Our aim is to examine whether changes in both financial and non-financial assets particularly stock returns affect top and bottom earning households the same way, or if there are remarkable differences on how these variables affect individuals within these selected percentiles. The results from these analyses will be an important contribution in understanding what is driving the changes in the income share of the rich in the United States. The results are presented in turn below on tables 3.5, 3.6, and 3.7.

Table 3.5 GMM regression estimates for top 1 percent income earners 1970Q1 to 2011Q4

	$\beta_0\alpha_t$	$\beta_1 tp_{t-1}$	$\beta_2 tp_{t-2}$	$\beta_3 st_t$	$\beta_4 hp_t$	$\beta_5 by_t$	$\beta_6 ue_t$	$\beta_7\pi_t$
$Coefficients$	0.64 [1.06]	1.01*** [3.31]	-0.54*** [-2.77]	0.13*** [1.89]	-0.07 [-0.54]	-1.56 [0.76]	-0.14 [-1.37]	0.31 [0.75]
$(tp_{t-1} + tp_{t-2}) = \delta$	0.47							
$Adj\ R^2$	0.60							
$Prob$ $(J - statistic)$	0.50							

Notes:

$\alpha, \beta_1 tp_{t-1}, \beta_2 tp_{t-2}, \beta_3 st, \beta_4 hp\ \beta_5 by\ \beta_6 ue\ \beta_7\pi\ \theta$ represents the parameters in the model, where α is the constant, $\beta_1 tp_{t-1}$, is the lag 1 of the growth rate of the income of the top 1 percent, $\beta_2 tp_{t-2}$ is the lag 2 of the growth rate of the income of the top 1 percent, $\beta_3 st$ denotes growth rate of S&P 500 price index, $\beta_4 hp$ denotes the growth rate of median sales price for new houses sold in the United States $\beta_5 by$ is the Moody's Aaa corporate bond yield, $\beta_6 ue$ denotes the unemployment rate, $\beta_7\pi$ denotes the growth rate of the consumer price index and δ is the total effect of lagged income measured as $(tp_{t-1} + tp_{t-2})$. The parameter estimates are obtained by GMM estimation using HAC [Bartlett Kernel, Newey-West fixed bandwidth=50000] as the estimation weighting matrix. The instruments z used in the model are, a constant, lagged income of the top 1 percent (tp_{t-3}), lagged stock price (st_{t-1}), lagged house prices (hp_{t-1}), lagged bond yield (by_{t-1}), lagged unemployment rate (ue_{t-1}), lagged inflation (π_{t-1}), lagged index of globalization (kof_{t-1}), lagged college premium $(colpre_{t-1})$ measured as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education and a time trend. $pro.(j - stat)$ denotes the probability of the test statistic for over-identifying restrictions i.e. the probability of observing the value of the J-statistic, if the null hypothesis is true. The J-statistic tests the null hypothesis that the instruments are orthogonal to the error term of the regression. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $Adj\ R^2$ is the adjusted R^2.

$$tp_t = \alpha + \beta_1 tp_{t-1} + \beta_2 tp_{t-2} + \beta_3 st_t + \beta_4 hp_t + \beta_5 by_t + \beta_6 ue_t + \beta_7\pi_t/z_t + \varepsilon_t \quad \text{(a)}$$

The results presented in table 3.5 below suggest several conclusions: first the portion of the income of the top 1 percent that is explained by last period's income of this group of earners is significant. Secondly, the estimated coefficient on lagged income tp_{t-1} is positive and statistically significant at the 1 percent levels indicating a drift, which implies that the movement in the income of the top 1 percent this quarter continues the next quarter. The estimated coefficient on lagged income tp_{t-2} is negative and significant at I percent level of significance indicating a reversion towards an equilibrium value. Thirdly and perhaps the most important for the present study is that the estimated coefficient for the stock returns is positive and significant while house returns, and bond yields were found to be insignificant. Specifically, our result reveals that the effect of a one percent increase in stock returns tends to increase the income of the top 1 percent in the current period by 0.13 percent.

The impact of stocks on the income of the top 1 percent in table 3.5 suggests that the effect of changes in stock returns is distributed over a number of quarters. The total effect of the lagged income, i.e. the partial adjustment parameter δ from table 3.5 is 0.47

percent. The adjustment rate implicit in the partial adjustment coefficient is 0.53[92], meaning that 0.53 of the difference between desired and actual income of households within the top income spectrum is eliminated in one year i.e. 4 quarters. Given that we have estimated the short-run function equation (3.33) and have equally obtained the estimates of the adjustment coefficient, we can derive the long-run effect of changes in stock returns by dividing the short-run effect of changes in stock returns (contemporaneous effect st_t) on the top 1 percent by δ. We find that the long-run effect of stock returns on households within the top 1 percent income spectrum is 0.24.

Notice that there is not a huge difference between the short-run 0.13 and the long-run 0.24 effects of stock returns on top 1 percent income earners because the speed of adjustment is rapid. Our result suggests that holding all the other variables constant, that changes in stock returns can explain approximately 0.13% variations in the income of the top 1 percent. This is not surprising given that stock market participants are on average richer households and therefore, benefit disproportionately from a stock market boom. This finding provides substantial empirical evidence in support of the notion that the concentration of income at the top of the distribution could be driven at least in the short-run by developments within the stock market.

Table 3.8 below shows the percentage of total assets held by wealth class. The table reveals that about 64.4% of financial securities are owned by the top 1 percent population while 6.1% of the same asset class is owned by the bottom 90 percent in 2010. In addition, the top 1 percent income households owned about 48.8% of stocks and mutual funds and this same group of income earners owned 35% of all the listed stocks directly or indirectly during the period under review. While the bottom 90 percent owned only 8.6% and 19.2% of stocks and mutual funds and listed equities respectively.

Furthermore, this finding offers support to our suspicion that the reaction of monetary policy to the top 1 percent income inequality measure, as opposed to the lack of reaction to all the other measures of inequality we used in chapter 2 of this thesis could be an indirect reaction to the stock market. This is because the income of the top 1 percent earning population exhibits high levels of correlation with the S&P500 stock index. In addition, figure 3.1 above reveals that the incomes of the top 1 percent are closely tied to the peaks and valleys of the stock market. We will now turn our attention to the response of households at the lower end of the income distribution to changes in asset prices. The

[92] That is 1-δ and δ in the current case is 0.47. Therefore the speed of adjustment λ is 1-0.47= 0.53

result for the GMM estimates of the reaction of the lowest fifth percent income earners is presented in table 3.6 below.

Table 3.6 GMM regression estimates for lowest fifth percent income earners 1970Q1 to 2011Q4

	$\beta_0\alpha_t$	$\beta_1 lfinc_{t-1}$	$\beta_2 lfinc_{t-2}$	$\beta_3 st_t$	$\beta_4 hp_t$	$\beta_5 by_t$	$\beta_6 ue_t$	$\beta_7 \pi_t$
$Coefficients$	0.04 [0.44]	1.53*** [5.76]	-0.83*** [-5.31]	-0.01** [1.83]	0.05*** [2.40]	-0.01 [-0.04]	-0.02 [-1.06]	-0.01 [0.75]
$\overline{lfinc_{t-1}} + \overline{lfinc_{t-2}}) = \delta$	0.70							
$Adj\ R^2$	0.77							
$Prob$ $(J-statistic)$	0.85							

Notes:

$\alpha, \beta_1 lfinc_{t-1}, \beta_2 lfinc_{t-2}, \beta_3 st, \beta_4 hp\ \beta_5 by\ \beta_6 ue\ \beta_7 \pi\ \theta$ represents the parameters in the model, where α is the constant, $\beta_1 lfinc_{t-1}$, is the lag 1 of the growth rate of the income of the lowest fifth percent income earning households, $\beta_2 lfinc_{t-2}$ is the lag 2 of the growth rate of the income of the lowest fifth percent income earning households, $\beta_3 st$ denotes growth rate of S&P 500 price index, $\beta_4 hp$ denotes the growth rate of median sales price for new houses sold in the United States $\beta_5 by$ is the Moody's Aaa corporate bond yield, $\beta_6 ue$ denotes the unemployment rate, $\beta_7 \pi$ denotes the growth rate of the consumer price index and δ is the total effect of lagged income measured as $(lfinc_{t-1} + lfinc_{t-2})$. The parameter estimates are obtained by GMM estimation using HAC [Bartlett Kernel, Newey-West fixed bandwidth=50000] as the estimation weighting matrix. The instruments z used in the model are, a constant, lagged income of the lowest fifth percent earning households $(lfinc_{t-3})$, lagged stock price (st_{t-1}), lagged house prices (hp_{t-1}), lagged bond yield (by_{t-1}), lagged unemployment rate (ue_{t-1}), lagged inflation (π_{t-1}), lagged index of globalization (kof_{t-1}), lagged college premium $(colpre_{t-1})$ measured as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education and a time trend. $pro.(j-stat)$ denotes the probability of the test statistic for over-identifying restrictions i.e. the probability of observing the value of the J-statistic, if the null hypothesis is true. The J-statistic tests the null hypothesis that the instruments are orthogonal to the error term of the regression. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $Adj\ R^2$ is the adjusted R^2.

$$lfinc_t = \alpha + \beta_1 lfinc_{t-1} + \beta_2 lfinc_{t-2} + \beta_3 st_t + \beta_4 hp_t + \beta_5 by_t + \beta_6 ue_t + \beta_7 \pi_t / z_t + \varepsilon_t \qquad \text{(b)}$$

Table 3.6 above is the result of the regression for the lowest fifth percent earning households. The result from this model presents several interesting findings, first just as in the top 1 percent model; the past values of income of the lowest fifth earning population can explain variations in their current income. Secondly, the estimated coefficient on lagged income $lfinc_{t-1}$ is positive and statistically significant at the 1 percent levels indicating a drift, which implies that changes in the income of the lowest fifth percent this quarter continues the next quarter. The estimated coefficient on lagged income $lfinc_{t-2}$ is negative and significant at I percent level of significance indicating a reversion towards an equilibrium value. Thirdly, the contemporaneous effect of changes in stock returns is negative and significant at the 5 percent levels. Specifically, the result suggests that holding all the other variables constant, an increase in stock returns will result to a 0.01 percent reduction in the income of households at the lowest fifth percent income spectrum.

The inverse relationship between our measure of inequality and stock returns in this model suggests some sort of redistribution. The total effect of lagged income of the lowest fifth percent income earning households, i.e. the partial adjustment parameter δ from table 3.6 is approximately 0.70 percent. The adjustment rate implicit in the partial adjustment coefficient is 0.30 percent indicating that only about 30 percent of the difference between desired and actual income of households within the lowest fifth percent income spectrum is eliminated in one year i.e. 4 quarters. The long-run effect of stock returns on households within the lowest fifth income percentile is -0.05. Although the short run and long run distributive effects of changes in stock returns is minimal, this finding however provides support for the notion that monetary policy induced stock price inflation can exacerbate inequality.

Allowing return in house prices to enter the model suggests a positive and significant relationship between the incomes of individuals at the lowest fifth percent income spectrum and house returns. This finding seems to suggest that a percentage increase in house prices, holding other variables constant favours those households at the low end of the income distribution. Quantitatively, one percent increase in house prices will increase the income of households at the lowest fifth percent by 0.05 percent and is significant while the same increase for the top 1 percent model will result to an increase of 0.07; however, this is not statistically significant.

This finding can be understood within the context of home ownership wealth effect. According to Belsky and Prakken (2004), housing wealth is far more broadly distributed across income levels than stock wealth. According to them, the top 1 percent of stock holders in 2001 held one out of every three dollars of stock wealth, while the top one percent of homeowners held a lesser one out of every eight dollars of home equity. This implies that home equity is particularly important to lower income households. Table 3.8 reveals that the ownership of principal residence was more within the bottom income earners.

Specifically, 59.8% of bottom 90 percent income earners own their residence as compared to only 9.2% of top 1 percent that owned their residence in 2010 meaning that residential assets are more widely distributed than stock. Levine (2012) reported that in 2007, the wealthiest 10% of households held 38.5% of the gross equity in principal residences compared with 90% of the value of stock. In addition, households in the next 40% of the distribution i.e. 50th to 90th percentile held 48.9% of gross equity in principal residence compared to 9.0% of the value of stock. Thus appreciation in house price appears

to have the potential of reducing the income gap between the top and low income earners via housing wealth and home equity borrowing. Inflation, unemployment rate and bond yield were all insignificant in both models suggesting that these variables do not explain changes in the incomes of both the top and lowest fifth percent income earners.

Table 3.7 below presents the GMM model for the bottom 90 percent income earning households. The result from this table shows that both the first and second lags of bottom 90 percent income explains variations in the current income of this group of wage earners. In this model just like in the other two models above the estimated coefficient on lagged bottom 90 percent income $b\_90\_inc_{t-1}$ is positive and statistically significant at the 1 percent levels indicating a drift, which implies that movements in the income of households within the bottom 90 percent of the income distribution in this quarter continues in the same direction the next quarter. The estimated coefficient on lagged bottom 90 percent income $b\_90\_inc_{t-2}$ is negative and significant at I percent level of significance indicating a reversion towards an equilibrium value.

Table 3.7 GMM regression estimates for bottom 90 percent income earners 1970Q1 to 2011Q4

	$\beta_0\alpha_t$	$\beta_1 b\_90\_inc_{t-1}$	$\beta_2 b\_90\_inc_{t-2}$	$\beta_3 st_t$	$\beta_4 hp_t$	$\beta_5 by_t$	$\beta_6 ue_t$	$\beta_7 \pi_t$
$Coefficients$	0.05 [0.62]	1.90*** [8.15]	-1.01*** [-5.35]	0.01 [1.29]	0.01 [0.30]	0.07 [0.22]	-0.01 [-0.44]	-0.01 [0.18]
$\overline{b\_90\_inc_{t-1} + b\_90\_{}_{t-2}) = \delta}$	0.89							
$Adj\ R^2$	0.87							
$Prob$ $(J-statistic)$	0.91							

Notes:

$\alpha, \beta_1 b\_90\_inc_{t-1}, \beta_2 b\_90\_inc_{t-2}, \beta_3 st, \beta_4 hp\ \beta_5 by\ \beta_6 ue\ \beta_7 \pi\ \theta$ represents the parameters in the model, where α is the constant, $\beta_1 b\_90\_inc_{t-1}$, is the lag 1 of the growth rate of the income of the bottom 90 percent earning households, $\beta_2 b\_90\_inc_{t-2}$ is the lag 2 of the growth rate of bottom 90 percent earning households, $\beta_3 st$ denotes growth rate of S&P 500 price index, $\beta_4 hp$ denotes the growth rate of median sales price for new houses sold in the United States $\beta_5 by$ is the Moody's Aaa corporate bond yield, $\beta_6 ue$ denotes the unemployment rate, $\beta_7 \pi$ denotes the growth rate of the consumer price index and δ is the total effect of lagged income measured as $(b\_90\_inc_{t-1} + b\_90\_inc_{t-2})$. The parameter estimates are obtained by GMM estimation using HAC [Bartlett Kernel, Newey-West fixed bandwidth=50000] as the estimation weighting matrix. The instruments z used in the model are, a constant, lagged income of the bottom 90 percent earning households $(b\_90\_inc_{t-3})$, lagged stock price (st_{t-1}), lagged house prices (hp_{t-1}), lagged bond yield (by_{t-1}), lagged unemployment rate (ue_{t-1}), lagged inflation (π_{t-1}), lagged index of globalization (kof_{t-1}), lagged college premium $(colpre_{t-1})$ measured as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education and a time trend. $pro.(j-stat$ denotes the probability of the test statistic for over-identifying restrictions i.e. the probability of observing the value of the J-statistic, if the null hypothesis is true. The J-statistic tests the null hypothesis that the instruments are orthogonal to the error term of the regression. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $Adj\ R^2$ is the adjusted R^2.

$$b\_90\_inc_t = \alpha + \beta_1 b\_90\_inc_{t-1} + \beta_2 b\_90\_inc_{t-2} + \beta_3 st_t + \beta_4 hp_t + \beta_5 by_t + \beta_6 ue_t + \beta_7 \pi_t / z_t + \varepsilon_t \quad \text{(c)}$$

The total effect of lagged bottom 90 percent incomes, i.e. the partial adjustment parameter δ from table 3.7 is approximately 0.89 percent. The adjustment rate implicit in the partial adjustment coefficient is 0.11 percent suggesting that only 11 percent of the difference between desired and actual income of households within the lowest 90 percent income spectrum is eliminated in one year i.e. 4 quarters in this case. The adjustment parameters in the low income models are very low suggesting that it takes a long while before a shock in the income of households within the low income spectrum returns to equilibrium. In this model, changes in stock returns, house price returns, bond yield do not explain variations in the income of the bottom 90 percent.

This finding supports the notion that low income households have almost zero investment in financial markets, therefore, developments within the financial asset markets does not affect their income. In summary, the analysis thus far reveals that changes in stock returns can provide some explanation to variations in the income of the top 1 percent while stock returns do not provide any explanations to changes in the income of both lowest fifth and bottom 90 percent income earners. The results from this study provides empirical evidence to Favilukis (2011) overlapping generations model that showed that stock prices played a major role in increasing wealth inequality.

Table 3.8 Percentage of total assets held by wealth class 2010

Investment assets	Top 1 percent	Bottom 90 percent
Stocks and mutual funds	48.8	8.6
Financial securities	64.4	6.1
Trusts	38.0	19.0
Business equity	61.4	8.1
Non-home real estate	35.5	20.9
Stocks directly or indirectly owned	35.0	19.2
Housing, liquid and pension assets and debt		
Principal residence	9.2	59.8
Deposits	28.1	29.5
Life insurance	20.6	45.3
Pension accounts	15.4	34.5
Total debt	5.9	72.5

Source Wolf (2012): "The asset price meltdown and the wealth of the middle class"

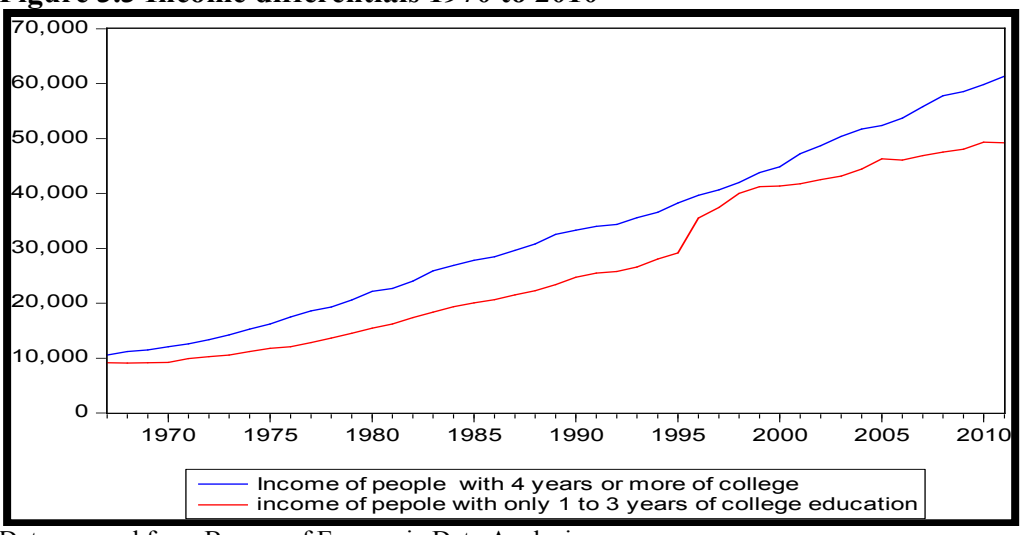
Notes:

Stocks directly or indirectly owned include direct ownership of stocks and indirect ownership through mutual funds. Top 1 percent according to Wolf (2012) has a net worth of $6,616,000 or more, while the bottom 90 percent has a net worth of less than $890,000. Net worth is defined as the difference in value between total assets and total liabilities or debt.

3.5 Skill/college wage premium and income inequality

The contribution of education or skill gap to widening income inequality has given rise to numerous studies in recent years. This has been especially true since the notion became widespread that the increasing income inequality could be attributed to differences in educational attainment and skill levels, Goldin and Katz (2008), Mankiw (2013), amongst others. Our data supports this notion as can be observed from the plot of income of individuals with 4 years or more of college education and that of individuals with only 1 to 3 years of college education- figure 3.3 (income differentials).

Figure 3.3 Income differentials 1970 to 2010



Data sourced from Bureau of Economic Data Analysis

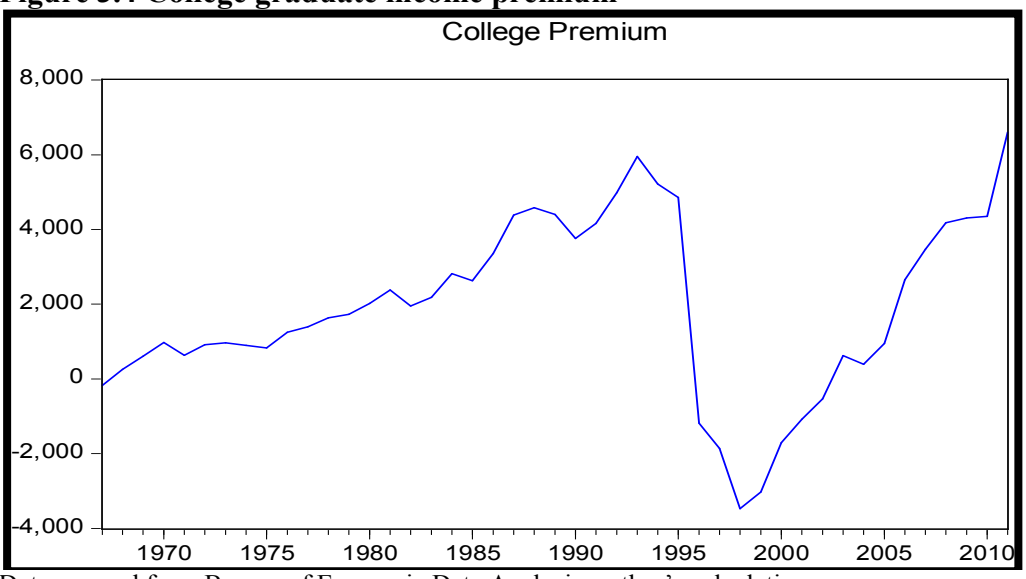
Figure 3.3 reveals that the income of individuals with only 1 to 3 years of college education has trailed behind that of individuals with four years or more of college education since 1967 to 2012. A closer look at the chart reveals a slight increase in the earnings of less skilled workers during the mid 1990s specifically in 1995, before a decline in early 2000s.

In addition, Goldin and Katz (2007) using two components of wage/income inequality measured as the college graduate wage premium relative to those who stopped at high school and the high school graduate wage premium relative to those who left school at eight grade showed that bulk of the widening wage/income inequality of the 1980s could be traced to an increase in educational income differentials. Specifically, the authors found that about 65% of the growth of overall wage inequality from 1980 to 2005 for men and women can be accounted for by the expansion of educational wage differentials. Furthermore, Lemieux (2006) in his own contributions provided documented

evidence which seems to suggest that the increased returns to post-secondary education can explain in part the rise in male hourly wage inequality from 1973 to 2005.

To test the stability of our findings we included a measure of education premium namely skill premium,[93] as part of the endogenous regressors and the growth rate of the income of individuals with four years or more of college education (skilled worker) as one of the instruments to capture the contributions of education and college income premium to income inequality. The basic idea of this section is to test if the financial and non-financial variables we used in the baseline model will still be significant if we control for the effect of skill premium on the top 1 percent income variable.

Figure 3.4 College graduate income premium



Data sourced from Bureau of Economic Data Analysis: author's calculation

Figure 3.4 is a plot of the college graduate premium which is measured as the difference between individuals with four years or more of college education and those with no college education. The growth in college premium has been somewhat zigzag since the 1970s although the general trend seems to be upward which is in line with previous studies. The plot of the college premium (figure 3.4) showed a steep decline in the mid 90s, which can be attributed to an attempt from the U.S government to narrow the widening income differentials via the increase in Federal minimum wage[94], targeted tax

[93] We define the skill premium as college wage premium measured as the wage differential between individuals over 25 years with 4 years or more of college education and those individuals with only 1 to 3 years of college education.

[94] A 2013 New York Times report suggests that increasing the Federal minimum wage from $7.25 an hour to $9 would directly address the United States yawning levels of income inequality, Lowrey (2013). According to this report, tying the minimum wage to inflation would allow it to increase in tandem with the cost of

credits and transfers, United States Department of Labour, Wage and Hour Division (2012). However, the premium returned to its upward trajectories during the late 1990s and early 2000s and has continued with this trend; thus exacerbating income inequality.

Over the past decades, the United States underwent significant structural changes, driven in part by the integration of the local economy into the global economy and rapid technological advancement. These changes tilted the income distribution in favour of highly skilled workers than low-skilled ones and thus affected the way earnings from work were distributed. However, changes in the earnings distribution alone cannot account for much of the overall trends in household income inequality in the U.S. Income from asset prices particularly equities can also have an impact on overall earnings inequality because the income it generates is much more unevenly distributed than wages and salaries.

Our point is that incomes from stock price explains changes in the income of the top 1 percent income earners given that the ownership of large amount of corporate stocks is concentrated within the upper and middle income households in the U.S. as can be seen from the results of our empirical analysis. Therefore, it is necessary that we test the robustness of our findings by allowing college premium to enter the model. This allows us to see if the stock market channel will still be significant if we account for the college premium or which of the two provides better explanatory power for the concentration of income at the top end of the income distribution.

The result from this model table 3.9 below corroborates the finding of a positive and statistically significant relationship between stock returns and the income of households at the top 1 percent Specifically, a one percent increase in stock prices will result to a 0.11 percent rise in the income of households at the top 1 percent. This finding provides strong support for the financial asset price channel of income inequality. The college premium variable in this model is not significant. This finding seems to suggest that stock price changes have played a more significant role in the concentration of income within the top echelon of the income distribution than the college premium in this model. The total effect of the lagged income δ in this model is approximately 0.51 percent. The adjustment rate implicit in the partial adjustment coefficient is 0.49 percent suggesting that about 0.49 percent of the difference between desired and actual income of households within the top 1 percent income spectrum is eliminated in one year i.e. 4 quarters in this case.

living and has the potential of boosting the wages of about 15 million low-income workers; hence, narrowing the income gaps between the low and high income earners.

Table 3.9 GMM regression estimates for top 1 percent income earners 1970Q1 to 2011Q4 robustness check

	$\beta_0\alpha_t$	$\beta_1 tp_{t-1}$	$\beta_2 tp_{t-2}$	$\beta_3 st_t$	$\beta_4 hp_t$	$\beta_5 by_t$	$\beta_6 ue_t$	$\beta_7 \pi_t$	$\beta_8 colpregr_t$
$Coefficients$	0.65 [1.45]	1.13*** [3.33]	-0.62*** [-2.95]	0.11* [1.76]	-0.05 [0.32]	-1.04 [-0.43]	-0.12 [-1.09]	-0.11 [0.17]	0.11 [0.42]
$\overline{tp}_{t-1} + \overline{tp}_{t-2}) = \delta$	0.51								
$Adj\ R^2$	0.69								
$Prob\ (J-statistic)$	0.25								

Notes:

$\alpha, \beta_1 tp_{t-1}, \beta_2 tp_{t-2}, \beta_3 st, \beta_4 hp\ \beta_5 by\ \beta_6 ue\ \beta_7 \pi\ \beta_8 colpregr\ \delta$ represents the parameters in the model, where α is the constant, $\beta_1 b\_90\_inc_{t-1}$, is the lag 1 of the growth rate of the income of the bottom 90 percent earning households, $\beta_2 b\_90\_inc_{t-2}$ is the lag 2 of the growth rate of bottom 90 percent earning households, $\beta_3 st$ denotes growth rate of S&P 500 price index, $\beta_4 hp$ denotes the growth rate of median sales price for new houses sold in the United States $\beta_5 by$ is the Moody's Aaa corporate bond yield, $\beta_6 ue$ denotes the unemployment rate, $\beta_7 \pi$ denotes the growth rate of the consumer price index, and δ is the total effect of lagged income measured as $(b\_90\_inc_{t-1} + b\_90\_inc_{t-2})$. The parameter estimates are obtained by GMM estimation using HAC [Bartlett Kernel, Newey-West fixed bandwidth=50000] as the estimation weighting matrix. The instruments z used in the model are, a constant, lagged income of the bottom 90 percent earning households $(b\_90\_inc_{t-3})$, lagged stock price (st_{t-1}), lagged house prices (hp_{t-1}), lagged bond yield (by_{t-1}), lagged unemployment rate (ue_{t-1}), lagged inflation (π_{t-1}), lagged index of globalization (kof_{t-1}), lagged college premium $(colpre_{t-1})$ measured as the income differential between individuals with 4 years or more of college education and individuals with 1 to 3 years of college education and a time trend. $pro.(j-stat$ denotes the probability of the test statistic for over-identifying restrictions i.e. the probability of observing the value of the J-statistic, if the null hypothesis is true. The J-statistic tests the null hypothesis that the instruments are orthogonal to the error term of the regression. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic, $Adj\ R^2$ is the adjusted R^2.

$$tp_t = \alpha + \beta_1 tp_{t-1} + \beta_2 tp_{t-2} + \beta_3 st_t + \beta_4 hp_t + \beta_5 by_t + \beta_6 ue_t + \beta_7 \pi_t + \beta_8 colpregr_t / z_t + \varepsilon_t \quad \text{(d)}$$

3.6 Conclusions

This chapter analysed the role of asset prices on the income of households within the top 1 percent, lowest fifth percent and bottom 90 percent of the income distribution. We used household incomes at these selected percentiles to understand the reaction of income to both financial and non-financial assets while controlling for the effects of inflation and unemployment. One of the novelties that the present study has brought to the income inequality literature is the use of GMM to examine the effects of stock returns on the selected percentiles. An important finding from this analysis, which is one of the key results of this chapter, is the substantial heterogeneity in the degree of sensitivity of income across different percentiles of household income to changes in stock returns and returns from home ownership. Application of this estimation approach enabled us to identify winners and losers among segments of the workforce to changes in stock prices and also evaluate how financial markets and economic policy initiatives affect the top and low income earners during the period under review.

Specifically, we found strong reaction to stock prices by households at the top 1 percent of the income spectrum while no statistical significant reaction was found at the lower income percentiles. This pattern of stronger reaction makes it clear that households at the top of the income distribution made much greater gains over time than those at the bottom of the distribution to stock price changes. This finding has some intuitive appeal given that higher income households are generally better positioned to invest/trade in stocks than those at the lower end of the income distribution. On the other hand, increases in the returns from homeownership favours households within the low income brackets more than those at the top income brackets. Hence if appreciation in house prices favour more low income earners, it implies an increase in household wealth and a reduction in wealth/income inequality given that housing wealth is far more broadly distributed across income levels than stock wealth.

According to Belsky and Prakken (2004), among homeowners with under $20,000 in income in 2001, three quarters have more home equity than stock equity and the median wealth of these low income owners is 81 times greater than the median wealth of renters with comparable incomes. The decreases in the incomes of the top 1 and bottom 90 percent income earners during 2007-2009 can be attributed to the decreases in the value of home and stock equity during the global recession. However, the recovery periods witnessed a strong rebound in the income of households within the top income distribution at the expense of those in the low income percentile. This rebound was orchestrated in part with the recovery of stock prices from their 2007 lows but the continuing problems in the residential real estate market have continued to widen the income gap, hence exacerbating income inequality.

In addition we found through the causality analysis that changes in stock returns has the efficacy of producing changes in the income of the top 1 percent wage earners. In other words, the causal relation between these two variables is such that when one changes, the other follows invariably. Given that an evidence of unidirectional causality from stock returns to top 1 percent income was established, it implies that the top 1 percent income earners benefits more disproportionately from stock price appreciations, at the same time they are also supposed to be penalized by stock price depreciation. However, this group of workers appears not to have been penalized as much as they gained during the boom years. For instance, the median value of stocks and equity in non-residential property fell by 23% during the global recession while the primary residence absolute value dropped by $18,700 (measured in 2009 dollars), more than that of any other financial or non-financial asset.

In other words, owners of stocks and non-residential properties lost only 23% of the value of their investments while owners of primary residential homes (mostly low income earners) lost more value than the equity owners. A possible explanation of this is the finding of monetary policy asymmetric reaction to stock prices which favours high income earners more. A major policy implication of this study is that government policies that are targeted at stimulating economic activities through the stock market will worsen the rising income disparities between high and low income earners.

Chapter 4

Financial development and income inequality

(A dynamic panel GMM approach)

4.0 Introduction

The findings from the previous empirical chapter (chapter three) that asset prices particularly stock prices can explain in part the super concentration of income at the top end of the income distribution seems to suggest that economic policies that prop-up the stock market will result to an increase inequality. Some of such policies were witnessed during the financial crisis and the recovery period. National governments particularly in America and Europe used some unconventional policies to prevent their financial systems from total collapse at the peak of the global recession. The rationale behind their actions would be implicitly or explicitly attributed to the economic importance of the financial sector over the real sector. The socialization of financial institution's losses and the asymmetric reaction of monetary policy to asset prices particularly at the peak of the economic crises have given rise to the re-emergence of the question regarding the contribution of financial system to the economy particularly to the widening income inequality in the United States and elsewhere.

For instance, the Fed in a bid to prevent the collapse of the U.S financial system embarked on aggressive purchase of large quantities of long-term securities from predefined financial institutions, the so called quantitative easing, Dudley (2010). Monetary authorities in the U.S and elsewhere embarked on massive balance sheet expansions in a bid to save their financial systems. Bernanke the ex-Federal Reserve chairman opined that the quantitative easing had contributed to the rebound in stock prices over the past few years and suggested this as a positive outcome. In his words "This effect is potentially important, because stock values affect both consumption and investment decisions[95]", Bernanke (2010).

[95] Bernanke's assertion seems to suggest that the economic benefits from the rebound in stock prices orchestrated in part by the monetary policy stance of the Federal Reserve will benefit low income households by improving the economy as a whole, the so called "trickle down" economic policy.

If the finding of a unidirectional causality from stock prices to the income of top 1 percent of the U.S population from the previous chapter is anything to go by, it implies that the rebound in stock prices as a result of the Fed's quantitative easing will exacerbate inequality given that ownership of stocks is concentrated within the top income households. Empirical evidence suggests that the effect of some of these policies was a widening of income gap between the rich and the poor. For instance, Wolf (2012) reported that quantitative easing helped in boosting wealth for those already engaged in the financial sector while passing little along to the rest of the economy. This line of argument suggests that the trickle down policy has benefited the wealthy more than the rest of the population; hence, resulting in the widening of the income gap between the rich and the poor.

The benefits of financial system that should warrant such type of special attention from the government fall short in being acknowledged by the public as the main operators (bankers and brokers) are seen as highly paid 'selfish' individuals who use the system to satisfy their high financial ambitions. Despite the widespread criticisms of the developments within the financial markets, particularly during the periods leading up to the global financial crisis, from an economic perspective, financial markets boost economic growth and provide the platform for wealthy as well as poor people to borrow and finance investments thus, ensuring that capital is distributed most efficiently irrespective of one's financial background. The success of microfinance for the poor in most developing economies is a typical example of the effect of financial systems in reducing income inequality. A well developed financial system is expected to reduce the income gap between the rich and the poor via the granting of loans to finance human capital development and business investment, with the resultant effect of increased income and upward social mobility[96].

Beck Demirguc-Kunt and Levine (2004) argued that financial sector development disproportionately raises the income of the poorest quintile and reduces income inequality. Also; Li, Squire and Zou (1998) found that financial sector development reduces inequality by increasing the income of the bottom income earners. On the other hand, other studies suggested that the benefits of financial sector development accrues mostly to the rich during the early stages of development thus exacerbating income inequality; however, this would tend to reduce as the economy develops and more agents gain access to the financial

[96]Demirguc-Kunt and Levine (2010) provided an overview of the relation between microfinance and income inequality and cited studies in favour of inequality-reducing effect of financial development.

market, Greenwood and Jovanovic (1990). Conversely, some authors have emphasized the negative distributional consequences of financial sector development. Tomaskovic-Devey and Ken-Hou (2011) suggests that income rents associated with financial sector development were realized primarily by capital in the banking, insurance and real estate industries and by employees in the securities industry. Their study found that the substantial increase in income rents to finance sector employees were not equally shared to all employees.

Given the not so clear effect of financial development on income inequality, this chapter investigates the link between financial sector development and income inequality for a large unbalanced dataset of 91 countries classified according to the income categories defined by the World Bank (high-income, middle-income, and the low income countries). The World Bank's criterion for classifying countries into different income groups is the gross national product (GNI) per capita[97]. Based on its GNI per capita every economy is classified as low income, middle income made up of lower and upper middle income and high income countries, World Bank (2013). Countries are classified according to 2012 GNI per capita[98], calculated using the World Bank Atlas method. Low income countries are countries with a GNI per capita of $1,035 or less, lower middle income countries are economies with $1,036-$4,085, upper middle income countries have a GNI per capita of $4,086-$12,615 and high incomes countries have a minimum per capita GNI of $12,616, World Bank (2013).

We tried to provide answers to the following questions; does financial sector development reduce income inequality? Is there any evidence that financial sector development favours high income earners? Can we spot major differences within countries based on their stage/level of economic development? Or is the effect the same around the world, irrespective of country peculiarities? Specifically, the null hypothesis tested in this study is that well developed financial markets reduce income inequality since efficient credit allocation will allow household choices and decisions to be made based on economic optimality rather than inherited wealth i.e. the linear negative influence hypotheses of

[97] There are some changes that were made in the World Bank's 2014 financial year (FY 14) classification. First the Russian Federation was moved to high income countries. Chile, Lithuania and Uruguay also became high income countries moving from upper middle income countries for the first time. Hungary slipped back to upper middle income country after being high income since financial year 2009 (FY09). The new income classification was released after our analysis which explains why Russian Federation, Chile, Lithuania and Uruguay were shown as upper middle income countries.

[98] It is important to mention that income classifications are set each year on July 1 and they remain fixed during the World Bank's fiscal year. Therefore, countries remain in the categories in which they are classified irrespective of any revisions to their per capita income data.

Galor and Zeira (1993). Against the alternative hypothesis that better developed financial markets favour the rich more than the poor given that they can afford the collateral requirements needed to obtain credit. We also tested the inverted U-shaped hypothesis of Greenwood and Jovanovic (1990) as well as the Kuznet (1955) inverted U-shaped path of income inequality along economic development.

A major preoccupation of the present study is the provision of empirical explanation of the influence of financial sector development on income inequality within countries included in the datasets. To model this influence, we employed the Arellano and Bond (1991) and Arellano and Bover (1995) dynamic panel GMM estimators which have the advantage of controlling for country characteristics via differencing and the orthogonal deviations respectively. To analyze the link between financial sector development and income inequality we used standard proxies in the financial development literature, namely the ratio of private credit to GDP, bank deposit to GDP and stock market capitalization to GDP as measures of financial development and the GINI coefficient of income distribution within countries as well as income share of the top 1 percent as measures of income inequality.

Our contributions to existing literature on financial system development and income inequality is the analysis of the distributional consequences of different dimensions of financial sector development (stock market, deposit and non-deposit financial institutions) on GINI index of gross and net income inequality as well as the income of the top 1 percent of the population in the target countries. Finally, to test the stability of our benchmark specification, we divided our dataset in subsamples, according to income levels. The idea is to provide additional insight on how financial sector development affects income inequality in countries at various stages of economic development and we also used bank deposit to GDP as a measure of financial sector development. The rest of the chapter is structured as follows:

Section 4.1 presents an overview of related literature; section 4.2 analyzes trends in income inequality around the countries covered in our datasets, and describes the data used in this chapter. In section 4.3 we conducted the econometrics analysis, in section 4.4 we tested the stability of our findings and evaluated the impact of financial development on the income of the top 1 percent while section 4.5 is the discussion of results and conclusion.

4.1 Literature review on financial development and income inequality

In this section, we provide both theoretical and empirical literatures on the impact of financial sector development on income inequality. Several studies have highlighted the important role that finance[99] play in theories of persistent inequality, Mckinnon (1973), Greenwood and Jovanovic (1990), Banerjee and Newman (1993), Shahbaz et al (2010) amongst others. The level of financial sector development of a country will determine the extent of the gap between the rich and the poor since financial system influence who becomes an entrepreneur and who cannot, who can afford quality education and who cannot, and who can take advantage of economic opportunities and who cannot. Thus, finance can shape the gap between rich and the poor as well as the degree to which that gap persists across generations, Demirguc-Kunt and Levine (2009).

Early empirical investigation into the relationship between the distribution of income and economic development was by Kuznet (1955). He established the inverted U-shaped path of income inequality along economic development-the so called Kuznets curve. Kuznet argument was premised on the notion that rural areas are more equal with somewhat lower average income than the urban areas at the onset of industrialization; therefore, a society becomes more unequal through urbanization. According to him, as families move from rural to urban areas, new generations of former poor rural families are able to profit from industrialization. Consequently, wages of former low income families who are beneficiaries of industrialization rises and overall income inequality narrows. A major underpinning of Kuznets' argument of industrialization is financial development, which helps children of formerly poor migrants to choose the education they desire and to start their own businesses irrespective of their inherited wealth.

Economic theory predicts conflicting relationship between finance and inequality. On the one hand financial sector development can reduce the intergenerational persistence of relative incomes because it can expand the economic opportunities of disadvantaged groups, thus, reducing the intergenerational persistence of relative incomes. On the other hand, financial sector development can equally enhance the financial services of those already accessing the financial system, which are generally high-income earners and well established firms. Therefore, the direct effect of improving the quality of financial services

[99] Finance consists of the ability of financial contracts, markets and financial intermediaries to facilitate the selection/screening of investment opportunities, the monitoring of investments after providing investment capital and the sourcing, trading and management of risk, Demirguc-Kunt and Levine (2009)

could have disproportionate impact on the rich, thus widening inequality and exacerbating inequality of economic opportunities between individuals from low and high income households, Greenwood and Jovanovic (1990).

Townsend and Ueda (2006) in their study provided an indirect mechanism in which changes within the financial sector can affect inequality. According to them, changes in the financial system can influence both aggregate production as well as the allocation of credit, each of which may change the demand for low-and high-skilled workers with implications on the distribution of income. The finance-inequality relationship has resulted in different schools of thoughts; the inverted U-shape hypothesis of Greenwood and Jovanovic (1990), the linear hypothesis of Banerjee and Newman (1993) and Galor and Zeira (1993), the human capital investment of Becker and Tomes (1979, 1986), and finally discrimination theory of Becker (1957).

All these theoretical models sought to provide an insight into the role of finance in explaining persistent inequality. Some of the models cited above motivate the use of the ratio of private credit over GDP as a proxy for financial development. A pronounced theme in most of these models is the notion that financial sector development has the potential of improving an individual's future income possibilities through easy access to credit. For example, Banerjee and Newman (1993), modelled households' occupational choice, which depends on credit availability. Galor and Zeira (1993), in their contribution modelled human capital investment which again depends on credit availability.

Finally, Greenwod and Jovanovic (1990) modelled household portfolio selection where the use of financial institution enhances household capital income; however, it comes at a small fixed cost. This cost element implies that at the initial stages of development poor households cannot afford using banks for their savings, resulting in increased inequality with financial development, as only those born in wealthy households are able to use bank finance. However, as the economy grows and matures overtime, a poorer household becomes richer and can also access bank finance. Consequently, inequality after some time decreases with financial development. (In what follows is an in-depth analysis of the theoretical models tested in this chapter)

Theoretical studies

Greenwood and Jovanovic inverted U-shaped hypothesis

This theory suggests an inverted U-shaped relationship (i.e., financial sector development might increase income inequality at the early stages of development, but then

tend to lower it when the average income increases and more household gain access to financial market) between financial sector development and income distribution. In their pioneering work Greenwood and Jovanovic (1990) explored the finance-inequality nexus within the context of an endogenous growth model. Their theoretical model analyzed growth and inequality dynamics in a situation where finance plays an important role in households' access to higher expected-return projects. In Greenwood and Jovanovic (1990) model, it is difficult to assess the quality of projects by individuals.

The development of financial intermediations can overcome the information friction on risky investment through collecting and analyzing information of a large number of potentially viable projects so as to discover their true quality and risk. In addition, the development of financial intermediary will also contribute in smoothing away the idiosyncratic risks associated with these projects through risk diversification, trading and pooling. To pay for these functions, agents pay a fixed cost to join financial intermediaries. Growth in this model implies that more agents can afford to join financial intermediaries thus, giving more individuals access to higher rates of return.

Given this entry cost, not every agent will join the financial market immediately because of wealth constraints. Therefore, the participation in the financial market may be restricted only to agents with the amount of wealth higher than a certain threshold level. Thus, for a given period, all the agents can be divided into two groups- the agents who are already in the financial market (participants) and agents who are not in the financial market (non-participants). The financial intermediaries make decisions on projects and allocation of funds based on the information in their possession.

The theoretical model of Greenwood and Jovanovic (1990) produces a dynamic solution to the relationship between finance and inequality. According to the model, at low levels of developments few agents join the financial system as a result of the high fixed entry cost relative to income. Consequently, growth is slow and the distribution of income is equal. Over time, i.e. in the intermediate stage of development some agents join the financial intermediary and enjoy greater returns; inequality widens coinciding with the rapid growth. At maturity, when a sophisticated and extensive financial structure has been fully developed the degree of inequality will reduce because more agents will have access to the financial system which maximizes growth and reduces inequality.

The linear hypothesis on finance-inequality relationship

The theoretical models of Galor and Zeira (1993), and Banerjee and Newman (1993) suggest a negative and linear relationship between financial development and

income inequality. Galor and Zeira (1993) model the dynamic pattern of income distribution in an economy with investment indivisibility, where economic agents live for two periods and there are inter-generational linkages through bequests (a gift of personal property by will). In their model, agents can either work as unskilled labours for both periods, or make an indivisible investment in human capital in the first period and then work as skilled labours in the second period. However, because of financial imperfections, opportunity for investment in human capital may be restricted to agents with sufficiently large inheritance or those that have access to external credits to cover the cost of human capital investment.

Assume an economy with single consumption good that can be produced with either the skilled-intensive technology or the unskilled-intensive one. The wage of skilled and unskilled workers are given as w_s and w_u respectively, with $w_s \gg w_u$. i.e., the wage of skilled labour is much greater than that of an unskilled labour. An agent with a certain level of wealth that lives for two-periods will consume some amount in the first period, and will bequeath the capital amount to his children. Given that the cost of human capital development is very expensive, it means that only agents with substantial large inheritance will invest in human capital and then become the skilled labours, while the other agents will remain unskilled

Galor and Zeira (1993), and Banerjee and Newman (1993) models implies that the initial wealth distribution matters for the long run level of income. This implies that income inequality will be perpetuated through bequests between generations. There will be a polarization of wealth between high-income skilled labours and low-income unskilled labours: the wealthy and high educated households will converge to the high-income steady state, while the poor and less-educated households will converge to the low-income steady state. These theoretical models predict a linear relationship between finance and inequality. In the sense that the development of financial market and financial intermediation, through the elimination of capital market imperfections and provision of easy access to credit for poor households enables them to borrow and invest in human capital. This contributes to improvement in income distribution thus, reducing income inequality.

As can be seen from the theoretical models[100] examined finance plays an important role in theories of inequality. Becker and Tomes (1979) and Galor and Zeira (1993)

[100] For an extensive review of the role of finance in explaining the persistence of intergenerational inequality see Demirguc-Kunt and Levine (2009).

highlights information and transaction costs associated with borrowing to finance education as a major factor that hinders the ability of poor households to borrow, thus strengthening the connection between family wealth and human capital accumulation. Inequality reduces in these models when poor households borrow to pay for more education. Therefore, it is the use of finance by households that did not have access to those financial services that affects economic opportunities.

Other models emphasize the relationship between education and the ability of households to smooth adverse income shocks. In a less developed financial markets, shocks to family income might force parent to remove their children from school and engage them in income earning activities. Therefore, financial system underdevelopment disproportionately hinders human capital accumulation in poor households. In these models, inequality will reduce when the economic disadvantaged families have easy access to financial markets to smooth income shocks.

Financial sector development can also disproportionately favour those that are already using financial services. In Greenwood and Jovanovic (1990), improvements in the financial systems that do not lower the fixed costs of accessing financial services will improve the quality of financial services enjoyed by those already in the financial system. In other words, the direct benefits of financial system development will accrue primarily to the rich, widening both the distribution of income and disparities in economic opportunities. This however, does not prevent the potential indirect general equilibrium effects from financial development. As was noted by Demirguc-Kunt and Levine (2009) financial development may have dynamic general equilibrium effects if it improves the efficiency in the allocation of resources and boost wage rates.

The authors argue that under these conditions, the fixed cost of accessing financial services falls relative to wage rates, potentially allowing a greater proportion of the population to access financial services. Thus while the initial effects of financial development favours those individuals that are already within the financial market more than non-participants intensifying inequality, the broader effects of financial development may work to expand economic opportunities and reduce inequality. In conclusion, theory provides both direct and indirect mechanisms through which changes in the operation of the financial systems can intensify or reduce the inequality of economic opportunity with concomitant implications for income inequality.

Empirical evidence

Plethora of empirical evidence supports the notion that in the long run a well developed financial system will reduce income inequality. Li et al (1998) employing data for 40 developed and developing countries from 1947 to 1994 found that well functioning financial markets are strongly associated with lower income inequality. Clark et al (2003)[101] tested these different theories using a dataset of 91 countries from both developed and developing countries between 1960 and 1995 found that inequality is lower in countries with better-developed financial sector and that income inequality decreases with the development of financial markets and financial intermediaries. Their study provides support to the linear hypothesis suggested by Banerjee and Newman (1993) and Galor and Zeira (1993) but rejected Greenwood and Jovanovic's (1990) model. Beck, Demirguc-Kunt and Levine (2004) also tested the three theories using private credit over GDP as a proxy for financial development for a panel of 52 countries from 1960 to 1999. They confirm the linear negative influence of financial development on income inequality. According to them financial development disproportionately raises the income of the poorest quintile and reduces income inequality.

In a similar study, Li, Squire and Zou (1998) explains variations in income inequality across counties and found that financial development lowered inequality and increased the average income of the bottom 80th percentile of the population. They measured financial development as M2 over GDP, which has a significantly negative effect on inequality in their sample of 49 countries. Further empirical studies that provided support for Galor and Zeira and Banerjee and Newman models is Kappel (2010) that reported a linear negative relationship between financial development and income inequality.

The following studies also provided documented evidence that financial sector development leads to a reduction in income inequality; Liang (2006) using a dynamic panel estimation GMM approach in studying the impact of financial development on income inequality in rural and urban China found a negative and linear relationship between financial development and inequality in both rural and urban China. But their

[101] Clarke et al (2003) used both private credits over GDP and Bank deposits over GDP as measures of financial development. The control variables are GDP per capital and its squared term to follow the Kuznets curve. Other variables are government consumption, inflation and the share of the modern sector amongst others.

study offered a weak support for the inverted U-Shaped relationship. Specifically, they found that easy access to credit improved income inequality.

Ang (2008, 2010) found that financial development and higher banking density improved income share of the poor in India. Bittencourt (2006) examined the impact of financial development on earning inequality in Brazil in 1980s and 1990s and found that financial development improved access to credit for poor households, alleviated extreme inequality and consequently improved welfare without distorting economic efficiency.

Other studies, however, challenged the finding that financial sector development can lead to a reduction in income inequality. For instance Canavire-Bacarreza et al (2010) in their study of the impact of financial development on the distribution of income in Latin America and the Caribbean found that the income of the poorest quintile has not been affected by expansion in the financial system. Their study also found that financial development has had a disproportionate positive effect on the incomes of the second, third and fourth quintiles. The study found some evidence for the Greenwood-Jovanovic hypothesis that this positive effect started after a country crosses a certain economic development threshold.

Similarly, Law and Tan (2009) examined the role of financial development on income inequality in Malaysia for the period 1980 to 2000 using the ARDL bound test. Their result suggests that financial market development has not been successful in reducing income inequality in Malaysia. Specifically, their research found the proxy for financial development to be statistically insignificant in reducing income inequality in Malaysia. Their result is robust for three different measures of financial indicators, including the banking sector, and financial aggregate variables. Jaumotte et al (2008) analyzed income inequality with a particular focus on trade and financial globalization in a sample of 51 countries from 1981 to 2003. They used private credit over GDP as a control variable and found a positive and significant coefficient for financial development in all the different models, thus rejecting the financial development-inequality reducing hypotheses. Jauch and Watzka (2012) using an unbalanced dataset of up to 138 developed and developing countries over the years 1960 to 2008 also found that financial development has a positive effect on income inequality thus rejecting the negative linear relationship.

Paulson and Townsend (2004) in their own contribution showed that financial constraints played an important role in shaping the patterns of entrepreneurship in Thailand. They showed that Wealthier households are more likely to start businesses than poor families. Theses constraints are more binding on entrepreneurship in the poor

Northeast compared to the richer Central region. They concluded that increased access to financial services via financial development is likely to accelerate economic growth and increase the demand for labour; however, the initial gains are likely to concentrate disproportionately on a small group of talented individuals. But at the long run, a much wider class of workers will benefit from increases in employment and wages, as new entrepreneurs are able to build and expand their businesses with greater access to credit. Their study supported the inverted U-shaped hypothesis of financial sector development and income inequality.

The general equilibrium model has also been used to analyze the effect of financial sector development on income inequality. Gine and Townsend (2004) developed a model using information about wealth, wage rate, financial transactions and occupational choices to evaluate the evolution of Thai growth and savings rates. The authors used their model to study how increases in the share of households with access to credit affects entrepreneurship, employment, wages, economic growth and income distribution. They provided evidence which seems to suggest that financial liberalization and increased access to credit can explain the GDP per capita growth in Thailand over the sample period spanning from 1976 to 1996. This development was accompanied with occupational shifts from subsistence sector to the intermediate sector which increased employment and wages.

The general equilibrium model of Gine and Townsend (2004) suggests that the greatest quantitative impact of improved access to finance on income inequality comes through indirect labour market effects of higher employment and wages. In other words they showed that the reduction in inequality is not primarily as a result of households at the lower end of the income distribution increasing their use of financial services or from poor households accessing the financial markets for the first time. Rather, finance reduces inequality by increasing the demand for labour in the long term, which off-sets the short term increases in inequality due to the gains that accrue to new entrepreneurs. Townsend and Ueda (2006) extended the model and endogenized the size of the intermediated sector by introducing fixed transaction costs into the model and found similar results. These authors concluded that some of the restrictive financial sector policies in Thailand might have slowed the growth of financial intermediation below the endogenous growth rate that would have resulted from increasing per capita income, as predicted by Greenwood and Jovanovic (1990).

Natural policy experiment is another method of assessing the impact of financial development on economic opportunity. In contrast to the general equilibrium models that

examine the impact of parameter changes within the model, natural policy experiments evaluate the impact of an actual policy change on different outcomes, Demirguc-Kunt and Levine (2009). An important element in using policy experiments is with the identification of an exogenous change in policy. Burgess and Pande (2005) used this type of experiment to evaluate the impact of Indian government's policy on banking branching[102] on access to credit and poverty.

Their study found that the bank branching policy led to a decline in poverty in states that started the period with a lower level of financial development during the program period. In addition, they found that there were increases in the wages of agricultural workers over the period while the wages of urban factory workers did not record such increase. The study seems to suggest that the increase in the number of branches in the rural area facilitated easy access to credit which led to the reductions in poverty and increase in the wages of farmers. Using the same policy experiment methodology, Jayaratne and Strahan (1998) found that the removal of geographic restrictions on banks in the United State improved banking efficiency by lowering interest rates on loans, interest margins, overhead costs and loan losses.

The authors also found evidence of a significant rate of economic growth across states after removing intrastate branching restrictions[103]. According to them, branching deregulation improved the ability of banks to direct savings to the most profitable projects and to also oversee the successful execution of these projects. They noted that banks function better after branching deregulation as is evidenced by the sharp reduction in loan losses, Jayaratne and Strahan (1998). These improvements were as a result of banks ability to screen and monitor loans with positive implications to economic growth because savings flow more consistently into profitable investment opportunities.

In a recent study by Beck, Levine and Levkov (2008) using a semi-natural experiment associated with bank deregulation to examine the impact of finance on inequality and the mechanisms that drive the finance-inequality relationship. They found that the GINI coefficient of income inequality decreases in states that have removed geographical restrictions relative to other states and relative to the state's own level of inequality before deregulation. According to them, deregulation exerts a disproportionately

[102] In 1977 the Reserve Bank of India mandated that a commercial bank could open a new branch in a location that already had bank branches only if it opened four in locations with no branches. This policy led to the opening of 30,000 new rural branches as well as increase in deposit and credit volume in states with initially low levels of financial development.

[103] The United States witnessed an imposition of restrictions on the ability of banks to branch within state borders (intrastate regulations) and ability of banks from one state to operate in other states (interstate regulation) for the most part of the 20th century, Jayaratne and Strahan (1996).

positive increase in the demand for lower-skilled workers, which increases the annual earnings of lower-income workers relative to higher-income individuals.

Levine and Rubinstein (2008) in their study used bank deregulation across the states of the United States to evaluate the impact of bank deregulation and reduction in lending rates on the high school dropout rates. Their study showed that reduction in the lending rate eased credit market constraints and lowered high school dropout rates. According to the authors, this effect only holds among poor households and they concluded that financial sector reforms that reduced the cost of borrowing increased the rate of human capital accumulation among lower-income families. Levine and Rubinstein (2008) study provided support to Lazear (1980) and Lang and Ruud (1986) who also showed that finance affects the persistence of income inequality by hindering the poor from accumulating human capital.

Most of these studies found evidence that support the notion that financial sector reforms that boost availability of credit for poor and low income families will reduce income inequality. The present study departs from most of the studies described above in that we distinguished the effect of financial development on the rich (measured using the income share of the top 1 percent in some selected high income countries)[104]. In addition, we used dynamic panel GMM estimation method while majority of the previous studies have used pooled OLS with the exception of Liang (2006) who studied the impact of financial development on income inequality in rural and urban China and Jauch and Watzka (2011) that analyzed the link between financial development and income inequality for up to 138 developed and developing countries using both OLS and instrumental variable estimation method.

The present study is different from these two in terms of the additional proxy that we used to capture the direct effect of stock market development on within country inequality and the panel corrected robust standard error we used in our estimation, as well as the analysis of financial sector development on the income of the top 1 percent wage earners in some developed economies.

4.2 Trends in income inequality around the world

Over the past five decades the world has observed increasing levels of income inequality in many countries, especially, in the developed world. The current chapter employed the recently compiled cross-country dataset that distinguishes market or gross

[104] The selection is based on countries that have complete information on the top 1 percent income earners.

inequality defined as GINI index of inequality before taxes and transfers and net inequality defined as GINI index of inequality after taxes and transfers to analyze the trends in income inequality around the world, Solt (2009)[105]. We divided our sample into three income groups namely, high income countries, middle income countries and low income countries. Our analysis reported in table 4.1b reveals that inequality is highest in middle income countries and the lower income countries.

Table 4.1a Distribution of gross and net inequality according to income groups, 1960q1 to 2007q4

	High income		middle income		Lower middle income	
	Gross	Net	Gross	Net	Gross	Net
Mean	42.83	29.65	48.42	43.03	47.07	42.09
Maximum	67.19	59.34	80.52	71.89	66.64	58.23
Minimum	26.04	17.56	19.67	16.94	21.36	21.72
Std.dev	6.83	6.02	10.34	9.36	8.11	7.46

Data source: Solt (2013) Standardizing the world income inequality database

Very high and increasing levels of income inequality can also be observed within the high income groups. Specifically, we observed massive difference in the levels of inequality measured either as gross or net GINI coefficient. For instance, in table 4.1a we found that the level of net income inequality (29.65), i.e., after redistribution is much lower than gross income inequality at (42.83) in developed countries. Country specific comparison of net and gross inequality for some selected high income countries can be seen in figures A4.1 to A4.4, for middle income countries figures A4.5 to A4.8 and for lower income countries in figures A4.9 to A4.12 in the appendix. An analysis of these graphs reveals that countries that might be considered as being relatively equal, such as Sweden have high levels of gross income inequality. In Sweden figure A4.3 we observed higher volatility in gross inequality over time compared to relatively stable movement in the graph of net inequality.

This might be an indication that redistribution in Sweden changes whenever there is an increase in gross inequality. The same volatility in gross GINI can be seen in Germany figure A4.4. The country witnessed a sharp drop in gross inequality during the early 1980s indicating how the governments of these countries react to gross inequality using redistributive policies. In the case of United States and United Kingdom, we observed that

[105]Solt (2009) combined information from available surveys to infer comparable series of the GINI coefficients for net and gross inequality for many countries. He divided the surveys into 21 types and used the entire dataset to decide how to map each of these 21 survey types into standard measures of net and market inequality. According to Slot (2009) net inequality is associated with income after direct taxes and subsidies, and market or gross inequality as pre-tax and pre-subsidy income.

gross and net inequality have moved in tandem during the periods under review (1960 to 2007). This could mean that redistribution in these countries does not change when gross inequality increases or decreases. Table A4.2b below presents inequality within the countries included in our dataset.

Table 4.2b Income inequalities around the world 1960q1 to 2007q4

High income countries	Maximum Gini_gross Column 1	Maximum Gini_net Column 2	Upper middle income countries Column 3	Maximum GINI_gross Column 4	Maximum GINI_net Column 5	Low income Countries Column 6	Maximum GINI_gross Column 7	Maximum GINI_net Column 8
Australia	44.01	31.70	Argentina	53.03	46.24	Armenia	49.34	41.85
Austria	44.54	28.01	Brazil	69.70	55.95	Bolivia	60.69	55.18
Bahamas	61.40	54.01	Chile	55.58	50.60	Cameroon	58.85	53.31
Barbados	61.54	57.63	Colombia	63.32	59.37	Cape Verde	57.56	52.54
Belgium	51.28	30.87	Cost Rica	60.04	49.04	Ecuador	61.04	55.65
Canada	43.36	31.83	Dominican Republic	52.25	47.31	Egypt	48.43	43.12
Croatia	34.98	33.14	Iran	56.60	44.63	El Salvador	58.69	51.89
Cyprus	50.21	29.25	Jamaica	69.52	60.96	Georgia	48.04	42.72
Czech Republic	36.76	26.23	Kazakhstan	39.31	37.91	Ghana	59.49	44.20
Denmark	56.29	27.38	Lithuania	57.41	35.47	Honduras	66.64	57.65
Estonia	51.57	36.86	Macedonia	37.95	34.97	India	55.39	48.80
Finland	53.65	35.07	Malaysia	67.06	50.49	Indonesia	47.56	41.28
France	55.79	38.31	Mauritius	49.57	45.17	Guatemala	59.64	54.72
Germany	51.07	30.50	Mexico	62.94	53.91	Jordan	48.39	43.24
Greece	50.83	34.89	Panama	56.66	52.49	Moldova	41.94	39.67
Hong Kong	59.89	42.20	Peru	63.24	60.04	Morocco	62.11	55.01
Hungary	43.09	32.28	Romania	60.50	53.77	Nigeria	56.83	58.28
Ireland	46.78	33.64	Russian Federation	51.27	44.96	Pakistan	46.71	37.19
Israel	48.61	37.00	South Africa	80.52	71.89	Paraguay	59.80	57.35
Italy	52.32	37.21	Turkey	64.90	52.34	Philippines	56.05	47.17
Japan	54.31	32.54	Uruguay	51.91	50.05	Sri Lanka	52.06	40.48
Korea Republic	46.99	30.96	Venezuela	50.40	44.95	Thailand	53.59	46.32
Latvia	52.52	37.63				Tunisia	56.16	48.62
Luxembourg	45.52	27.75				Yemen	44.27	39.69
Malta	67.19	59.35						
Netherlands	48.82	30.34						
New Zealand	60.60	53.51						
Norway	50.34	36.10						

Poland	47.97	32.01		
Portugal	64.82	37.78		
Singapore	51.49	38.08		
Slovak Republic	35.94	26.38		
Slovenia	34.79	26.56		
Spain	46.62	35.19		
Sweden	51.31	31.58		
Switzerland	42.66	30.90		
United Kingdom	53.04	36.06		
United States	49.21	37.93		

Data source: Solt (2013) Standardizing the world income inequality database

Table 4.2a columns 1, 2, and 3 reveal that countries such as Belgium has very high levels of gross inequality at 51.28, Cyprus at 50.21, Denmark 56.29, Estonia 51.57, Finland 53.65, France 55.79 and Germany 51.07. These countries are more unequal in terms of gross income relative to the U.S that has a gross GINI of 49.21. A major difference between these countries and the U.S is with the way that they have used redistributive policies to manage their distribution of income. Table 4.2b column 1 shows a significant drop in gross GINI from 51.28 percent to 30.87 percent in Belgium and similar level of drop was witnessed in Denmark from 56.29 to 27.38 representing drops of 66 percent and 105 percent in both countries respectively. Germany is another interesting case within the high income group. Germany witnessed a massive drop in gross inequality; from 51.07 percent to 30.50 percent about 67 percent drop in gross income inequality. This expands our knowledge of how different high income governments address the issues of unequal income distribution; this can be considered as a major finding.

Shifting our focus to middle income countries, we observed high levels of gross inequality in countries like South Africa (80.52), Brazil (69.70), Jamaica (69.52) and Turkey (64.90) amongst many others-refer to table 4.2b. Comparing the gross income inequality with the net income inequality in these countries reveal lower levels of redistribution. For instance, South African which has perhaps the highest level of gross income inequality amongst all the countries in our datasets has a net income inequality of 71.89 percent. This suggests that the direct effect of redistribution is only 12 percent For Brazil it is 25 percent and for Jamaica and Turkey it is 14 and 24 percent respectively.

These effects are somewhat minimal if we compare them to countries like Denmark, Belgium and Germany that used redistribution transfers to tackle the problem of unequal distribution of income. For the lower income group, the difference between gross inequality and net inequality in most of the countries is equally low. For instance in Morocco gross inequality is 62.11 percent while net inequality is 55.01 percent representing a drop of approximately 13 percent. In general we found that in all the countries included in this analysis, redistribution transfers have played an important role in reducing income inequality albeit at varying degrees. The only exception is the interesting case of Nigeria where gross income inequality at 56.83 percent seems to be slightly lower than net income inequality at 58.28 percent.

The main findings from the analysis of income inequality around the world are that the level of income inequality tends to decrease if one accounts for the role of

redistribution. In addition, we observed within the high income countries that unequal societies tend to redistribute more while the reverse seems to be the case for both upper middle income and lower income countries.

4.3 Data description and summary statistics

Table 4.3a Descriptive statistics 1960q1 to 2007q4

	$gini\_net$	$gini\_gross$	$pcgdp$	$bdgdp$	$prmse$	$gdppercap$	$indglob$
Mean	36.88	46.08	0.54	0.48	100.92	9696.02	59.48
Median	35.20	46.07	0.41	0.39	101.62	4438.90	57.61
Maximum	71.89	80.52	2.02	3.90	147.51	106919.5	92.70
Minimum	19.68	27.23	0.03	0.02	40.84	146.44	26.97
Std.Dev	9.54	7.50	0.40	0.38	11.36	11911.12	16.23

Notes:
$gini\_net$ denotes the GINI coefficient of net income, $gini\_gross$ is the GINI coefficient of gross income, $pcgdp$ private credit divided by GDP; claims on the private sector by deposit money banks and other financial institutions.$bdgdp$ denotes bank deposits divided by GDP; demand, time and savings deposits in deposit money banks.$prmse$ denotes primary school enrolment; gross enrolment ratio.$gdppercap$ denotes the GDP per capita, $indglob$ denotes the index of globalization.

Table 4.3a (descriptive statistics for all the countries) shows that average gross income inequality for all the countries is 46.08% while the average for the net income inequality is 36.88%. The sample maximum for the gross GINI is 80.52% while the sample minimum is 27.23%. South Africa has a gross GINI that is exactly the same with the sample maximum-see (table 4.2b column 4) indicating that South Africa has the largest level of gross income inequality amongst all the countries. For net GINI the sample maximum is 71.89% while the sample minimum is 19.68%. Slovenia has the lowest income inequality in our dataset. The country's gross inequality 34.76% is lower than the sample average of 46.08%, indicating that gross inequality in Slovenia is about 33% lower than the sample average.

Table 4.3b Correlation Matrix

	gini_net	*gini_gross*	*pcgdp*	*bdgdp*	*prmse*	*gdppercap*	*indglob*
gini_net	1.00	0.78	-0.37	-0.33	0.05	-0.52	-0.58
gini_gross	0.78	1.00	-0.06	-0.12	0.10	-0.19	-0.28
pcgdp	-0.37	-0.06	1.00	0.72	0.07	0.69	0.53
bdgdp	-0.33	-0.12	0.73	1.00	0.02	0.62	0.40
prmse	0.05	0.10	0.07	0.02	1.00	0.04	0.18
gdppercap	-0.52	-019	0.69	0.62	0.04	1.00	0.72
indglobl	-0.58	-0.28	0.53	0.40	0.18	0.72	1.00

Notes:
gini_net denotes the GINI coefficient of net income,*gini_gross* is the GINI coefficient of gross income, *pcgdp* private credit divided by GDP; claims on the private sector by deposit money banks and other financial institutions.*bdgdp* denotes bank deposits divided by GDP; demand, time and savings deposits in deposit money banks.*prmse* denotes primary school enrolment; gross enrolment ratio.*gdppercap* denotes the GDP per capita, *indglob* denotes the index of globalization.

The correlation matrix in table 4.3b shows a strong positive correlation between the net and gross GINI at 78%. Both measures of income inequality has negative relationships between our measures of financial development namely credit to private sector as a ratio of GDP and bank deposit as a ratio of GDP. In addition, GDP per capita and index of globalisation has negative relationship with both net and gross GINIs. The strength of this relationship is stronger with net GINI at (-52%) for GDP per capita and
(-58%) for globalization index, compared to (-19%) and (-28%) respectively for gross GINI.

Measures of income inequality (Dependent variable)

Gross and Net GINI coefficient: Jauch and Watzka (2011) noted that redistributive policies may blur the theoretical relationship between financial development and income inequality, when it is modelled without an explicit role for redistribution. To account for the effect of redistribution on financial development-income inequality nexus we used both Gross and Net GINI coefficient in our empirical analysis. The two variables were sourced from Solt's Standardized World Income Inequality Database (SWIID)[106] (2009). Income inequality may be measured on a gross and a net basis. Gross income removes all income from non-private sources.

In other words, pensions provided by the state to pensioners, all types of social transfers to poor people are subtracted while taxes and social contributions are included in

[106] The (SWIID) according to Ortiz and Cummins (2011) is a cross-nationally comparable database of GINI indices across time. It uses the World Income Inequality Database by the United Nations University, which replaces Deininger and Squires (1996) database, data from the Luxembourg Income Studies (LIS), Brank Milanovic's World Income Distribution data, The Socio-Economic Database for Latin America and the ILO's Household Income and Expenditure Statistics. The SWID has a total coverage of 171 countries with 4285 country-year observations and 802 observations for five-year averages.

its calculation. Net income on the other hand includes all types of public transfers and deducts taxes and other deductions. The net GINI coefficient captures inequality after redistribution. It considers an individual's earning entitlements on pensions and other social benefits. Net income measures the disposable income of an individual which can be used for saving and consumption.

Income share of the Top 1 percent population[107]: This is a second measure of income inequality. It captures the aggregate income of the top 1 percent income earners for 8 high income countries. We used this proxy to test the direct effect of financial sector development on the income of top 1 percent populations of some of the countries included in our datasets. Only country year observation with information on top 1 percent income earners are used to explore this link.

Measures of financial sector development (Main variables of interest)

The three variables used to measure financial sector development include Private credit as a ratio of GDP, Bank deposits as a ratio of GDP and Stock market capitalization as a ratio of GDP. These variables were sourced from the updated 2010 version of the Financial Structure Database by Beck, Demirguc-Kent and Levine (2009).

Private credit as a ratio of GDP: Private credit is calculated based on the IMF's International Financial Statistics and consists of credit provided by deposit money banks and other financial institutions to the private sector, (private firms and households). This proxy is used to capture the extent to which private agents have access to financial intermediation-as in Greenwood and Jovanovic (1990) or access to loans as in Banerjee and Newman (1993) and Galor and Zeira (1993). It is plausible to argue that the magnitude of credit extended to private agents is a good indicator of financial development. This is because financial intermediaries are expected to limit the amount of credit given to households and private enterprise if they are unable to assess credit risk, overcome maturity mismatch and to mobilize savings.

Bank deposit to GDP: Bank deposits are also sourced from the IMF's International Financial Statistics and consists of demand, time and savings deposits in deposit money banks to economic activity. Bank deposit to GDP ratio measures the amount of resources available to the financial sector for its lending activities. This indicator captures the effectiveness of monetary institutions in mobilizing savings. This indicator measures the liability side of the financial intermediaries' balance sheets.

[107] Refer to chapter three for a definition of this proxy

Stock market capitalization to GDP: stock market capitalization as a ratio of GDP is used to gauge the size of equity markets and equals the value of listed shares divided by GDP. The stock market capitalization to GDP indicates the size of the stock market relative to the size of the economy. Some financial commentators and investors have argued that this variable can be used to judge whether the stock market is cheap (undervalued) or expansive (over-valued) since the ratio compares the valuation that investors are putting on companies with the output of the economy, Buffett and Loomis (2001)[108].

We control for other variables that have been used to explain inequality. GDP per capita is used in constant dollar terms sourced from the World Development Indicators of the World Bank. GDP per capita is taken as a proxy for the stage of development of a given economy. KOF index of globalisation is used to capture globalization effects. The KOF index of globalization measures the three dimensions of globalization namely, economic, political and social globalization[109]. Finally, the primary school enrolment rate is used as a proxy for human capital development. Increase in human capital development as a result of increase in education implies an increase in the supply of skilled labour and a decrease in the relative skilled/unskilled wage, thus a reduction in overall income inequality.

On the other, a sustained increase in the supply of skilled labour may keep the relative skilled/unskilled wages constant in the presence of the so called "skill biased technological change". All the control variables were sourced from the World Development Indicators World Bank.

[108] The price to earnings ratio (P/E) or its smoothed version; cyclical price to earnings ratio (cyclical P/E) has been used to spot equity price bubble. The use of this valuation metric in spotting market over-valuation was popularized by Shiller (2000). However, individual; company earnings or the earnings of entire sectors can be very volatile and this put limits on value of using price earnings ratios to identify bubbles. Buffet and Loomis (2001) argues that despite the limitations of this stock market capitalization to GDP in telling you what you need to know; it is probably the best single measure of where valuations stand at any given moment. Buffet used this measure to explain how he saw the dotcom bubble developing in the late 1990s. It is important to note that different countries have very different markets therefore, it could be misleading to use this ratio to spot bubbles in other countries, given that there are several factors that determine the size of a country's stock market capitalization including, stock-buying culture of the local population, company use of debt versus equity financing, and how easy or difficult it is to list on the local exchange.

[109] Economic globalisation characterized as long distance flows of goods, capital and services as well as information and perceptions that accompany market exchanges; political globalization characterized by a diffusion of government policies; and social globalization expressed as the spread of ideas, information, images and people, Axel et al (2008).

4.4 Econometric Specification and panel unit root test

Previous empirical literatures on financial development, economic growth and income inequality use the instrumental variable techniques as the preferred estimation method. This is largely because of the possibilities of reverse causality[110] in the relationship between financial development, economic growth and income inequality variables -see, King and Levine (1993b), and Jauch and Watzka (2012) amongst others. To control for unobserved time invariant unique characteristics across cross-sections most of the above mentioned studies apply the within estimator or the fixed effects estimator that allows for unobserved country specific heterogeneity that may be correlated with the regressors, Baltagi and Chang (1994). According to Baltagi and Chang (1994), such unobserved heterogeneity may lead to omitted variables bias.

The Fixed effect estimator has the advantage of controlling for country characteristics while using all observations of the dataset and developments over time. This estimator method removes period specific means from the dependent variable and exogenous regressors, and then performing the specified regression using the demeaned data, Baltagi (2005). However, some researchers have argued that the within group fixed effect estimator does not eliminate dynamic panel bias where the dynamic relationships of the variables are characterized by the presence of a lagged dependent variable among the regressors, Nickell (1981) and Bond (2002). The general model of the data-generating process for a dynamic panel can be written as:

$$y_{it} = \alpha y_{i,t-1} + X'_{it}\beta + \varepsilon_{it} \quad (4.1)$$
$$\varepsilon_{i,t} = \mu_i + v_{it}$$
$$E(\mu_i) = E(v_{it}) = E(\mu_i v_{it}) = 0$$

Where y_{it} is the dependent variable. The disturbance term in equation (4.1) has two orthogonal components: the fixed effects, μ_i' and the idiosyncratic shocks, v_{it}. The model in equation (4.1) above can also be written as:

$$\Delta y_{it} = (\alpha - 1)y_{i,t-1} + X'_{it}\beta + \varepsilon_{it} \quad (4.2)$$

[110] Levine (1997) provided a good account of this controversy over the direction of causality between financial development and growth in the introductory section of his study; while Demetriades and Hussein (1996) conduct a formal causality test between financial development and growth and found evidence of a bi-directional causation.

The model can also be thought of as being for the level or increase of y. In other to remove dynamic panel bias what is needed is a transformation of the data that is different from that of the within-groups estimator[111]. The Arellano and Bond (1991) first-difference transformation can be employed to expunge the cross-section fixed effects. Applying this transformation to equation (4.1) yields:

$$\Delta y_{it} = \alpha \Delta y_{i,t-1} + \Delta X'_{it}\beta + \Delta v_{it} \qquad (4.3)$$

According to Roodman (2009) first-difference transformation although has the ability of removing fixed effects, the lagged dependent variable is still potentially endogenous, since the $y_{i,t-1}$ term in $\Delta y_{i,t-1} = y_{i,t-1} - y_{i,t-2}$ is correlated with the $v_{i,t-1}$. A major weakness of the first-difference transformation is that it magnifies gaps in unbalanced panels. For instance, if some of the dependent variable y_{it} is missing then both Δy_{it} and $\Delta y_{i,t+1}$ will also be missing in the transformed data. In addition, the first-difference method makes successive errors correlated even if they are uncorrelated before the transformation: $\Delta v_{it} = v_{it} - v_{it-1}$ is related to $\Delta v_{i,t-1} = v_{i,t-2}$ mathematically through the common $v_{i,t-1}$ term that they share.

Given that the assumption of Homoscedasticity is not a necessary condition when applying the difference GMM or system GMM this property does not matter much.

This forms a major motivation for the second common transformation the Arellano and Bover (1995) forward or orthogonal deviations or simply orthogonal deviations. This transformation method subtracts the average of all future available observations of a variable unlike the first-difference approach that subtracts the previous observation from the contemporaneous one. According to Roodman (2009) no matter the gap in the panel, the orthogonal deviations approach subtracts the average of all future available observations except the last for each cross-section; therefore, it minimizes data loss. The resilience of this estimation method to gaps is one of the main reasons we have used it in addition to the Arellano and Bond (1991) estimator. Given that lagged observations do not enter the formula, they are valid as instruments, Roodman (2009). According to Arellano

[111] Under the within-groups transformation, the lagged dependent variable changes to $y^*_{i,t-1} = y_{i,t-1} - \{1/(T-1)\}(y_{i2} + \cdots + y_i T)$, while the error becomes $v^*_{it} = v_{it} - \{1/(T-1)\}\ (v_{i2} + \cdots + v_i T)$. Observe that the introduction of the lagged dependent variable as a regressor restricts the sample to $t = 2, \ldots, T.$). The problem with this method in the presence of such dynamic is that the $y_{i,t-1}$ term in $y^*_{i,t-1}$ correlates negatively with the $-\{1/(T-1)\}v_{i,t-1}$ in $v^*_{it,}$ while symmetrically, the $-\{1/(T-1)\}y_{it}$ and v_{it} terms also move together. Consequently, the regressor and the disturbance/error are still correlated after transformation, Roodman (2009).

and Bover (1995) in balanced panels, any of the two transformations of full row rank will give numerically identical estimators, holding the instrument set fixed.

Given that the current study has lag 1 of the dependent variable as part of the regressors, we employed a dynamic panel GMM estimation method. This method is used to examine the effect of financial sector development on income inequality within countries. We estimated a first-order reduced model of this form;

$$Y_{it} = \sum_{j=1}^{p} \alpha_j Y_{it-j} + X'_{it}\beta + \delta_i + \lambda_t + \varepsilon_{it} \quad (4.4)$$

Where $i\ and\ t$ denote country and time period respectively. $Y_{i,t}$ is the contemporaneous measures of income inequality which could be gross GINI, net GINI or income of the top 1 percent of the population. Y_{it-1} is lag 1 of the dependent variable, X_{it} is a vector of the explanatory variables namely the log of private credit divided by GDP $pcgdp_{i,t}$, and the quadratic term of private credit to GDP $pcgdp_{i,t}^2$, log of GDP per capita $gdppercap_{i,t}$ and it's quadratic term $gdppercap_{i,t}^2$, the log of KOF index of globalization $inglob_{i,t}$, log of primary school enrolment level $prmsel_{i,t}$, and ε_{it} is the error term with $E(\varepsilon_{it}) = 0$, for all i and t while δ_i Picks up the fixed effects that differ among countries but are constant over time. That is the time invariant country-specific factors that might influence GINI coefficient, such as geographic and demographic dynamics and λ_t denotes a year-specific effect.

The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. Controlling for period effects is important in this study because countries included in the dataset employs different redistributive policy interventions to tackle the problem of income inequality and ameliorate the sufferings of low income households. First-differencing equation (4.4) as in Arellano and Bond (1991) or applying forward orthogonal deviations an alternative to differencing proposed by Arellano and Bover (1995) eliminates the individual heterogeneous effects δ_i and produces an equation of the form:

$$Y_{it} = \sum_{j=1}^{p} \alpha_j\, Y_{it-j} + X'_{it}\beta + \lambda_t + \varepsilon_{it} \quad (4.5)$$

The current study employed the GMM dynamic panel method that allows dynamic effects to be introduced into the model and also has the advantage of controlling

endogeneity of the independent variables in lagged-dependent-variable models such as the one used in this study. To account for individual fixed effects in dynamic models, a transformation is applied to the specification to expunge cross-section fixed effects. The transformation method we used in this study are both the Arellano and Bond (1991) and the orthogonal deviations as proposed by Arellano and Bover (1995). While the Arellano and Bond employs first differencing the Arellano and Bover transforms each observation as the deviation from the average of future observations in the sample for the same cross section, and weights each deviation to standardize the variance[112]. The Arellano and Bover (1995) approach has better small sample properties and the estimator allows to consistently estimate non-stationary data in levels as opposed to first difference using variables in first differences as instruments.

This transformation method has three major advantages: first, it does not magnify gaps in unbalanced panels. It does not matter how many gaps, it is computable for all observations except the last for each of the countries, and therefore, it minimizes data loss. Second, because the orthogonal deviations method supports the use of lagged values of the variables as valid instruments since lagged observations do not enter the formula, it is well suited for this study; since we used lagged values of all variables in the model as instruments. Third, the orthogonal deviations allows the estimation of the equation in levels, using variables in first differences as instruments as opposed to estimation in first difference using level instruments, Roodman (2009).

Specifically, Blundell and Bond (1998) showed that in employing the Arellano and Bover (1995) orthogonal deviations to dealing with dynamic panel bias, it is possible to transform/difference the instruments to make them exogenous to the fixed effects instead of transforming the regressors to expunge the fixed effects. According to Roodman (2009), this is valid assuming that changes in any of the variables, w, used as instruments are uncorrelated with the fixed effects: $E(\Delta w_{it}\mu_i) = 0$ for all i and t. If this holds, then $\Delta w_{i,t-1}$ is a valid instrument for the variables in levels:

$$E\left(\Delta w_{i,t-1}\varepsilon_{it}\right) = E\left(\Delta w_{i,t-1}\mu_i\right) + E\left(w_{i,t-1}v_{it}\right) - E\left(w_{i,t-2}v_{it}\right) = 0 + 0 - 0 \qquad (4.6)$$

[112] In the Arellano and Bover (1995) orthogonal deviations, data is transformed using the following formula: $\varepsilon_{it}^{*} = \left(\frac{T-t}{T-t+1}\right)^{1/2}\left[\varepsilon_{it} - \frac{1}{T-t}\left(\varepsilon_{i(t+1)} + \cdots + \varepsilon_{iT}\right)\right]$, i.e. the transformation subtracts the mean of the remaining future observations available in the sample. The first term weights the transformed errors to equalize their variance, Greene (2003).

To put it succinctly, where Arellano and Bond (1991) instruments differences with levels, Blundell and Bond (1998) employing orthogonal deviations instruments levels with differences. According to Roodman (2009), for variables that behave like random walk, past changes may in fact be more predictive of current levels than past levels are of current changes so that the new instruments are more relevant. It is important to mention again that the validity depends on the assumption that the v_{it} are not serially correlated, if they are, then $w_{i,t-1}$ and $w_{i,t-2,}$ which are correlated with past and contemporaneous errors may also correlate with future ones. Blundell and Bond noted that if w is endogenous, $\Delta w_{i,t-1}$ is available as an instrument because $\Delta w_{i,t-1} = w_{i,t-1} - w_{i,t-2}$ should not correlate with v_{it}; earlier realizations of Δw can serve as instruments as well. On the other hand, if w is predetermined, the contemporaneous $\Delta w_{it} = w_{it} - w_{i,t-1}$ is also valid, since $E(w_{it}v_{it})$=0.

The Blundell and Bond (1998) approach that instruments $y_{i,t-1}$ with $\Delta y_{i,t-1,}$ brings up issues of stationarity. According to Blundell and Bond (1998) the assumption can hold, if the data-generating process is such that the fixed effect and the autoregressive process governed by α, the coefficient on the lagged dependent variable in equation (4.2) offset each other in expectation across the whole panel. Consequently, they posit that α must have absolute value less than unity so that the process converges. For the reasons discussed above, we specified both the Arellano and Bover (1995) dynamic panel estimator that uses orthogonal deviations and the Arellano and Bond (1991) dynamic estimator that uses differences. In the model we specified, we included the squared terms of financial development and GDP per capita respectively $pcgdpl_{i,t}^2$ and $gdppercapl_{i,t}^2$ in other to test both the linear and inverted U-shaped relationship between financial development and inequality and Kuznets curve. Specifically the model we estimated is;

$$\Delta Y_{i,t} = \alpha \Delta Y_{i,t-1} + \beta_1 \Delta pcgdpl_{i,t} + \beta_2 \Delta pcgdpl_{i,t}^2 + \beta_3 \Delta gdppercapl_{i,t} + \beta_4 \Delta gdppercapl_{i,t}^2 + \beta_5 \Delta inglobl_{i,t} + \beta_6 \Delta prmsel_{i,t} + \lambda_t + \varepsilon_{i,t} \quad (4.7)$$

Equation (4.7) allows a comparison of the effect of financial sector on income inequality within the countries included in our datasets. The estimation also allows for nonlinearities due to the Kuznets curve as well as the initial increasing and then decreasing influence of financial development on inequality. Equation (4.7) is estimated using GMM estimator of Arellano and Bond (1991) and Arellano and Bover (1995). The GMM method requires that the theoretical relation between the parameters satisfies the so called

orthogonality conditions implying that the sample correlations between the explanatory variables and instruments are as close to zero as possible. To ensure the validity of the statistical results from the GMM dynamic panel data analysis, we adjusted the standard errors of the coefficient estimates for possible dependence in the residuals using panel corrected standard error (PCSE) that is robust to non-spherical errors[113], Bailey and Katz (2011). Specifically, we used the period weights (PCSE) that is robust to heteroskedasticity across periods.

This is one of the main differences separating our econometric approach from previous studies such as Jauch and Watzka (2012) that used (HAC) robust standard error. Others such as Clarke et al (2003), and Kappel (2010) did not report what type of standard errors they used. MacKinnon and White (1985) noted that the PSCE bears some resemblance to heteroskedasticity consistent (HC) estimators; however, the (HC) estimators do not explicitly incorporate the known time-series-cross-section structure of the data. While acknowledging the fact that most empirical studies now provide standard error estimates that are heteroskedasticity and autocorrelation consistent, cross-sectional or spatial dependence is still largely ignored[114]. For the GMM weights we applied the period weights that allows for period heteroskedasticity.

This chapter investigates how gross and net income inequalities as well as income of the top 1 percent of the population are affected by financial and stock market development and other explanatory variables. Our specification also allows us to test the hypotheses of Galor and Zeira (1993) and Banerjee and Newman (1993) namely that financial development has a negative impact on income inequality against the hypothesis of Greenwood and Jovanovic (1990) that the influence of financial development on income inequality follows an inverted U-shape. Table 4.4a below is a summary of the hypotheses tested and the expected signs.

[113] Non-spherical errors are common to Time-Series-Cross-Section (TSCS) data which are characterized by having repeated observations over time on some set of units such as countries. Such data according to Bailey and Katz (2011) show non-spherical errors because of contemporaneous correlation across the units and unit level heteroskedastic.

[114] According to Petersen (2009), large fraction of published papers in leading financial journals still fails to adjust the standard errors appropriately.

Table 4.4a Summary of the hypotheses tested and expected signs

Linear Negative Influence: Galor and Zeira (1993) and Banerjee and Newman (1993) Expected Signs	
$\beta_1 fd_{i,t}$	Negative and Significant
$\beta_2 fd_{i,t}^2$	Insignificant
Inverted U-shape hypothesis of Greenwood and Jovanovic (1990)	
$\beta_1 fd_{i,t}$	Significant and positive
$\beta_2 fd_{i,t}^2$	Significant and Negative
Kuznets Curve (1955) Inverted U-shaped path of income inequality along economic development	
$\beta_3 gdppercapl_{i,t}$	Positive and significant
$\beta_4 gdppercapl_{i,t}^2$	Negative and significant

Note:
$fd_{i,t}$ denotes financial development. We used two measures of financial development in this study namely, log of private credit to GDP, $pcgdpl_{i,t}$ and log of bank deposit to GDP $bdgdpl_{i,t}$ and $gdppercapl_{i,t}$ denotes log of GDP per capita.

Table 4.4a provides a summary of the hypotheses tested. Following the hypothesis of a linear negative influence, we expect β_1 to be negative and significant and we expect β_2 to be insignificant. For the inverted U-shape hypothesis, we expect β_1 to be positive and significant and β_2 to be negative and significant. For the Kuznet curve, we expect β_3 to be positive and significant and β_4 to be negative and significant. We further investigated whether financial development has different effects on income inequality for different country groups. This is achieved by splitting the sample into three groups according to income categories defined by the World Bank. This allows us to test the hypothesis of differential effect of financial and economic development on countries depending on the stages of their development. Countries are classified into; high income countries, middle income countries and lower income countries.

We performed unit root test to the test for the presence of unit or otherwise in the variables used for this estimation. Panel-based unit root tests have higher power than unit root test based on individual time series since they make use of the larger cross-section sample. A summary of three tests namely the Levine, Lin & Chu (2002) test, the Im, Pesaran and Shin (2003) W-stat test and ADF-Fisher Chi-square tests fail to reject the null of a unit root on the series log of GDP per capita, log of index of industrial globalization, and log of bank deposit to GDP. These series however, became stationary after first differencing. Levin, Lin & Chu tests as well as Im Pesaran and Shin-W-stat rejects the null hypothesis of unit root on the series Logs of Gini index of gross and net income inequality, while ADF-Fisher Chi-square fail to reject the null hypothesis. Given the fair amount of disagreement in these results as to whether the logs of gross and net Gini index of inequality have a unit root or not we decided to first difference the two series. Table 4.4 below presents the panel unit root tests.

Table 4.4b Panel unit root test

	$Im, Pesaran\ and\ Shin\ W - stat$	$ADF - Fisher\ Chi - Square$	$Levin, lin\ \&\ Chu$
$\Delta gini\_netl$	-3.45838***	487.699***	-5.56095***
$\Delta gini\_grossl$	-3.62090***	279.760***	-8.19106***
$\Delta pcgdpl$	-23.6630***	918.458***	-24.8463***
$\Delta gdppercapl$	-32.1310***	1313.09***	-35.6177***
$\Delta bdgdpld$	-28.3307***	1147.96***	-26.1995***
$\Delta inglob$	-36.9564***	1503.54***	-39.1548***
$prmsel$	-4.34604***	284.684***	-5.04347***

Note:
$gini\_netl_{i,t}$ denotes the log of GINI coefficient of net income, $gini\_grossl_{i,t}$ denotes the log of GINI coefficient of gross income, $pcgdpl_{i,t}$denotes the log of private credit divided by GDP. $gdppercapl_{i,t}$ denotes log of GDP per capita, $bdgdpl_{it}$ denotes the log of bank deposit to GDP, $inglobl_{i,t}$ denotes the log of KOF index of globalization, $prmsel_{i,t}$ denotes the log of primary school enrolment and Δ is the first difference operator.

4.4.1 Empirical results

In line with Clarke, Xu and Zou (2003) and Jauch and Watzka (2012) and Arcand et al (2011), we estimated a model regressing the natural log of GINI coefficient of net income, gin_netl on the common regressors the log of private credit to GDP $pcgdpl$, and its quadratic term $pcgdp^2$, the log of GDP per capita $gdppercapl$ and its quadratic term $gdppercap^2$. Following Romer and Romer (1999) and Jaumotte, et al (2008), we used yearly data as opposed to the five-year averages used by Clarke et al (2003) and Jauch and Watzka (2012) which implies a loss in the number of observations. The current study departs from the aforementioned studies by including in the model a lagged dependent variable which is used to capture potential temporal or cross-sectional dynamics.

To test the linear hypothesis suggested by Galor and Zeira (1993) and Banerjee and Newman (1993), and the inverted U-shaped hypothesis of financial development and income inequality, as well as the Kuznet curve we regress the natural log of GINI index of net income inequality on both linear and quadratic terms of private credit to GDP and both linear and squared term of GDP per capita while controlling for globalization and human capital development effects on income inequality. To deal with dynamic panel bias, we use the two commonly used transformation methods Arellano and Bond (1991) "first-difference transform" and Arellano and Bover (1995) "orthogonal deviations transform". The results or Arellano and Bond (1991) model are reported in table 4.5a below.

Table 4.5a Arellano and Bond difference Dynamic panel GMM (gini_net models) 1960 to 2007

Parameters	Column 1 All countries	Column 2 high income countries	Column 3 middle income countries	Column 4 low income countries
$\alpha\Delta gini\_netl_{t-1}$	-0.281*** (-9.34)	-0.432*** (-16.44)	-0.46*** (-27.88)	0.30** (2.37)
$\beta_1\Delta pcgdpl_{i,t}$	-0.002 (0.87)	-0.018 (-1.38)	-0.013** (-2.08)	-0.014 (-0.89)
$\beta_2\Delta pcgdp^2_{i,t}$	0.084*** (-2.81)	-0.07 (-0.79)	-0.17*** (-4.26)	-0.087 (0.49)
$\beta_3\Delta gdppercapl_{i,t}$	0.005 (0.45)	-0.006 (-0.99)	0.003 (0.811)	0.005 (0.29)
$\beta_4\Delta gdppercap^2_{i,t}$	0.01 (1.28)	0.35*** (4.35)	-0.006 (0.311)	0.03 (0.26)
$\beta_5\Delta inglobl_{i,t}$	-0.005 (0.59)	-0.002 (0.19)	-0.002 (-0.16)	0.064* (1.80)
$\beta_6\Delta prmsel_{i,t}$	-0.02*** (3.87)	0.02 (0.97)	0.022 (0.86)	-0.067*** (-1.88)

Notes:
$\alpha\Delta gini\_netl_{t-1}$ denotes lag 1 of the log of GINI coefficient of net income, $\Delta pcgdpl_{i,t}$denotes the log of private credit divided by GDP. $\Delta pcgdpl^2_{i,t}$ denotes the quadratic term of private credit divided by GDP, $\Delta gdppercapl_{i,t}$ denotes log of GDP per capita, $\Delta gdppercapl^2_{i,t}$ denotes the quadratic term of GDP per capita, $\Delta inglobl_{i,t}$ denotes the log of KOF index of globalization, $\Delta prmsel_{i,t}$ denotes the log of primary school enrolment, λ_t represents the time period fixed effects from the countries. The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. $\varepsilon_{i,t}$ is the error term and Δ is the first difference operator. The standard errors for the GMM regression coefficient estimates were computed using the White diagonal standard errors, for the GMM weight the White diagonal instruments weighting matrix was used. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic,

$$\Delta gini\_netl_{i,t} = \alpha\Delta gini\_netl_{i,t-1} + \beta_1\Delta pcgdpl_{i,t} + \beta_2\Delta pcgdpl^2_{i,t} + \beta_3\Delta gdppercapl_{i,t} + \beta_4\Delta gdppercapl^2_{i,t} + \beta_5\Delta inglobl_{i,t} + \beta_6\Delta prmsel_{i,t} + \lambda_t + \varepsilon_{i,t} \quad \text{(a)}$$

First to analyse whether financial development always reduce income inequality in the countries included in our dataset we used data on all the countries, the result is reported in table 4.5a column 1. The coefficient on lagged gini index of inequality in net income $\alpha\Delta gini\_netl_{i,t-1}$ is negative and significant at the 1 percent levels indicating that countries starting the estimation period with more skewed distribution of income (high initial gini) tend to witness faster reductions in income inequality than countries with lower levels of initial income inequality. The linear term of private credit to GDP enters negatively but insignificant while the quadratic term of private credit is positive and significant in this model, suggesting that financial development tends to increase income inequality.

A plausible explanation of increasing income inequality effect of financial sector development could be the so called financial markets imperfections. Explaining this finding within the context of Galor and Zeira (1993) theoretical model, an economy with financial market imperfections (i.e. more difficulties in borrowing funds to finance

profitable business investments and human capital development) and an initial unequal distribution of wealth will maintain this inequality even in the presence of financial sector development. As a result of these financial market imperfections, only rich agents with the necessary collateral requirements can borrow enough money to finance profitable investments thus resulting in higher inequality. Controlling for GDP per capita growth given that financial development may influence income inequality by affecting economic growth, both the linear and quadratic terms of this variable were insignificant. Next controlling for the level of globalization our result shows a negative but insignificant relationship between income inequality and globalization in this model. Finally, we control for human capital development in this model using the level of primary school enrolment as our measure of human capital development. The estimated coefficient on this variable is negative and statistically significant suggesting a negative relationship between human capital development and inequality in net income. This result is in line with theory that predicts that increase in human capital should result in a reduction in income inequality.

The questions are is the positive quadratic relationship between financial development and income inequality the same irrespective of country characteristics and stages of development? Secondly, is the impact of globalization on income distribution the same or different between developed and developing nations? Thirdly, does the negative relationship between human capital development and income inequality the same in all society or are there important differences across and within countries based on their levels of economic development? To answer these questions we split the sample into three groups according to the income categories defined by the World Bank, namely the high income group, the middle income group and the low income group. The results of equation 4.6 for high income countries is reported in table 4.5a column 2, for middle income countries column 3 and for low income countries in column 4.

For the high and middle income countries, the lagged coefficients of gini net income inequality is negative and significant like that of the all countries model in column 1 of table 4.5a suggesting a faster reduction in net income inequality for countries included in these data sets while the same coefficient of gini net income inequality is positive and significant for low income countries-see table 4.5a column 4. The positive coefficient of past realizations of gini net income inequality suggests that increasing inequality in net income will lead to an increase in contemporaneous inequality in net income. This could mean that countries starting the estimation period with somewhat low initial gini tend to witness slower reductions in income inequality than countries with higher levels of initial

net income inequality. For the financial development variables our main variable of interest, we observe that increasing private credit to GDP in middle income countries results to a reduction in gini inequality of net income. Indeed, the result for the low income countries reveals that the coefficients on both the linear and quadratic terms of private credit to GDP are negative and statistically significant at the 1 and 5 percent levels of significance respectively. Based on the estimated coefficient in column 3 of table 4.5a a one percent increase in private credit to GDP reduces net income inequality by 0.013 percent, controlling for all time invariant heterogeneity in the countries. The same level of increase in the non-linear term will result in a higher decrease 0.17 percent in net income inequality in the middle income countries.

The coefficients of the GDP per capita in both linear and quadratic terms in all the models except for the high income model enters statistically insignificant while the coefficient of the quadratic term of GDP per capita in the high income model is positive and significant. Quantitatively, the result suggests a 0.35 percent increase in income gap for a one percent increase in economic development. This result indicates that after a certain stage of economic development is reached, more economic development begins to increase the income gap between the rich and the poor. This result seems to suggest that low income differentials cannot be maintained at fast growth. A plausible explanation of this finding could be linked to the 'incentive driven inequality' hypothesis, which suggests that higher levels of inequality may have boosting effects on an economy from an incentive point of view given that the economy channels more reward to agents who incur extra efforts for the production of goods and services. Therefore, as agents are incentivised to get ahead of others in business, technological and social innovations the economy tends to grow at a faster rate, offering more income to talented individuals resulting in more inequality.

Controlling for the level of globalization, we found that increased globalization worsens income distribution in low income countries indicating that increased globalization affects the poor and favours the rich. The result suggests that the globalization indices explain approximately 0.064 percent of the variation in within country income inequality. We control for human capital development using the level of primary school enrolment as our measure of human capital development. The estimated coefficient on this variable is negative and statistically significant for the low income group suggesting a positive relationship between human capital development and inequality in net income. This is in line with theoretical expectations. In summary, we

found significant differences in the manner in which income inequality measured using gini index of net income reacts to financial sector development using the Arellano and Bond difference GMM estimator. Using instead the Arellano and Bover estimator which transforms data by employing orthogonal deviations yields more consistent results with respect to the response of gini inequality of net income. The estimator allows for endogeneity of the explanatory variables and is robust to gaps in panel data analysis. The results from Arellano and Bover estimator are reported in table 4.5b below.

Table 4.5b Arellano and Bover orthogonal deviations Dynamic panel GMM (gini_net models) 1960 to 2007

Parameters	Column 1 All countries	Column 2 high income countries	Column 3 middle income countries	Column 4 low income countries
$\alpha gini\_netl_{t-1}$	0.87*** (38.53)	0.85*** (25.58)	-0.80*** (35.79)	0.58*** (4.55)
$\beta_1 pcgdpl_{i,t}$	-0.007* (-1.63)	-0.027*** (-2.63)	-0.013** (-2.08)	-0.165*** (-3.27)
$\beta_2 pcgdp_{i,t}^2$	-0.003*** (-1.20)	-0.029* (-1.78)	-0.17*** (-4.26)	-0.153*** (-3.16)
$\beta_3 gdppercapl_{i,t}$	-0.025 (-0.84)	-0.14 (-1.23)	-0.006 (-0.61)	-0.142 (-0.429)
$\beta_4 gdppercap_{i,t}^2$	0.004 (1.06)	0.019 (1.40)	-0.008 (0.12)	0.029 (0.53)
$\beta_5 inglobl_{i,t}$	-0.004 (0.59)	-0.004 (-0.34)	-0.005 (-0.14)	0.19** (1.80)
$\beta_6 prmsel_{i,t}$	0.025** (2.08)	-0.017 (-0.85)	0.023 (0.75)	0.021 (0.37)

Notes:
$\alpha gini\_netl_{t-1}$ denotes lag 1 of the log of GINI coefficient of net income, $pcgdpl_{i,t}$denotes the log of private credit divided by GDP. $pcgdp_{i,t}^2$ denotes the quadratic term of private credit divided by GDP, $gdppercapl_{i,t}$ denotes log of GDP per capita, $gdppercap_{i,t}^2$ denotes the quadratic term of GDP per capita, $inglobl_{i,t}$ denotes the log of KOF index of globalization, $prmsel_{i,t}$ denotes the log of primary school enrolment, λ_t represents the time period fixed effects from the countries. The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. $\varepsilon_{i,t}$ is the error term. The standard errors for the GMM regression coefficient estimates in this model were computed using the period weights (PCSE) standard errors & covariance, for the GMM weight the period weights instrument weighting matrix was used. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic,

$$gini\_netl_{i,t} = \alpha gini\_netl_{i,t-1} + \beta_1 pcgdpl_{i,t} + \beta_2 pcgdpl_{i,t}^2 + \beta_3 gdppercapl_{i,t} + \beta_4 gdppercapl_{i,t}^2 + \beta_5 inglobl_{i,t} + \beta_6 prmsel_{i,t} + \lambda_t + \varepsilon_{i,t} \quad \text{(b)}$$

The estimated coefficients for all the countries model is reported in column 1, for high income countries column 2, for middle and low income countries columns 3 and 4 respectively. The coefficients on lagged gini inequality of net income of 0.87 percent for all the countries, 0.85 percent for high income countries, 0.80 percent for middle income countries and 0.58 percent for low income countries suggests high level of persistence in the gini inequality of net income. Comparing these values with that of the Arellano and Bond (1991) estimator of 0.28 percent for all countries, 0.43 percent for high income, 0.46

percent for middle income countries and 0.30 percent for low income countries confirms the finding of Blundell and Bond (1998) that for high values of $\alpha_{i,t}$, the first difference GMM estimator suffers "both a huge downward bias" and yields "very imprecise estimates for $\alpha_{i,t}$".

Focusing now on the coefficients of the lagged dependent variable, we found that the past values of gini net income inequality is positive and statistically significant across all countries, high income countries and low income countries. This indicates that high values of past inequality in net income is followed by high contemporaneous values and vice versa, while for middle income countries, high values is followed by low values, which may indicate faster reductions of income inequality in these countries. Turning our attention to the financial development variable measured using private sector credit to GDP suggests increasing reductions of income inequality with better financial sectors in all the models. These results are in line with economic theory that predicts a negative impact of financial development on income inequality.

The result seems to suggest that more financial development will lead to further reduction in income inequality in almost all the countries. This can be observed from the magnitude of the estimated coefficient between the two variables. While a one percent increase in linear financial development variable results in a 0.013 percent decrease in inequality for middle income countries, an increase of the same amount in the quadratic term will lead to a 0.17 percent reduction in income inequality. Since the coefficient on the squared term is statistically significant in the entire models, the results provide support for some aspects of the inverted u-shaped hypothesis of Greenwood and Jovanovic (1990) that suggests that after a certain stage of financial development is reached, more financial development starts to reduce income inequality.

These findings are consistent with the insight of Banerijee and Newman (1993) and Galor and Zeira (1993) that financial development has a significant effect in reducing income inequality in the target country. This is because better developed financial system and markets widen the availability of credit, thereby allowing both the rich and the poor access to credit for human capital development as well as starting their own businesses. Both the quadratic and linear terms of GDP per capita in all the models are insignificant while the worsening effect of increased globalization found in the difference GMM model for low income countries was confirmed with the Bond and Bover estimator. However, in this model, the contribution of globalization to gini net income inequality is stronger at 0.19 percent.

This finding seems to provide empirical support to the view that globalization causes economic insecurity and contributes to the growing inequality in developing countries, Stiglitz (2004), Borjas and Ramey (1994), and Bergh and Nilsson (2011). The estimated coefficient on primary school enrolment variable for all countries model, column 1 table 4.5b is positive and statistically significant suggesting a positive relationship between human capital development and inequality in net income. This result is rather puzzling given that theory predicts that increase in human capital should result in a reduction in income inequality.

4.5 Robustness tests

To test the internal stability of our findings we used GINI index of gross income inequality as our dependent variable. There is a big difference between gross and net GINI coefficients as can be seen from section 4.2 (trends in income inequality around the countries included in our dataset). Gross GINI coefficient captures inequality in gross income before redistribution and taxes the so called "market inequality" while net GINI coefficient captures inequality in net income after redistribution and taxes also known as "net inequality", Solt (2009). Consequently, it is possible for redistributive policies to distort the theoretical relationship between financial development and income inequality when it is modelled without accounting for redistribution. It is therefore important to distinguish the effect of financial system development on both market and net inequality in our effort to understand the financial development-inequality nexus. Gini coefficient based on pre-tax income ($gini\_net$) captures redistribution of wealth from rich to poor and this tend to lower the overall Gini coefficient.

First we present the results from the Arellano and Bond (1991) difference GMM in table 4.6a bellow.

Table 4.6a Arellano and Bond difference Dynamic panel GMM (gini_gross models) 1960 to 2007

Parameters	Column 1 All countries	Column 2 high income countries	Column 3 middle income countries	Column 4 low income countries
$\alpha\Delta gini\_grossl_{t-1}$	-0.19*** (-7.43)	-0.12** (-16.44)	-0.53*** (-9.66)	-0.25** (-5.92)
$\beta_1\Delta pcgdpl_{i,t}$	-0.002 (-0.66)	-0.008 (-0.21)	0.004 (0.611)	-0.019** (-2.44)
$\beta_2\Delta pcgdp^2_{i,t}$	0.098*** (2.96)	-0.073 (-0.33)	-0.115*** (-3.16)	-0.217** (2.14)
$\beta_3\Delta gdppercapl_{i,t}$	-0.006*** (-2.47)	-0.010 (-0.42)	0.003 (-0.67)	-0.016*** (-3.19)
$\beta_4\Delta gdppercap^2_{i,t}$	-0.049*** (1.28)	0.63** (4.35)	-0.019 (-0.63)	-0.083** (0.26)
$\beta_5\Delta inglobl_{i,t}$	-0.054*** (0.59)	-0.024 (-0.79)	-0.048** (-1.93)	0.013 (072)
$\beta_6\Delta prmsel_{i,t}$	-0.008*** (3.87)	-0.095* (1.74)	0.023 (0.56)	-0.037*** (-4.05)

Notes:
$\alpha\Delta gini\_grossl_{t-1}$ denotes lag 1 of the log of GINI coefficient of gross income, $\Delta pcgdpl_{i,t}$denotes the log of private credit divided by GDP. $\Delta pcgdp^2_{i,t}$ denotes the quadratic term of private credit divided by GDP, $\Delta gdppercapl_{i,t}$ denotes log of GDP per capita, $\Delta gdppercap^2_{i,t}$ denotes the quadratic term of GDP per capita, $\Delta inglobl_{i,t}$ denotes the log of KOF index of globalization, $\Delta prmsel_{i,t}$ denotes the log of primary school enrolment, λ_t represents the time period fixed effects from the countries. The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. $\varepsilon_{i,t}$ is the error term and Δ is the first difference operator. The standard errors for the GMM regression coefficient estimates were computed using the White diagonal standard errors, for the GMM weight the White diagonal instruments weighting matrix was used. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic,

$$\Delta gini\_grossl_{i,t} = \alpha\Delta gini\_grossl_{i,t-1} + \beta_1\Delta pcgdpl_{i,t} + \beta_2\Delta pcgdpl^2_{i,t} + \beta_3\Delta gdppercapl_{i,t} + \beta_4\Delta gdppercapl^2_{i,t} + \beta_5\Delta inglobl_{i,t} + \beta_6\Delta prmsel_{i,t} + \lambda_t + \varepsilon_{i,t} \quad (c)$$

Looking at the result for Arellano and Bond difference GMM in table 4.6a column 1 we found that the coefficients of the lagged gini inequality in gross income in all the models are negative and statistically significant. The effect of financial development on income inequality within the low income countries is negative and significant at the 5 percent levels of significance in both the linear and quadratic terms. In the Arellano and Bond net GINI model, we observed no reaction to financial sector development while in this model an increase in private sector credit will result to a 0.22 reduction in gross income inequality. This result shows that the distribution of gross income reacts more strongly than the distribution of net income to financial development. For the middle income countries, we found that a 1 percent increase in the quadratic term of private credit will lead to a 0.12 percent reduction in gross GINI inequality in the non-linear term. This result seems to suggest that increasing access to credit for private agents results to the

narrowing of gross income gaps between the rich and the poor[115]. In addition, we observed that the influence of economic development on gross income inequality for the entire country group is negative and significant in both the linear and quadratic terms. This result suggests that Income inequality first decreases with the process of economic development and continues to decrease as the economy develops more.

The negative coefficient on both the linear and quadratic terms reject the Kuznet (1955) inverted U-shaped path of income inequality, with income inequality decreasing in countries at the earlier stages of development and increasing in countries with more economic development. However, the result in this model suggests a linear negative relationship between economic growth and income inequality. In other words, income inequality reduces at the initial stages of economic development and continues to narrow as economies continue on the path of accelerating development. Industrial globalization in this model is negative and significant suggesting that increasing globalization reduces inequality in gross income. The level of primary school enrolment is negative and significant in this model. This result seems to suggest that in countries included in our datasets increasing human capital development will reduce inequality in market income, i.e. income before redistribution and taxes.

The results for high income, middle upper income and lower income countries shows that financial development, have a significant negative effect on gross income inequality. An important point to note here is with regards to high income countries where we found that credit to private sector although has a negative sign has no significant explanatory power for variations in gross income inequality. Allowing economic growth to enter the model, the result for high income countries in table 4.6a columns 2 reveals that economic growth starts to have a significant explanatory power to increase in gross income inequality once it passes a certain threshold; specifically, we found that at the initial stages of development GDP per capita does not explain changes in gross gini income however, once a critical level of GDP per capital income is surpassed, additional economic development will result to increase in inequality of gross income.

For the middle and low income countries, we found no evidence of the Kuznets inverted U-shaped curve. GDP per capita does not explain changes in income inequality in

[115] Easy access to main stream financial services remains a challenge to low income families not only in developing but also in developed economies. A recently released book titled Savings, Assets, Credit and Banking among Low-Income Households edited by Blank and Barr (2011) suggests that one in four American adults doesn't have a bank account. A similar finding for emerging economies was documented by Fernando (2007) who opined that the formal financial sectors in most developing countries serve only about 20-30% of the population. According to him, majority of the households that do not have access to basic financial services are concentrated in low-income categories.

middle income countries while for the low income countries the effect is negative and significant. Controlling for globalization, we observed significant negative relationship between this variable and income inequality in all the country groups and the middle income countries. The result seems to suggest that the influence of globalization on income inequality depends on first the type of inequality whether it is gross or net income inequality and secondly on the income category which the target country belongs to. Controlling for the effect of human capital development measured using the level of primary school enrolment this variable becomes negative and significant for all country, high income and low income categories. These results indicate that higher literacy level will reduce income inequality in gross income in these countries.

Table 4.6b Arellano and Bover orthogonal deviations Dynamic panel GMM (gini_gross models) 1960 to 2007

Parameters	Column 1 All countries	Column 2 high income countries	Column 3 middle income countries	Column 4 low income countries
$\alpha gini\_grossl_{t-1}$	0.88*** (37.95)	0.88*** (25.58)	-0.73*** (19.46)	-0.25*** (5.93)
$\beta_1 pcgdpl_{i,t}$	0.01 (1.01)	0.01 (0.32)	-0.03*** (-1.41)	-0.02*** (-2.44)
$\beta_2 pcgdp_{i,t}^2$	-0.04* (1.71)	-0.04* (-1.71)	-0.04*** (-4.01)	-0.22*** (2.14)
$\beta_3 gdppercapl_{i,t}$	-0.24 (0.86)	-0.24 (-1.37)	-0.07 (-1.41)	-0.02*** (-3.19)
$\beta_4 gdppercap_{i,t}^2$	0.03 (1.31)	0.03 (1.31)	-0.01 (1.52)	-0.08*** (-2.15)
$\beta_5 inglobl_{i,t}$	0.04*** (2.08)	0.04** (2.08)	-0.01 (-0.46)	0.013 (0.72)
$\beta_6 prmsel_{i,t}$	-0.06*** (-2.54)	-0.06*** (-2.54)	0.09** (2.34)	-0.04*** (-4.05)

Notes:

$\alpha gini\_grossl_{t-1}$ denotes lag 1 of the log of GINI coefficient of net income, $pcgdpl_{i,t}$denotes the log of private credit divided by GDP. $pcgdp_{i,t}^2$ denotes the quadratic term of private credit divided by GDP, $gdppercapl_{i,t}$ denotes log of GDP per capita, $gdppercap_{i,t}^2$ denotes the quadratic term of GDP per capita, $inglobl_{i,t}$ denotes the log of KOF index of globalization, $prmsel_{i,t}$ denotes the log of primary school enrolment, λ_t represents the time period fixed effects from the countries. The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. $\varepsilon_{i,t}$ is the error term. The standard errors for the GMM regression coefficient estimates in this model were computed using the period weights (PCSE) standard errors & covariance, for the GMM weight the period weights instrument weighting matrix was used. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic,

$$gini\_grossl_{i,t} = \alpha gini\_grossl_{i,t-1} + \beta_1 pcgdpl_{i,t} + \beta_2 pcgdpl_{i,t}^2 + \beta_3 gdppercapl_{i,t} + \beta_4 gdppercapl_{i,t}^2 + \beta_5 inglobl_{i,t} + \beta_6 prmsel_{i,t} + \lambda_t + \varepsilon_{i,t} \quad (d)$$

For the Arellano and Bover model, the negative effect of financial sector development within the middle and low income countries remains negative and significant. The impact of financial development on income inequality within these countries is such

that when the level of financial development is high, the level of inequality in both net and gross income tends to reduce, irrespective of the GMM estimator that is employed, thus confirming some aspects of the existence of negative and linear relationship of Galor and Zeira (1993) and Banerjee and Newman (1993). Our results show that an increase in financial sector development within the low income economies is associated to a reduction of gross income inequality between the ranges of 0.02 to 0.22 in both the Arellano and Bond and Arellano and Bover models.

Considering the inverted U-shaped hypotheses proposed by Greenwood-Jovanovic (1993), the result for the all countries model reported in table 4.6b column 1 reveals that the linear relationship coefficient is positive but insignificant while the non-linear relationship coefficient is significant and negative confirming some aspects of the hypothesis. Quantitatively, we found that a 1 percent increase in credit to private sector will reduce inequality by 0.04 percent. This effect is consistent for the high income, middle income and low income countries, indicating that at an early stage of financial development credit to private sector have little or no effect on market income inequality. However, income inequality tends to decrease with advanced financial sector.

The impact of globalization on market income inequality in both the all countries model and high income model is positive and significant indicating that more globalization worsens income inequality in these countries. This increasing effect of globalization within the high income economies provides support for Miller (2001) that showed that globalization can explain the significant increase in earnings inequality in the U.S since the late 1970s. Miller (2001) opined that most of the increase in wage inequality since the late 70s was as a result of changes in the structure of production which entails the outsourcing of less intensive production process to low income countries with low labour costs.

The implication of production process outsourcing is a stiff competition between low-skilled workers in these countries and low-skilled workers from the rest of the world while the demand for high skilled workers in the outsourcing country is on the increase. These situations will depress the wages of low-skilled workers while increasing that of their highly skilled counterparts' thus increasing inequality of market income. The proxy for human capital development measured using the level of primary school enrolment in this model is negative and significant for the all countries model column 1, high income model column 2. And low income model column 4. Specifically, we found that one more year of schooling will reduce inequality of gross income by 0.06 percent in all the countries as well as the high income countries while the same increase is associated to a

0.04 decrease in market income inequality within the low income economies. The effect of human capital development within the middle income groups is positive and significant; specifically, we found that increase in primary school enrolment within these countries will increase inequality in gross income by approximately 0.09 percent. One possible explanation of this finding could be that primary education can only give the basic knowledge of reading, writing and arithmetic it does not give skills that are relevant for employment that can ensure high wages. Consequently, people with primary education still end up with low wages.

Table 4.7 Arellano and Bond difference dynamic panel GMM using bank deposit to gdp (gini_net models) 1960 to 2007

Parameters	Column 1 All countries	Column 2 high income countries	Column 3 middle income countries	Column 4 low income countries
$\alpha\Delta gini\_netl_{t-1}$	-0.192*** (-6.915)	-0.44*** (-20.62)	-0.68*** (-17.90)	0.21 (0.82)
$\beta_1\Delta bdgdpl_{i,t}$	0.004 (0.81)	-0.01*** (-2.31)	0.003 (0.40)	-0.05*** (-2.57)
$\beta_2\Delta bdgdp_{i,t}^2$	0.19*** (7.77)	0.27*** (5,53)	-0.25*** (-3.42)	-0.62*** (2.13)
$\beta_3\Delta gdppercapl_{i,t}$	0.016*** (4.47)	-0.01*** (-3.81)	0.004 (-1.02)	0.01 (0.99)
$\beta_4\Delta gdppercap_{i,t}^2$	0.017 (047)	0.27*** (7.27)	-0.02 (-1.02)	0.06 (0.53)
$\beta_5\Delta inglobl_{i,t}$	-0.013 (-0.98)	-0.01*** (-2.59)	-0.03** (-1.97)	0.05* (1.64)
$\beta_6\Delta prmsel_{i,t}$	0.006 (0.718)	-0.001 (0.23)	0.09*** (1.97)	-0.07* (-1.71)

Notes:
$\alpha\Delta gini\_netl_{t-1}$ denotes lag 1 of the log of GINI coefficient of net income, $\Delta pcgdpl_{i,t}$denotes the log of private credit divided by GDP. $\Delta pcgdp_{i,t}^2$ denotes the quadratic term of private credit divided by GDP, $\Delta gdppercapl_{i,t}$ denotes log of GDP per capita, $\Delta gdppercap_{i,t}^2$ denotes the quadratic term of GDP per capita, $\Delta inglobl_{i,t}$ denotes the log of KOF index of globalization, $\Delta prmsel_{i,t}$ denotes the log of primary school enrolment, λ_t represents the time period fixed effects from the countries. The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. $\varepsilon_{i,t}$ is the error term and Δ is the first difference operator. The standard errors for the GMM regression coefficient estimates were computed using the White diagonal standard errors, for the GMM weight the White diagonal instruments weighting matrix was used. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic,

$$\Delta gini\_netl_{i,t} = \alpha\Delta gini\_netl_{i,t-1} + \beta_1\Delta bdgdpl_{i,t} + \beta_2\Delta bdgdpl_{i,t}^2 + \beta_3\Delta gdppercapl_{i,t} + \beta_4\Delta gdppercapl_{i,t}^2 + \beta_5\Delta inglobl_{i,t} + \beta_6\Delta prmsel_{i,t} + \lambda_t + \varepsilon_{i,t} \quad \text{(e)}$$

Using a different measure of financial sector development that has been used in the literature, bank deposit to GDP our results (table 4.7), confirmed the negative relationship between financial sector developments and inequality in net income in all the models

expect the all countries model in column 1 of table 4.7. For the high income category, we found a linear negative relationship between financial sector development and inequality. However, at a certain stage of financial development, wealthier household's starts to benefit disproportionately from advanced financial sector. Within the high income countries, development of this sector results to a 0.01 percent decrease in net income. At a certain stage, more development in this sector will lead to approximately 0.27 percent increase in the income of richer households. For the middle income countries, the coefficient of financial development in the linear form is insignificant, however, that of the non-linear is negative and significant indicating that more financial development in these countries will narrow the income gap between the rich and the poor.

The inverse relationship between financial development and inequality in the low income countries that was found in the previous models is confirmed. . In general, the results seem to support inequality reducing effect of financial system development. Therefore, improvements in financial markets and intermediaries expand economic opportunities and reduce inequality. In addition, we found that the effect of economic development on income inequality measured using net GINI is insignificant within the middle and low income models. For the high income model, the linear term of GDP per capita is negative and significant while the quadratic term is positive and significant confirming the earlier findings.

The results in table 4.7 columns 1, 2 and 3 for reveal that globalization has a reducing impact on income inequality in these countries. Specifically, we found that as countries that make up the income groups become more integrated with the world economy, inequality in net income is reduced by approximately 0.01 percent for all the countries model, 0.01 percent for high income countries and 0.03 for the middle income countries . This finding provides empirical evidence in support of the neoclassical growth theory that predicts that national economies will converge in their average productivity levels and average incomes because of increased mobility of capital, Wade (2001). For the low income countries, we found that globalization worsen income disparity between the rich and the poor.

The result suggests that globalization explains 0.05 percent of the increases in net income inequality indicating that integration into the world economy leads to increasing gaps in the distribution of income in the target countries. This finding provides support for the endogenous growth theory that predicts that diminishing returns to capital as a result of more integration into the world economy is offset by increasing returns to technological

innovation in the target countries thus increasing inequality. Summarising the findings of sections 4.4.1 and 4.5, we obtained a consistent strong negative impact of financial sector development on income inequality in most of the models. Specifically, we found that financial sector development measured using credit to private sector and bank deposit to GDP reduces inequality in net and gross income within the low income countries and depending on the measure of financial sector development employed, the same reducing impact can be seen within the high and middle income countries. Indeed, access to financial services for all households particularly low-income households has been recognised as crucial for the reduction of not only inequality in income but also other dimensions of inequality including education, economic and health inequalities, Rojas-Suarez (2010) and Fernando (2007).

Access to finance broadly defined as the ability of agents and firms to use financial services if they chose to do so, allows households as well as firms to move away from short-term decision making toward an inter-temporal allocation of resources, Rojas-Suarez (2010). Low income families with less stable employment and earnings have more reasons to smooth their income over short-term fluctuations. Consequently, they have an ongoing need for financial services that can make it easier for them to save or access credit, thus improving their incentive for productive investments.

4.6 Financial development and top 1 percent income group

Bulk of the empirical studies that have analyzed financial development-income inequality nexus have frequently used a rather narrow definition of financial development such as total credit extended by deposit money banks and other financial institutions as a measure of financial sector development or bank deposit to GDP. A major reason for the wide use of these proxies in cross country panel studies is their availability across countries and time, Demirguc-kent and Levine (2008). However, we know that the financial sector is more than just the banking sector; we also have the financial markets particularly the stock market. In other to capture the effect of stock market development on income inequality we used the stock market capitalization to GDP. We sort to circumvent the limitations of data availability for all countries by including in this analysis countries that have complete data for this variable.

In addition, most of the empirical studies on financial development and income inequality employ different variants of GINI coefficient as a measure of income inequality. As we alluded in chapter 2 of this thesis this measure of income inequality has some

limitations. For example, Gini statistic is sensitive to outliers-a few very wealthy or very poor individuals can change the statistic significantly, even in large samples. One of the gaps in literature that the current study intends to bridge is the use of the income of top 1 percent of the population as a measure of inequality. Again because of lack of availability of information on this variable across countries and time we have included countries that have information on the income of the top 1 percent of the population in this analysis. The variables used for this analysis were all transformed to growth rates.

Countries included in the analysis are Australia (AUS), France (FRA), Japan (JPN), Norway (NOR), Singapore (SPG), Sweden (SWE) and the United States (USA). The time period covered is 1988 to 2008. An important point to bear in mind with regards to the countries included in the analysis is that they all belong to the same income category (high income countries). The cross-sectional descriptive analysis in table 4.8a reveals the trend in the income share of top 1 percent, level of stock market capitalization, extent of credit to private sector as well as the GDP per capita income in the countries under review. A closer look at the table shows that the United States has the highest level of income share going to the top 1 percent of the population with an average of 14.42 percent followed by Singapore with an average of 12.39 percent. Countries such as Australia, France, Japan, and Norway have the income share accruing to the top 1 percent of population hovering between 8.05 and 8.62 percent; while Sweden has the lowest share of income going to the top 1 percent at 5.60 percent in the group.

Table 4.8a Cross-section specific descriptive statistics financial development and top 1 percent income earners 1988 to 2009

	Mean	Maximum	Minimum	Std.Dev
Income of top 1 percent income earners in the target countries				
$top1\_aus$	8.05	10.06	6.34	1.22
$top1\_fra$	8.24	8.94	7.65	0.45
$top1\_jpn$	8.25	9.62	7.06	0.91
$top1\_nor$	8.62	16.49	4.28	3.20
$top1\_sgp$	12.39	15.07	9.84	2.07
$top1\_swe$	5.60	6.61	4.38	0.56
$top1\_usa$	14.42	18.06	12.17	1.93
Stock market capitalization as a ratio of GDP in the target countries				
$stmkcap\_aus$	0.86	1.33	0.40	0.30
$stmkcap\_fra$	0.60	1.11	0.27	0.30
$stmkcap\_jpn$	0.79	1.23	0.56	0.20
$stmkcap\_nor$	0.36	0.71	0.19	0.15
$stmkcap\_sgp$	1.71	2.50	0.95	0.48
$stmkcap\_swe$	0.85	1.46	0.39	0.35
$stmkcap\_usa$	1.08	1.64	0.58	0.36
Private credit as a ratio of GDP in the target countries				
$pcgdp\_aus$	0.79	1.08	0.57	0.17
$pcgdp\_fra$	0.88	0.94	0.81	0.04
$pcgdp\_jpn$	1.48	1.95	0.98	0.39
$pcgdp\_nor$	0.93	1.04	0.81	0.08
$pcgdp\_sgp$	1.10	1.36	0.93	0.16
$pcgdp\_swe$	0.65	0.67	0.64	0.01
$pcgdp\_usa$	1.53	1.95	1.17	0.30
GDP per capita in the target countries				
$gdppercap\_aus$	23109.95	36113.00	17658.08	6272.91
$gdppercap\_fra$	26017.98	35457.05	21268.25	5130.89
$gdppercap\_jpn$	34548.76	42522.07	25123.63	4506.16
$gdppercap\_nor$	41914.90	72959.77	27404.59	15015.93
$gdppercap\_sgp$	22281.02	31585.60	11845.41	5522.33
$gdppercap\_swe$	31469.42	43948.62	23173.30	6620.12
$gdppercap\_usa$	34288.32	46443.81	23954.52	7750.21
Primary school enrolment (gross ratio)				
$prmse\_aus$	102.25	105.56	100.26	1.98
$prmse\_fra$	104.96	113.84	101.51	3.52
$prmse\_jpn$	101.66	102.81	100.74	0.66
$prmse\_nor$	99.58	100.94	98.51	0.93
$prmse\_swe$	103.14	109.73	95.71	5.03
$prmse\_usa$	101.31	104.20	98.87	1.66
KOF Index of globalization in the target countries				
$indglob\_aus$	78.87	81.57	73.40	2.84
$indglob\_fra$	80.18	83.74	73.24	3.45
$indglob\_jpn$	55.85	64.83	46.64	5.17
$indglob\_nor$	80.82	83.24	76.46	1.89
$indglob\_sgp$	84.47	87.57	80.85	2.46
$indglob\_swe$	86.53	88.78	80.44	2.69
$indglob\_usa$	74.64	77.02	70.21	2.02

Notes:

countries included in this analysis are Australia (AUS), France (FRA), Japan (JPN), Norway (NOR), Singapore (SGP), Sweden (SWE) and United States (USA). $top1$ denotes the income share of the top 1 percent in the target countries, $stmkcapl$ denotes stock market capitalization in the target country, $pcgdp$ denotes private credit divided by GDP, $gdppercap$ denotes GDP per capita in the country,$prmse$ denotes primary school enrolment; gross enrolment ratio, $indglob$ is the KOF index of globalization in the countries involved. Singapore is not included in the primary school enrolment ratio because it does not have any information on it.

Although the total national income share of the top 1 percent is smaller in Norway (8.62) and Singapore (12.39) percent compared to the U.S (14.42) percent, Norway and Singapore have higher standard deviations of 3.20 and 2.07 percent compared to the U.S 1.93 percent indicating that the income of the top 1 percent of the population in Norway and Singapore vary more than that of the United States. Effectively, the data suggests that the top 1 percent income earners in the United States are more similar in their incomes than the top 1 percent in Norway and Singapore.

With regards to stock market capitalization as a ratio of GDP we observed high level of stock market capitalization to GDP in Singapore, at 171 percent followed by the United States at 108 percent and Australia at 86 percent, Sweden at 85%, Japan at 79% France at 60% with Norway having the lowest at 36%. In addition, looking at the extent of private credit relative to GDP we observed that the U.S has the largest lending to private sector at 153% followed by Japan at 148% with Sweden having the lowest at 65% during the period under review. The GDP per capita shows that Norway has the highest in the group, with an average GDP per capita of about $41,914.90, followed by the U.S at $34,288.32 with Singapore reporting the lowest GDP per capita of $22,281.76.

Average primary school enrolment (gross ratio) in the countries used for the analysis stood between 100 and 104% with Norway having a slightly lower ratio of 99.58%. The KOF index of globalization reveals that all the countries in the datasets have almost the same level of economic, social and political globalization hovering between 74 and 86%, with Japan having the least level of integration with the world economy at 55.85%.

Table 4.8b Correlation matrix financial development and top 1 percent income earners 1988 to 2009

	$gdppercap$	$indglob$	$pcgdp$	$prmse$	$stmkcap$	$top1$
$gdppercap$	1.00	0.54	0.91	0.12	0.89	0.69
$indglob$	0.54	1.00	0.80	-0.59	0.82	0.93
$pcgdp$	0.91	0.80	1.00	-0.10	0.99	0.88
$prmse$	0.12	-0.59	-0.10	1.00	-0.15	-0.38
$stmkcap$	0.89	0.82	0.99	-0.15	1.00	0.88
$top1$	0.69	0.93	0.88	-0.38	0.88	1.00

Notes:
$gdppercap$ denotes GDP per capita,$indglob$ is the KOF index of globalization, $pcgdp$ denotes private credit divided by GDP; claims on the private sector by deposit money banks and other financial institutions.$prmse$ denotes primary school enrolment; gross enrolment ratio.$stmkcap$ denotes the stock market capitalization to GDP, $top1$ denotes the income share of the top 1 percent.

The correlation matrix on table 4.8b shows a positive correlation between the two measures of financial development. Specifically, the matrix reveals a 99% correlation

between stock market capitalization to GDP and private credit to GDP. Given this high level of correlation, it might be tempting to suggest that an analysis differentiating the effect of these two variables on the income share of the top 1 percent may not be important since one can substitute for the other. This argument may not be entirely correct since the two variables represent different dimensions of financial development; while credit to private sector as a ratio of GDP represents access to loan-advancing financial institutions, stock market capitalization represents financial markets. It is possible that the influence of stock market development and financial institutions' on the income of the top 1 percent may differ in terms of direction and significance. In addition, we found that primary school enrolment has a negative relationship between stock market capitalization, globalization index and top 1 percent income share.

We tested the stationarity or otherwise of all the variables used in this study. The three tests namely, Im, Pesaran and Shin, ADF-Fisher and Levin, Lin and Chu tests were unanimous in confirming the presence of unit root in the variables. The null hypothesis for Im Pesaran and Shin W-stat is that the variable assumes common unit root process, for the ADF-Fisher, and Levin, Lin & Chu the null hypothesis is that the variables assumes individual unit root process. Consequently, we differenced the variables, included in the test equations are the individual intercepts. Table 4.8c reports the panel unit root test of the variables used in this section of the analysis.

Table 4.8c Panel unit root test for the top 1 percent income analysis

	$Im, Pesaran\ and\ Shin\ W - stat$	$ADF - Fisher\ Chi - Square$	$Levin, lin\ \&\ Chu$
$\Delta top1$	-3.59558***	37.9901***	-6.54331***
$\Delta pcgdp$	-3.29344***	45.9507***	-5.97536***
$\Delta\Delta gdppercap$	-3.23018***	35.5856***	-2.57679**
$\Delta stmkcap$	-5.54328***	56.1698***	--5.93690***
$\Delta inglob$	-4.01702***	43.4413***	-2.99822***
$\Delta\Delta prmse$	-2.26977***	24.3805***	-1.93720**

Note:
$top1$ denotes the growth rate in the income share of the top 1 percent earnings population, $pcgdpl_{i,t}$ the growth rate of private sector credit to GDP. $gdppercap_{i,t}$ denotes the growth rate of GDP per capita, $stmkcap$ denotes the growth rate of stock market capitalization to GDP, $inglob_{i,t}$ denotes the growth rate of KOF index of globalization, $prmse_{i,t}$ denotes the growth rate of primary school enrolment and Δ is the first difference operator and ΔΔ denotes the second difference operator.

In this section we are particularly interested in testing how financial development affect the income share of the top 1 percent income earners in the target countries. To achieve this objective, we estimated two models using the Arellano and Bond (1991) Dynamic Panel GMM estimator. We employed the two measures of financial sector

development namely, growth rate of private credit to GDP $pcgdp$ and the growth rate of stock market capitalization to GDP $stmkcap$. The equation we estimated is of this functional form:

$$\Delta top1_{i,t} = \Delta\alpha top1_{i,t} + \Delta\Delta\beta_1 gdppercap_{i,t} + \Delta\Delta\beta_2 gdppercap_{i,t}^2 + \Delta\beta_3 pcgdp_{i,t} + \Delta\beta 4pcgdpi,t2+\Delta\beta 5indglobgi,t+\Delta\Delta\beta 6prmsei,t+\lambda+\varepsilon i,t \quad (4.8)$$

$$\Delta top1_{i,t} = \Delta\alpha top1_{i,t} + \Delta\Delta\beta_1 gdppercap_{i,t} + \Delta\Delta\beta_2 gdppercap_{i,t}^2 + \Delta\beta_3 stmkcap_{i,t} + \Delta\beta_4 stmkcap_{i,t}^2 + \Delta\beta_5 indglobg_{i,t} + \Delta\Delta\beta_6 prmse_{i,t} + \lambda + \varepsilon_{i,t} \quad (4.9)$$

Where $top1_{i,t}$ denotes the growth rate of the income of the top 1 percent, α denotes the coefficient of the lagged dependent variable, $gdppercap_{i,t}$ denotes the growth rate of GDP per capita, $gdppercap_{i,t}^2$ denotes the quadratic term of GDP per capita, $inglob_{i,t}$ denotes the growth rate of KOF index of globalization, $prmse_{i,t}$ denotes the growth rate of primary school enrolment, $pcgdp_{i,t}$ denotes the growth rate of private credit divided by GDP. $pcgdp_{i,t}^2$ denotes the quadratic term of private credit, $stmktcap$ denotes the growth rate of stock market capitalization to GDP. The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. $\varepsilon_{i,t}$ is the error term.

The results from table 4.9a suggests that inequality tends to be on the increase as countries included in our dataset achieve a higher level of per capita income, since the GDP per capita in the model is positive and significant in both the linear term and the quadratic terms. Specifically, the result in table 4.9a suggests that controlling for the influence of globalization, level of primary school enrolment and financial development a 1 percent increase in GDP per capita will result to a 0.05 and 0.001 percent increases in the income of the top 1 percent of the population. Globalization and primary school enrolment in this model does not have any significant explanatory power to changes in the income of the top 1 percent earning population. Focusing attention on our main variable of interest, credit to private sector one of the measures of financial sector development we observed a linear negative relationship between private sector credit and the income of the top 1 percent. Specifically, we found that a one percent increase in credit to private sector will reduce the income of the top 1 percent of the population by 0.07 percent. Looking at the

quadratic term, we observed a positive and statistically significant relationship between the income of the top 1 percent and this measure of financial sector development. This result seems to suggest that private sector development after a certain threshold starts to favour disproportionately households within the top income spectrum.

Table 4.9a Arellano and Bond difference dynamic panel GMM for top 1 percent using credit to private sector to GDP 1994 to 2009

Parameters	private sector credit
$\Delta\alpha top1l_{i,t-1}$	-0.70*** [-16.08]
$\Delta\Delta\beta_1 gdppercap_{i,t}$	0.05** [2.23]
$\Delta\beta_2 gdppercap_{i,t}^2$	0.001** [2.11]
$\Delta\beta_3 pcgdp_{i,t}$	-0.07*** [-3.32]
$\Delta\beta_4 pcgdp_{i,t}^2$	0.01*** [3.74]
$\Delta\beta_5 inglob_{i,t}$	0.07 [0.62]
$\Delta\Delta\beta_6 prmse_{i,t}$	-0.02 [-0.22]

Note:

. $\alpha\Delta top1_{t-1}$ denotes growth rate of the income share of the top 1 percent, $\Delta\Delta gdppercap_{i,t}$ denotes growth rate of GDP per capita, $\Delta\Delta gdppercap_{i,t}^2$ denotes the quadratic term of GDP per capita, $\Delta pcgdpl_{i,t}$denotes the growth rate of private credit divided by GDP. $\Delta pcgdp_{i,t}^2$ denotes the quadratic term of private credit divided by GDP, $\Delta inglob_{i,t}$ denotes the growth rate of KOF index of globalization, $\Delta\Delta prmse_{i,t}$ denotes the growth rate of primary school enrolment, λ_t represents the time period fixed effects from the countries. The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. $\varepsilon_{i,t}$ is the error term and Δ is the first difference operator and $\Delta\Delta$ is the second difference. The standard errors for the GMM regression coefficient estimates were computed using the White diagonal standard errors, for the GMM weight the White diagonal instruments weighting matrix was used. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic.

$$\Delta top1_{i,t} = \Delta\alpha top1_{i,t} + \beta_1 gdppercap_{i,t} + \beta_2 gdppercap_{i,t}^2 + \beta_3 pcgdp_{i,t} + \beta_4 pcgdp_{i,t}^2 + \beta_5 indglobg_{i,t} + \beta_6 prmse_{i,t} + \lambda + \varepsilon_{i,t} \quad (f)$$

Focusing on a different dimension of financial development i.e. financial market expansion measured using stock market capitalization to GDP we found different reactions by the top 1 percent income earners. The result from this model is reported in table 4.9b below. First the positive relationship between GDP per capita and the top 1 percent income earners is confirmed in this model at least in the linear term. This finding provides support to the argument that increasing inequality is not only an inevitable effect of economic growth, but it is also a necessary condition for growth, Colman and Nixson (1988). According to the proponents of the pro-inequality argument, in order to ensure capital accumulation and growth, income has to be redistributed towards the groups that save and invest-the rich because savings are essential to increase productive capacity which leads to

higher rates of growth. Consequently, an economy with a high concentration of income within the top is more likely to grow faster than one with more equal distribution of income.

Table 4.9b Arellano and Bond difference dynamic panel GMM for top 1 percent using stock market capitalization to GDP 1994 to 2009

Parameters	private sector credit
$\Delta\alpha top1_{i,t-1}$	-0.69*** [-23.04]
$\Delta\Delta\beta_1 gdppercap_{i,t}$	0.06** [3.03]
$\Delta\beta_2 gdppercap_{i,t}^2$	0.004 [0.49]
$\Delta\beta_3 stmkcap_{i,t}$	0.03 [0.80]
$\Delta\beta_4 stmkcap_{i,t}^2$	-0.004*** [-2.78]
$\Delta\beta_5 inglob_{i,t}$	0.21*** [3.52]
$\Delta\Delta\beta_6 prmsel_{i,t}$	-0.06** [-2.10]

Note:

. $\alpha\Delta top1_{t-1}$ denotes lag 1 of the growth rate of income share of the top 1 percent, $\Delta\Delta gdppercap_{i,t}$ denotes the growth rate of GDP per capita, $\Delta\Delta gdppercap_{i,t}^2$ denotes the quadratic term of GDP per capita, $\Delta pcgdp_{i,t}$ denotes the growth rate of private credit divided by GDP. $\Delta pcgdp_{i,t}^2$ denotes the quadratic term of private credit divided by GDP, $\Delta inglob_{i,t}$ denotes the growth rate of KOF index of globalization, $\Delta prmse_{i,t}$ denotes the growth rate of primary school enrolment, λ_t represents the time period fixed effects from the countries. The time period effects λ_t are assumed fixed parameters to be estimated as coefficients of time dummies for each year that is used in the sample. $\varepsilon_{i,t}$ is the error term and Δ is the first difference operator and $\Delta\Delta$ is the second difference. The standard errors for the GMM regression coefficient estimates were computed using the White diagonal standard errors, for the GMM weight the White diagonal instruments weighting matrix was used. The asterisks ***, **, * indicate significance at the 1, 5, 10% levels respectively. The values in the brackets are t-statistic.

$$\Delta top1_{i,t} = \Delta\alpha top1_{i,t} + \beta_1 gdppercap_{i,t} + \beta_2 gdppercap_{i,t}^2 + \beta_3 stmkcap_{i,t} + \beta_4 stmkcap_{i,t}^2 + \beta 5indglobgi,t + \beta 6prmsei,t + \lambda + \varepsilon i,t \quad \text{(g)}$$

Allowing globalization to enter the model table 4.9b above, we observed a positive and statistically significant relationship between globalization and the income of households within the top 1 percent. The result suggests that increasing globalization increases the income of the top 1 percent thus exacerbating income inequality. This is in line with the hypothesis that suggests that globalization has increased the demand for talented workers around the world while demand for others is dwindling-creating a more polarized job market.

A possible explanation of this finding could be that as countries achieve higher levels of economic development and become more integrated with the world economy, talented individuals extract more rent form the economy via their innovations and productivity thus the income gap between these group and the rest widens resulting in

inequality. In addition, as economies develop and become more sophisticated, the top 1 percent will see growing demand for their specialized skills and knowledge thus receiving above average rewards than the rest. Quantitatively, 0.21 percent of changes in the income of the top 1 percent households can be explained by globalization. Controlling for the level of human capital development, we found that primary school enrolment in this model explains changes in the income of the top 1 percent. Specifically, we found that one more year of schooling is associated to a 0.06 percent reduction in the income inequality.

Turning our attention to the second measure of financial sector development-stock market capitalization as a ratio of GDP, we found that in the linear level, financial sector development does not explain changes in the income of the top 1 percent. There is however, a significant inverse non-linear relationship between the top 1 percent income earners and changes in stock market capitalization. The result suggests that increasing the depth of the stock market; will reduce the income of the top 1 percent by 0.004 percent thus narrowing the income gap between the top 1 percent of the population and the rest within the countries included in this analysis. The result seems to suggest that more capital market expansion in the target countries will result in reduction in the income of the top 1 percent although the magnitude of this reduction is somewhat minimal..

4.7 Conclusions

This chapter discussed theoretical models which explain the link between financial development and income inequality. We employed different measures of income inequality namely; Gini index of net and gross income as well as the income share of the top 1 percent of the population in a cross-country perspective. Some of the findings from our empirical estimations are worth discussing, especially those that fail to meet prior expectations. We start our discussions on financial sector development and income inequality. We found via the empirical estimations that the impact of financial sector development measured using bank deposit to GDP on inequality measured using the Gini index of net income inequality in the Arellano and Bover estimator table 4.7b does not explain changes in inequality within the all countries model, column 1, high income countries column 2 and middle income countries column 3. This finding is not surprising given that in most of these countries, majority of the population, low-income families in particular, do not have access to financial services. Some of the low-income households that have gained access to financial sector as a result of recent developments in financial services are often underserved both in terms of quantity and quality. Fernando (2007) in

his study of access to finance in middle income emerging economies documented that formal financial system at best serves no more than 20-30 percent of the population, and excludes 70-80 percent of the population and majority are from low-income households.

Another finding that seems contrary to prior expectation is the relationship between human capital development and income inequality. The results in almost all the models suggest that increasing human capital development increases income inequality, this implies that improvement in literacy level is not a sufficient condition to reduce income inequality, although it may help in improving the living standards of individuals at the bottom of the income distribution. One should expect that an increase in human capital development would translate to a reduction in income inequality. A plausible explanation of this finding could be that increase in the literate population acquiring primary education has reduced income inequality at least by improving the share of income going to the lowest income group, however, at the same time, external factors such as globalization and financial market expansion have concurrently increased the income share going to the top income group.

In general, we found that within the high income countries economic development reduces inequality at the initial stages of development given that the linear term of GDP per capita in most of the models are negative and significant; however, it gets to a level where the positive effect of increasing economic development starts to vanish. Most researchers have argued that the negative distributional effect of economic development at least in the U.S can be attributed to the excessive increase in the income and wages of top income earners, Bivens, and Mishel (2013). Using Alvaredo, Atkinson, Piketty and Saez (2013) data on top incomes, Bivens and Gould (2013) demonstrated that the decade following 1928, income inequality declined rapidly in the U.S (the only country with complete information on top 1 percent income earners before 1970s).

The top 1 percent claimed less than 10 percent of total income on the average between 1948 and 1979. According to their analysis, income growth during these periods was essentially shared proportionately. For the purposes of this study, these periods could be regarded as the initial periods of economic growth; however, as the U.S continued to expand its national income, the top 1 percent's take has soared. In fact Piketty and Saez (2013) in their study showed that 95% of income gains from 2009 to 2012 went to the top 1 percent of the earning population. Although one cannot generalize the case of U.S, it provides a reasonable insight into why increasing economic growth leads to widening instead of narrowing income differentials between the rich and the poor.

For the upper middle income and lower income countries, we found that the effect of economic growth depends on whether you use the GINI index of net or gross income as a measure of income inequality. Accounting for the effect of redistribution in income inequality we found evidence of the Kuznet inverted U-shape hypothesis within the low income countries table 4.7b column 4 which suggests that inequality increases at the initial stages of development (low income periods) and starts reducing as a country gets to an advanced level of development. However, using gross GINI with no explicit role for redistribution, we found that our measure of economic growth becomes insignificant for the middle income group while we found an increasing return of economic development on income inequality for the low income countries. The current study supports the use of net GINI index of inequality given that the analytical basis for economic development's effect on inequality concerns net (post-tax) inequality, which affects incentives and prospects for social stability.

With regards to financial development and income inequality which is the main focus of this chapter, the impact of financial development on income inequality depends on the dimension of financial development one is considering. Looking at the effects of financial development measured using private sector credit to GDP on gini index of net income inequality; we found inequality reducing effect of financial development across all the three different income groups' table 4.5b columns, 2, 3 and 4. Using credit to private sector as a measure of financial development and gross income inequality, we confirmed the inequality reducing effect of financial development within the middle and low income categories only while the effect for the high income economies is insignificant-see table 4.6a. However, using a different measure of financial sector development namely bank deposits to GDP, we found that the previous finding of inequality reducing effect of financial sector development within the middle and the low income countries is upheld.

For the high income countries, we observed a somewhat linear relationship between financial development and net inequality as indicated by the negative and statistically significant coefficient of the linear bank deposit to GDP variable ($bdgdpl$) while the quadratic term of bank deposit to GDP variable ($bdgdpl^2$) is positive and significant. This finding suggests that for countries within the high income group after a certain income threshold is surpassed, the inequality-reducing effect of economic development disappears and more development will start to favour the households that can extract economic rent from the system. Furthermore, employing the top 1 percent as a measure of inequality (the results are reported in tables 4.9a and 4.9b), we gained some interesting

insights. First, our analysis revealed that the impact of financial sector development on income inequality depends on the dimension of the financial sector been analyzed. Using the Arellano and Bond dynamic panel GMM we found that the effect of financial development (measured using credit to private sector as a ratio of GDP) on income inequality is negative and significant in the linear term and positive and significant in the quadratic term. This finding indicates that the inequality reducing effect of financial sector development across the countries included in this analysis is mainly seen at the initial stages of financial sector development. However, after a certain stage, the impact of further development within the financial sector starts to favour the rich.

Using a different measure of financial development namely, stock market capitalization as a ratio of GDP, we found some aspect of the inverted U-shaped hypothesis-table 4.9b. Although the coefficient of the linear stock market capitalization is insignificant in this model, the coefficient of the quadratic term is negative and highly significant; indicating that well developed capital market reduces inequality. In summary, the results in almost all the models suggest that increasing access to private credit for low income households will reduce income inequality. This topic is important in the light of the potential for using financial development as a policy tool to reduce the widening income inequality around the world.

In principle the result seems to suggest that policies that restricts access to financial services particularly the banking sector and other credit providing institutions will lead to deterioration in income distribution. In a more practical way; easy access to credit makes investment attractive, and small entrepreneurs are likely to benefit more. Furthermore, access to financial resources unleashes entrepreneurial talent which generates employment opportunities, increases output, and improves welfare of the poor. Rjan and Zingales (2004) pointed out that limited access to finance can significantly reduce the choices that agents have in deciding where to live and work. With easy access to finance all agents from low income households and connected individuals will be able to take advantage of economic opportunities.

The emphasizes in most of the theoretical and empirical literatures in finance and income inequality is 'access to financial services[116]' which is mostly limited by financial

[116]On the surface, access to financial services may seem to be a simple concept; however, measuring access to finance is usually very difficult largely because it is different from actual usage of financial services, Fernando (2007). According to Fernando (2007), an individual may be said to have access to financial services if he/she is able to use financial services in an "appropriate" form at reasonable prices when he/she requires such services. Consequently, some agents who do not use financial services at any given time may

market imperfections such as information asymmetries, contract enforcement costs and transaction costs. Poor entrepreneurs may be the most affected by these imperfections because of their lack of collateral and almost no credit history. Consequently, poor entrepreneurs with good business projects may not be able to access funding from financial markets and remain in poverty thus increasing income inequality.

The challenge of improved access implies making financial services available to all, thereby expanding equality of opportunities and reducing persistent inequality. From this perspective, one can argue that the challenge is more than granting consumer loans to economic agents. It is just as much about developing financial policies that will reduce financial market frictions, which are particularly binding on the talented poor and small enterprises that lack collateral, credit histories and connections, thus, limiting their opportunities and exacerbating inequality.

However, serious gaps in cross-country survey data about who has access to which financial services as well as about the barriers to broader access is a major impediment to our understanding of how reduced barriers and improved access affect household welfare. Continuing research in this area will expand our understanding of the relationship between improved access to finance and persistent inequality. This will in turn, inform the design of policy interventions to build more inclusive financial system

actually have access, whereas some other nonusers do not. For a classification of dimensions of access to finance refer to chapter Fernando (2007).

Conclusions

This thesis examined the reaction of monetary policy to income inequality as well as the relationship between income inequality, asset prices and financial development. Previously, income distribution and monetary policy were considered as separate issues. However, this view has recently been challenged after the global recessions of 2007 to 2009. The last six years witnessed the use of expansionary monetary policy stance in most developed countries to navigate their various economies out of the global recessions into recovery. In the U.S. for instance, the Fed used a combination of low interest rates environment and the unconventional monetary policy of quantitative easing to help the economy recover from the recession and reduce the unemployment rate.

Available evidence showed that such expansionary policy stance has contributed to the growth in income inequality. The low interest rates over the crises period have significantly benefited high income households because of the increase in the price of their large holdings of corporate stocks, due for the most part, to low interest rates. Low income households did not benefit. Indeed, low income earners may suffer to the extent that stock market boom results to a shift in the allocation of national income from labour to capital.

Our literature search showed that the richest 1% of Americans have seen real income gains of 31% since after the global recessions, while the poorest bottom 99% have gained less than 1%. This is because the richest 1% of the population gets much of their income from the financial markets either in the form of wages or stock ownership. Low income households have no assets so they get no returns from financial assets price booms and are often the worst hit form asymmetric monetary policy reaction to asset prices. Consequently, previously independent factors- income distribution and monetary policy are now considered interrelated. The current thesis was motivated by these developments and attempted to investigate the response of monetary policy to income inequality and the relationship between income inequality, asset prices and financial sector development, using a range of econometric and theoretical frameworks. In what follows is a summary of our main findings and potential policy implications.

Chapter 2 examined the response of monetary policy to income inequality within the context of a forward looking Taylor rule monetary policy reaction function. The rule takes the nominal short term interest rate (r_t^*) as the monetary policy instrument and predicts that it should increase if inflation (π_t) increases above its target range (π^*). In equilibrium, the deviation of inflation and output from their target values is zero and

therefore, the desired interest rate is the sum of equilibrium real rate plus the target value of inflation.

In that chapter, we focused on the response of the short term interest rate to changes in income inequality. Our principal innovation to the standard specification is the inclusion of three measures of income inequality namely, Gini index of income inequality, average income share going to the top 1 percent income earners and 90/10 wage differential ratio. A major motivation for the inclusion of these measures of income inequality in the Fed's reaction function is to test the inequality transmission mechanism proposed by Areosa and Areosa (2006). This channel implies that the objective of a monetary policy that is consistent with welfare maximization should include inequality stabilization as well as inflation and output gap stabilization. According to them, monetary policy influences both output gap and inequality which in turn affect inflation. We used quarterly data from the United States covering the period 1960-2009. The results suggested that monetary policy authorities in the U.S do take into account changes in income inequality when calibrating their policy stance, however, this reaction is dependent on the proxy used to measure income inequality.

Specifically, we found no evidence of monetary policy reaction to income inequality measured using the GINI index of inequality and the 90/10 wage gap. Conversely, for the top 1 percent income model we found a positive and statistically significant reaction, similar to the reaction of monetary policy to asset prices particularly equities. This finding is invariant to the use of an alternative measure of monetary policy- the three month Treasury bill as well as the unemployment rate as a measure of economic activity as opposed to the frequently used output gap. The Federal Reserve's reaction to income of the top 1 percent seems to be an indirect reaction to stock prices given that the income of this group of earning population correlates closely with the S&P 500 stock index as we have shown in this thesis. Available evidence suggests that increasing inequality combined with higher household debt, can trigger financial and real sector crises and both outcomes are a cause for concern for Federal Reserve with potential significant impacts on their transmission mechanisms as well as price and financial stability. To test the structural stability of our findings we reduced the sample size starting from 1984 to 2007 that marked the periods of the great moderation characterized by low inflation, strong economic growth, low macroeconomic risk and high income inequality.

The sub-sample analysis considered the potential reaction of monetary policy to the income of the top 1 percent during the 'great moderation' era until the on-set of the global

financial crisis in the second quarter of 2007. The results from the sub-sample model suggests that the Fed during the great moderation periods and before the start of the 2007 great recession observed changes in our measure of income inequality in setting the policy rate. In principle, a positive and significant reaction to the income of the top 1 percent indicates both interest rate cuts in times of sustained income decreases and rates hikes in times of sustained income increases. Using a state dependent dummy variable, we sought to find out whether the interest rate setting of Fed differs during periods of sustained increase and decrease in the income of top 1 percent income earners. The result revealed the presence of asymmetry in the response of monetary policy to the income of the top 1 percent income earners. This is because although monetary policy tightens during periods of prolonged income increases, the Fed did not increase interest rates high enough to curb the increase in income as they would cut rates in the event of a decline in income. This finding is similar to the sort of monetary policy asymmetric reaction to stock prices. Consequently, we concluded that the financial asset price channel could be the link between monetary policy and income inequality measured using the top 1 percent income share.

In chapter 3, we turned our attention to the relationship between income inequality and asset prices. First, we evaluated the causal relationship between the income share of the top 1 percent and bottom 90 percent and the stock market. The Austrian economists identified the portfolio channel as one of the channels through which changes in monetary policy can affect income inequality. According to the Austrian perspective the portfolio channel implies that high income households, with large concentration of financial assets gain more from asset market booms orchestrated by expansionary monetary policy. Consequently, developments within the financial asset markets should have a significant impact on the income of households within the top spectrum of the income distribution. Using data from the United States spanning the periods 1967 to 2012, we wanted to find out empirically if there is some sort of endogeneity in financial market development and the income of the top 1 percent.

The results from the causality tests revealed a unidirectional causality from stock returns to changes in the income share of the top 1 percent. We found no evidence of directional causality between stock returns and income of the bottom 90 percent either way. The absence of a significant causal relation between the two variables seems to suggest that development within the stock market does not have any effect on the income of the bottom 90 percent workers. Therefore, government policies that are targeted towards

stimulating the financial markets will have no associated effect on the bottom 90 percent income earners. In addition, we also analyzed the relationship between asset prices and income inequality. Using the Generalized Methods of Moment (GMM) estimator we examined the reaction of inequality measured using the income share of the top 1 percent, the bottom 90 percent and the lowest fifth percent households to changes in asset prices. Our task here is to examine whether changes in both financial and non-financial assets affects everyone in the top and bottom of the income distribution the same way, or if there are remarkable differences on how these variables affect individuals within the top and bottom income percentiles. To achieve our objective, we specified a parsimonious model for household income at the selected percentiles as a function of six factors (6 covariates): financial assets (stock returns), non financial assets (returns on house prices), bond yields, macro-economic factors (unemployment rate and inflation), education premium and a time trend.

The results from the GMM regressions showed that the effect of stock returns on the low income percentiles is statistically insignificant. However, we found that changes in stock returns have a significant impact on income of the top 1 percent households. This finding is not surprising given that the ownership of stocks is heavily concentrated at the top of the income distribution, thus providing support to the portfolio channel. The finding of unidirectional causality from stock market to the income of the top 1 percent, as well as a significant reaction of stock prices to the top 1 percent income spectrum, seems to suggest that monetary policy reaction to the income of the top 1 percent could be their reaction to stock prices. A major policy implication of this finding is that the inherent asymmetry in "mopping up" after a burst in asset price bubble will worsen the rising income disparity between high and low income earners through steep increases in stock prices. This kind of policy action could be destabilizing.

In chapter 4 we focused our attention on the relationship between financial sector development and income inequality. Our dataset comprised 91 countries classified according to the income categories defined by the World Bank (high-income, middle-income, and the low income countries). To analyze the link between financial sector development and income inequality, we used standard proxies in the financial development literature, namely the ratio of private credit to GDP, bank deposit to GDP and stock market capitalization to GDP as measures of financial development and the GINI coefficient of net and gross income distribution within countries as well as income share of the top 1 percent as measures of income inequality.

Using a broader datasets and controlling for time-invariant country specifics using Arellano and Bond (1991) differencing and Arellano and Bover (1995) orthogonal deviations, the results suggest that in majority of the countries under investigation, financial development leads to a reduction in income inequality. With regards to financial development and income inequality which is the main focus of this chapter, the impact of financial development on income inequality depends on the dimension of financial development one is considering. Looking at the effects of financial development measured using private sector credit to GDP on gini index of net income inequality; we found inequality reducing effect of financial development across all the three different income groups' table 4.5b columns, 2, 3 and 4. Using credit to private sector as a measure of financial development and gross income inequality, we confirmed the inequality reducing effect of financial development within the middle and low income categories only while the effect for the high income economies is insignificant-see table 4.6a. However, using a different measure of financial sector development namely bank deposits to GDP, we found that the previous finding of inequality reducing effect of financial sector development within the middle and the low income countries is upheld.

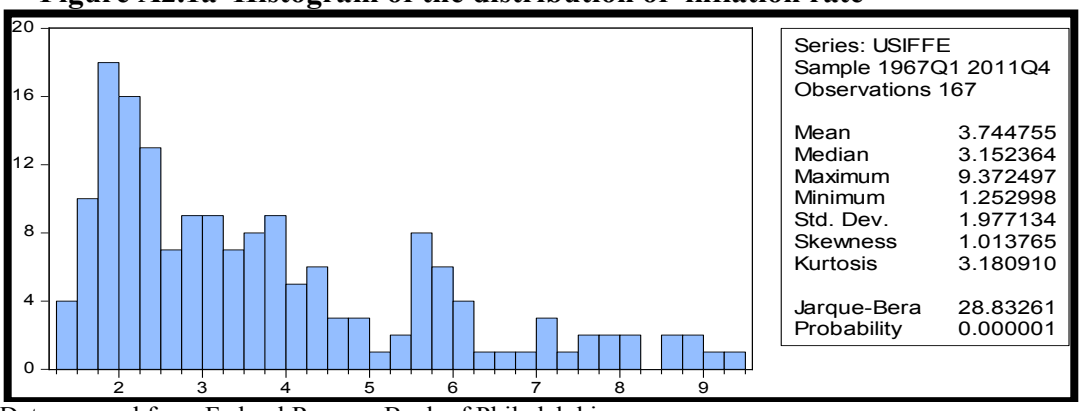
In addition, we analyzed the impact of financial development on income inequality using the income of the top 1 percent income earners to proxy for inequality in seven of the countries included in our dataset. We used the Arellano and Bond (1991) dynamic panel GMM estimator and found that the effect of financial development (measured using credit to private sector as a ratio of GDP) on the top 1 percent is negative and significant in the linear term. Specifically, we observed that a one percent increase in credit to private sector will reduce the income of the top 1 percent of the population by 0.07 percent. Looking at the quadratic term, we observed a positive and statistically significant relationship between the income of the top 1 percent and this measure of financial sector development. This result seems to suggest that private sector development after a certain threshold starts to favour disproportionately households within the top income spectrum.

Using a different dimension of financial development stock market capitalization to GDP we found that increasing the depth of the stock market; will reduce the income of the top 1 percent thus narrowing the income gap between the top 1 percent of the population and the rest within the countries included in this analysis. However, the problems in measuring financial development, particularly, the degree to which households-especially the low income ones-have access to the financial system is an area for future research. For instance, the extent to which low income earners have access to the banking system, can be

captured using key indicators like; the number of banks in rural areas, or the number of SME/micro loans from banks and microfinance institutions. However, these data are not easily available in developing countries.

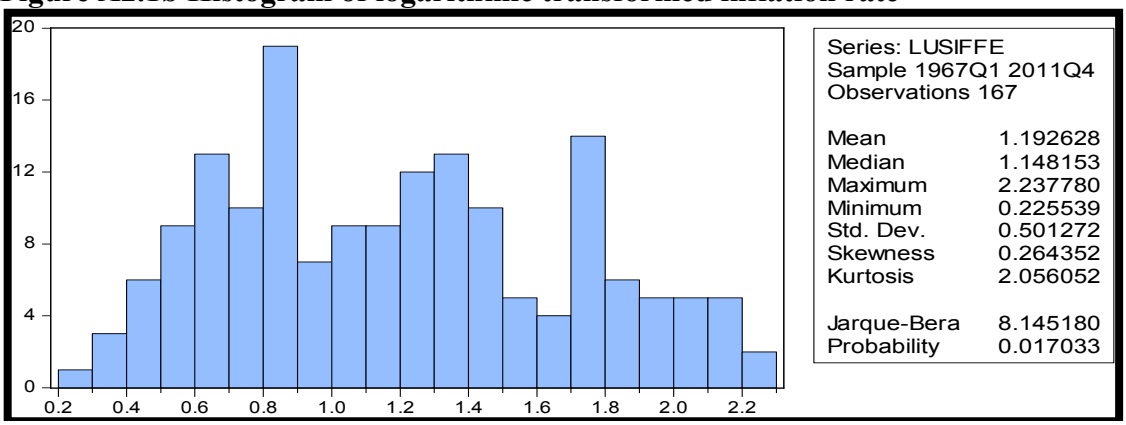
Chapter 2 Appendix

Figure A2.1a Histogram of the distribution of inflation rate



Data sourced from Federal Reserve Bank of Philadelphia

Figure A2.1b Histogram of logarithmic transformed inflation rate



Data sourced from Federal Reserve Bank of Philadelphia

Chapter 3 Appendix

Table A3.1 Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1511.70	NA	206448.8	17.95	17.95	17.93
1	-1323.86	369.01	23440.04	15.74	15.85	15.78
2	-1294.39	57.19*	17341.63*	15.44*	15.62*	15.51*
3	-1290.98	6.53	17464.71	15.44	15.70	15.55

Notes

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

Chapter 4 Appendix

Table A4.1 Countries included in the analysis

High Income Countries	**Number of Gross and Net GINI observation**
Australia	46
Austria	25
Bahamas	32
Barbados	12
Belgium	35
Canada	37
Croatia	19
Cyprus	11
Czech Republic	21
Denmark	37
Estonia	27
Finland	35
France	36
Germany	41
Greece	40
Hong Kong	30
Hungary	39
Iceland	5
Ireland	29
Israel	31
Italy	41
Japan	41
Korea Republic	37
Latvia	27
Luxembourg	23
Malta	8
Netherlands	34
New Zealand	47
Norway	35
Poland	39
Portugal	29
Singapore	30
Slovak Republic	21
Slovenia	21
Spain	30
Sweden	48
Switzerland	23
Trinidad and Tobago	18
United Kingdom	49
United States	49
Upper Middle Income	
Argentina	39
Botswana	10
Brazil	36
Bulgaria	44
Chile	29
Colombia	35
Cost Rica	35
Dominican Republic	32
Iran	13
Jamaica	32
Kazakhstan	26
Lithuania	27
Macedonia	18

Malaysia	32
Mauritius	27
Mexico	36
Panama	32
Peru	32
Romania	18
Russian Federation	26
South Africa	34
Turkey	30
Uruguay	28
Venezuela	32
Lower Middle Income	
Armenia	21
Bolivia	13
Cameroon	19
Cape Verde	14
Cote d'Ivoire	26
Ecuador	22
Egypt	31
El Salvador	33
Georgia	25
Guatemala	28
Honduras	19
India	38
Indonesia	34
Jordan	24
Lesotho	14
Moldova	26
Morocco	29
Nigeria	27
Pakistan	37
Paraguay	13
Philippines	32
Senegal	14
Sri Lanka	27
Thailand	31
Tunisia	29
Vietnam	12
Yemen	14

Source: World Bank database

Gross and net GINI income inequality for some selected high income countries

Figure A4.1 GINI gross and net income inequality (USA)

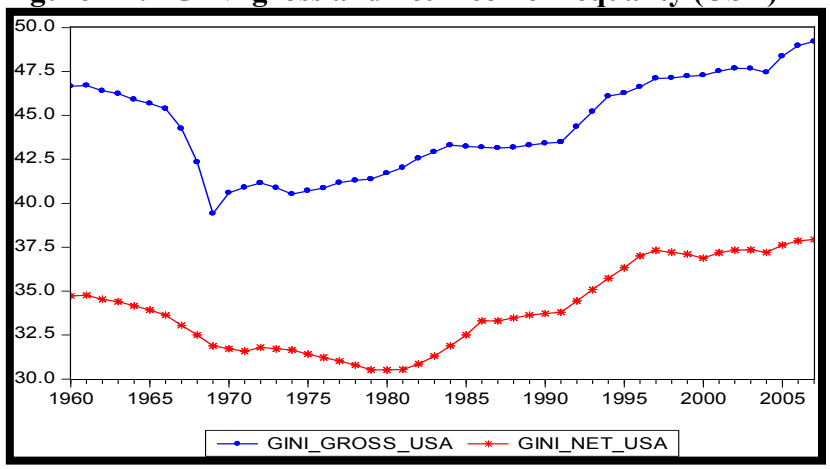


Figure A4.2 GINI gross and net income inequality (UK)

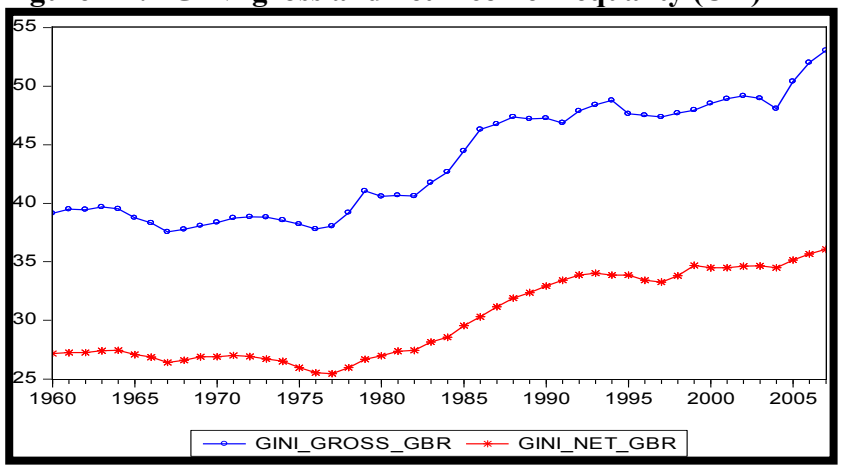


Figure A4.3 GINI gross and net income inequality (Sweden)

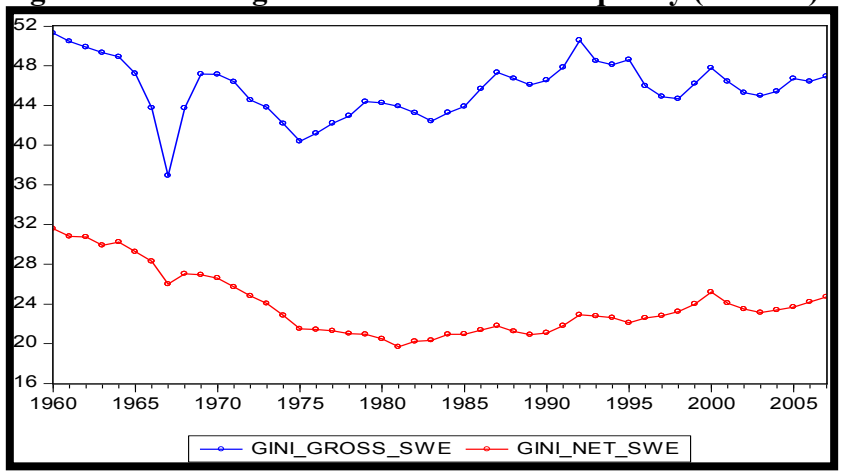
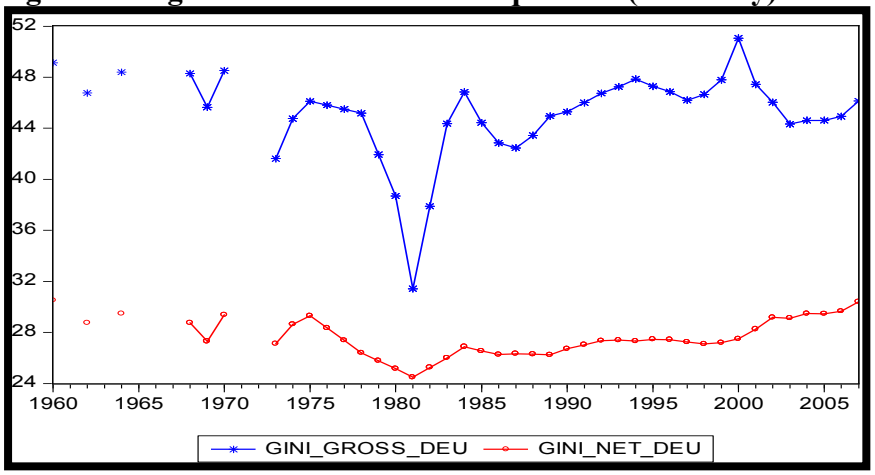


Figure A4.4 gross and net income inequalities (Germany)



Gross and net GINI income inequality for some selected upper middle income countries

Figure A4.5 gross and net income inequalities (Brazil)

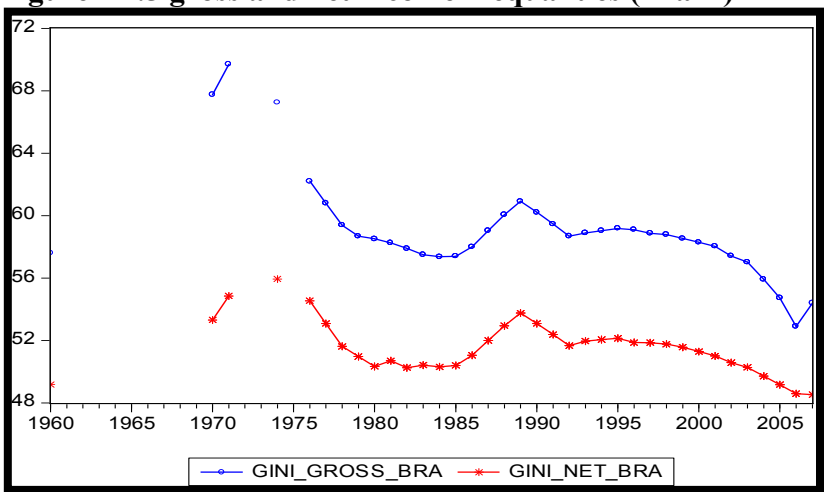


Figure A4.6 gross and net income inequalities (Jamaica)

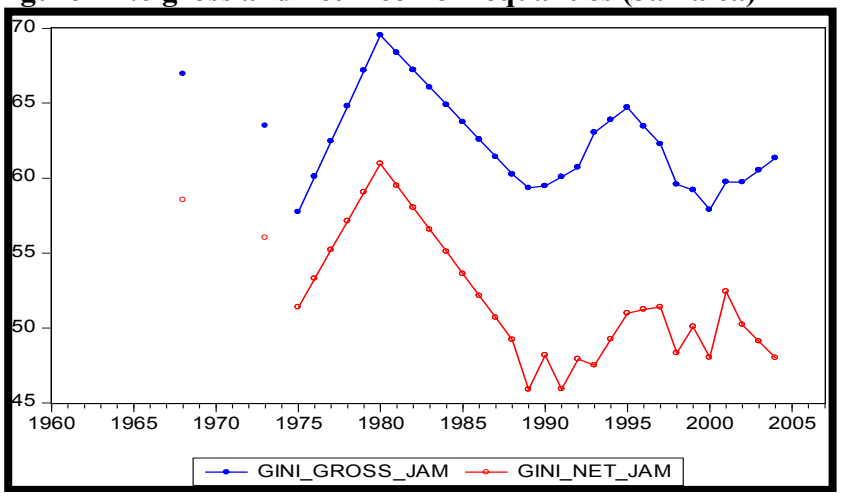


Figure A4.7 gross and net income inequalities (Malaysia)

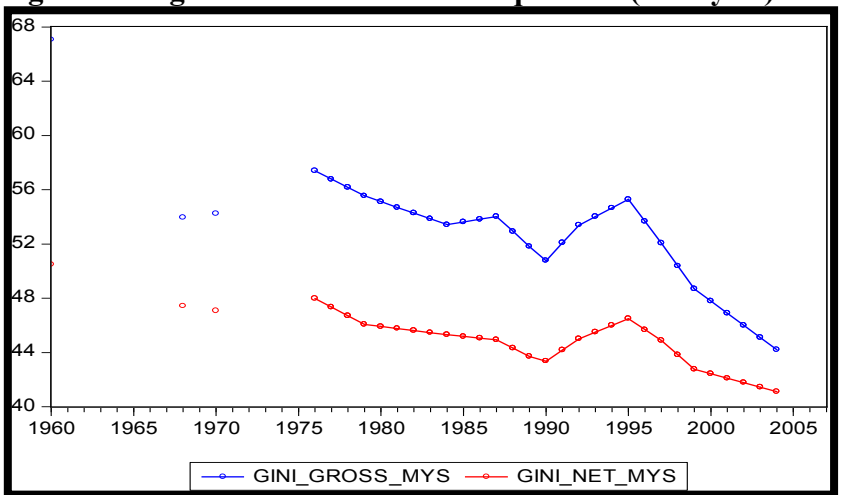
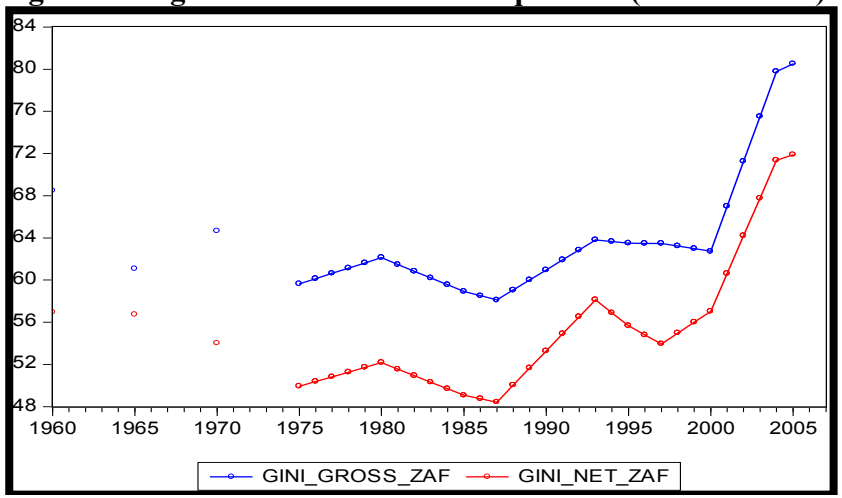


Figure A4.8 gross and net income inequalities (South Africa)



Gross and net GINI income inequality for some selected lower middle income countries

Figure A4.9 gross and net income inequalities (Bolivia)

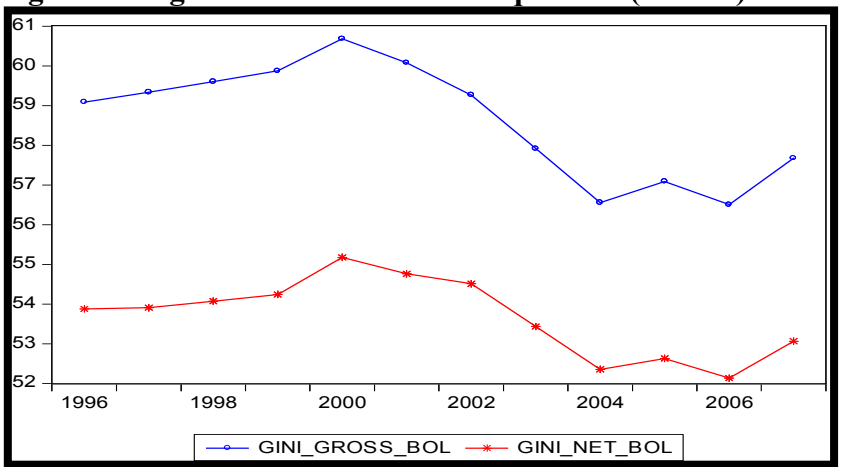


Figure A4.10 gross and net income inequalities (Ecuador)

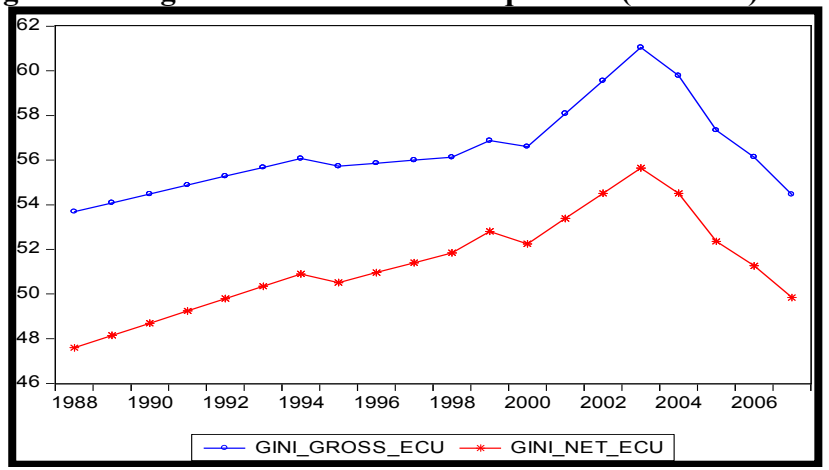


Figure A4.11 gross and net income inequalities (Honduras)

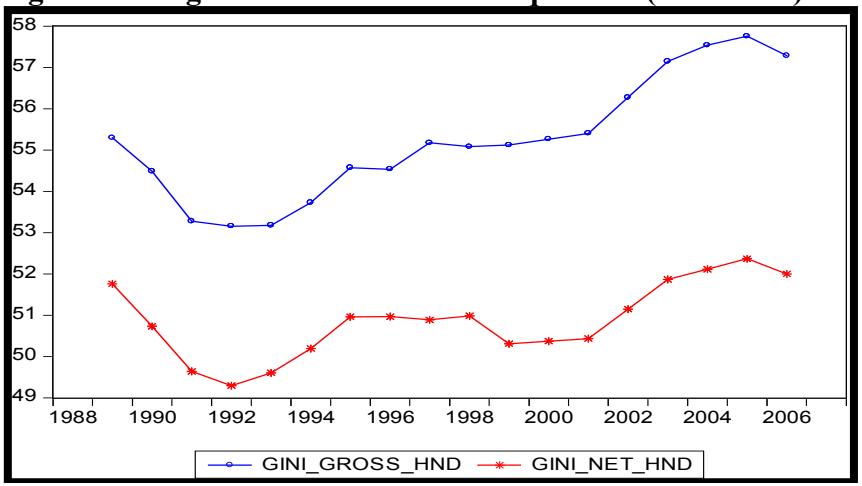


Figure A4.12 gross and net income inequalities (Paraguay)

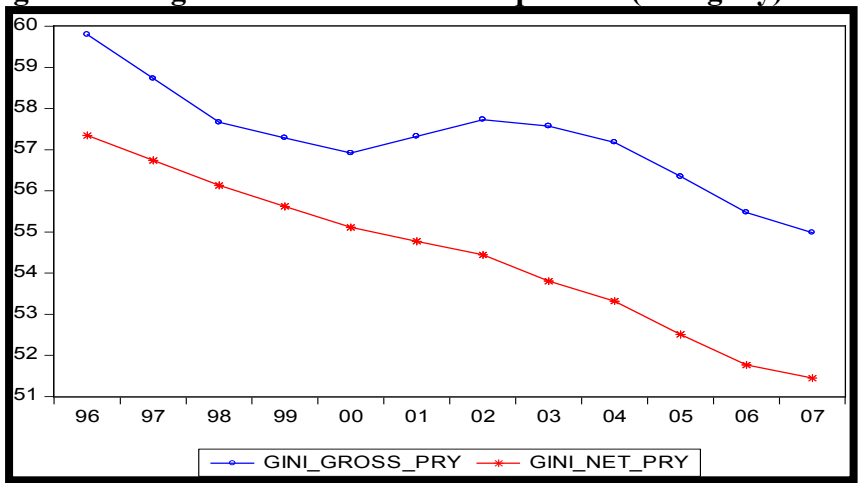


Figure A4.13 Top 1 percent income shares in the target countries

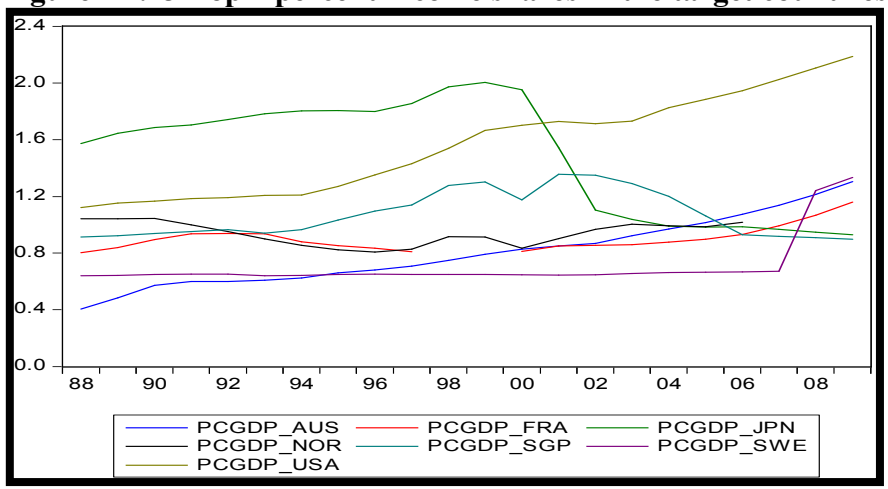


Figure A4.14 private credits to GDP in target countries

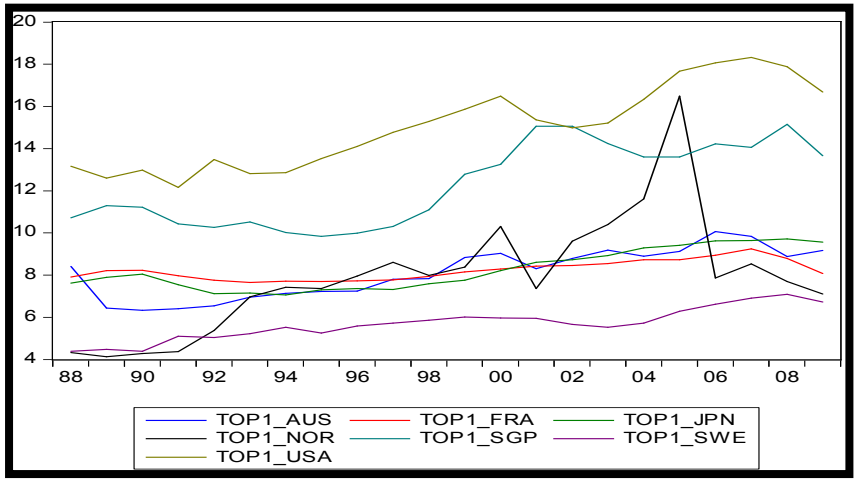
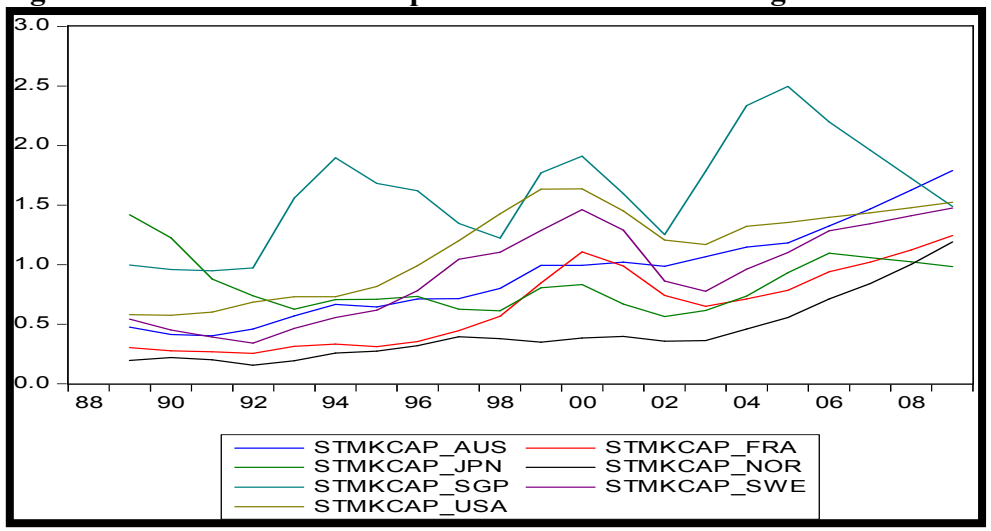


Figure A4.15 Stock market capitalizations to GDP in target countries



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