MONETARY POLICY AND INCOME INEQUALITY IN GHANA

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ESKİŞEHİR OSMANGAZİ UNIVERSITY

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ABSTRACT

MONETARY POLICY AND INCOME INEQUALITY IN GHANA

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The rise of inequality particularly income inequality in recent times has kept all stakeholders including policy makers, academic researchers and civil society organisation worried. This has resulted in the rise in interest regarding the various causes of economic inequality in general and income inequality in particular and how it can be curbed. Monetary policy, even if minimal and uncertain regarding the direction of causality, has been identified as one of the causes of income inequality especially in developed countries.

The purpose of this study is to investigate the impact monetary policy has on income inequality in a financially underdeveloped developing country, Ghana. In this study, the income Gini for the period 2002Q1 to 2013Q4 and the monetary policy rate for the same period are used. Also, the inflation rate, foreign exchange rate, the financial development index and GDP growth are used to control for their impact on inequality that may be ascribed to monetary policy.

Two estimations, the baseline estimation and the robustness check estimation, are made regarding the causality from monetary policy and income inequality. The baseline estimation employed a Vector Error Correction Model and the robustness check estimation employed the Impulse Response Functions (IRFs) by local projections methodology which is robust to misspecification.

From the IRFs by local projections, which is the preferred model, it is concluded that contractionary monetary policy leads to an increase in income inequality in Ghana marginally.

Keywords: Monetary policy, Income Inequality, Gini Index, Ghana

ÖZET

GANA'DA PARA POLİTİKASI VE GELİR EŞİTSİZLİK

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Eşitsizliğin yükselişi özellikle son zamanlarda gelir eşitsizlik, politika yapıcılar ve sivil toplum örgütleri de dahil olmak üzere tüm paydaşları endişelendiriyor. Bu, ekonomik eşitsizliğin çeşitli nedenleri ve bunun nasıl engellenebileceği konusunda ilgi artışına neden oldu. Para politikası, nedensellik yönüne ilişkin asgari ve belirsiz olsa bile, özellikle gelişmiş ülkelerde ekonomik eşitsizliğin sebeplerinden biri olarak belirlenmiştir.

Bu çalışma, finansal olarak gelişmemiş ve gelişmekte olan bir ülke olan Gana'da para politikasının gelir eşitsizliği üzerindeki etkisini araştırmaktadır. Bu çalışmada, 2002 yılının ilk çeyreğinden 2013 yılının 4. çeyreğine ait Gelir Gini Endeksi ve aynı dönemde para politikası oranı kullanılmıştır. Ayrıca, enflasyon oranı, döviz kuru, finansal kalkınma endeksi ve GSYİH büyüme oranı, kontrol değişkenleri olarak kullanılmaktadır.

Para politikasının gelir eşitsizlik üzerindeki etkisine ilişkin iki tahmin yürütülmektedir. Bunlar temel tahmin ve sağlamlık kontrol tahminidir. temel tahmininde Vektör Hata Düzeltme Modeli (VECM) kullanıp Sağlamlık kontrolü tahmini ise, Yerel İzdüşüm Etki Tepki Fonksiyonlar (IRFs) kullanıldı. Yerel İzdüşüm Etki Tepki Fonksiyonları (IRFs) yanlış tanımlanmasına karşı dirençli olduğu için tercih edilir. Yerel İzdüşüm Etki Tepki Fonksiyonlara göre daralma para politikası, marjinal olarak, Gana'da harcanabilir gelir eşitsizliğinde bir artışa yol açtığı sonucuna varıldı.

Anahatar Kelimeler: Para Politikası, Gelir Eşitsizlik, Gini Endeksi, Gana

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LIST OF ABBREVIATIONS

BoG : Bank of Ghana
B : Bonds
E.U : European Union
FDI : Foreign Direct Investment
Fed : Federal Reserve of America
find : Financial Development Index
g : Gini Index
GDP : Gross Domestic Product
H : Human Wealth
i_e : expected interest rate
i : interest rate
I : Investment
IFS : International Financial Statistics
IMF : International Monetary Fund
inf : Inflation
LHS : Left Hand Side
M : Money Supply
mpr : monetary policy rate
NH : Non-Human Wealth
OECD : Organization of Economic Cooperation and Development
PCHIP : Peace Wise Cubic Hermite Interpolation Polynomial
P_e : Prices of Equity
R : Resources
r : Rate of Return
reer : real exchange rate
RHS : Right Hand Side
SADA : Savana Accelerated Development Authority
SDGs : Sustainable Development Goals
SWIID : Standardized World Income Inequality Database
TUİK : Türkiye İstatistik Kurumu
U. K : United Kingdom
U.S : United States
W : Wealth
WDI : World Development Indicators
Y : Income/Output

DEDICATION AND ACKNOWLEDGEMENT

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INTRODUCTION

Global economic inequality is claimed to have reached alarming proportions with a clear rise in economic duality in many countries. Even in most developed countries that inequality ought to have fallen per extant economic theories, inequality seems to be on the rise. This has resulted in researchers looking at the possible impact of hitherto unconventional causes of economic inequality. One of these perhaps unconventional sources of economic inequality in general and income inequality in particular is monetary policy.

This has resulted in an increased number of studies attempting to establish the possible impact and direction of monetary policy on economic inequality in general and income inequality in particular. These studies however, are largely for advanced and to some extent emerging economies within the OECD league of countries to the neglect of developing economies of Africa in particular. Perhaps the neglect of developing countries in the study of economic inequality in general and the impact of monetary policy on economic inequality in particular is due to data unavailability.

The purpose of this study is to make use of the available inequality data from the Standardised World Income Inequality Database (SWIID) to determine if monetary policy does affect inequality in Ghana. This will be helpful in understanding the dynamics of inequality and the impact monetary policy has on income inequality in a financially underdeveloped developing economy like Ghana.

The study is organised into four chapters. In Chapter One, economic inequality is discussed. In particular, the concept of inequality, economic inequality and its measurements are discussed. Also, the theoretical trends of inequality, i.e. how previous economic theories have predicted economic inequality will behave in line with economic development or some form of it is discussed. The chapter also includes a survey of the state of some regional and country specific inequalities and is concluded with some determinants of economic inequality.

In Chapter Two, a brief overview of money and monetary policy is discussed. Since the conduct of monetary policy is based on the monetary policy regime and the monetary theory most favoured by the monetary authority in question, monetary policy

regimes and the various monetary theories of the various economic schools of thought are discussed. The chapter then sheds some light on monetary transmission by discussing the channels through which monetary policy impact on real economic activity and distribution with accompanying survey of the available empirical literatures.

Chapter Three is where the data and methodology of the empirical study are discussed. Specifically, the data and data transformations methods, stationarity checks, and the methodology used in testing for the short-run and long-run effects of monetary policy and the other variables on income inequality in Ghana is discussed.

Chapter Four presents and discusses the results in comparison to previous empirical studies on the subject and what could account for similarities or differences in results if they so exist.

The study is then concluded with the implications for Ghana and some weak recommendations on how to reduce the impact of monetary policy on economic inequality in Ghana are made.

CHAPTER 1

ECONOMIC INEQUALITY

In this chapter, the concept of inequality is introduced. A brief comment on economic inequality and how economic inequality is measured is made. The theoretical trends of inequality and the state of global and regional economic inequality is reviewed. The chapter is concluded with some determinants of inequality as found in the literature.

1.1. THE CONCEPT OF INEQUALITY

Inequality is the partitioning of society into different groups based on which these different groups are accorded different rights, privileges, opportunities, responsibilities or some form of it. In 'The Republic' by Plato, inequality is justified by the noble lie which associates societal status to creation itself. The concept of the noble lie is as captured in the following paragraph.

'So, god in fashioning out those who are competent to rule mixed gold in at their birth; this is why they are most honoured; in auxiliaries, silver; and iron and bronze in the farmers and the other craftsmen ……. there is an oracle that the city will be destroyed when an iron or bronze is made its guardian' (Plato, 1991:94)

This 'noble lie' was used to not only justify the status of the rulers as being ordained by the gods to rule but also to ensure that the status quo of 'born unequal' is never questioned. Some form of this noble lie could be said to have been/be the underpinning philosophy of the slave trade, the holocaust and racism where it was/is thought that a particular race is supposedly made of the bronze and iron and are naturally obliged to labour for the gold race or to say the least (i.e. the gold race) should be given precedence over the bronze and iron races which are supposedly less valuable. This social stratification in status is a corollary for the inequality of rights and opportunities in education, health, gender, income, wealth, employment and all other forms of inequality imaginable.

Mention must be made of the fact that in the utopian form of the noble lie, status mobility is made to sound straight forward and meritorious allowing people of

guardian parentage to become auxiliaries or farmers if they so tend out to be of an admixture of silver or of iron and bronze. In reality however, intergenerational transfer of status particularly in wealth is the norm. Feiveson and Sabelhaus (2018) found intergenerational transfer of wealth to be a key explanatory factor of wealth concentration with the transfer being directly through inheritance or indirectly through access to say, better education. Political power has also been seen transferred through family lines perhaps due to the grooming accomplished politicians give to their children and perhaps also without merit but rather through their networks. In countries like Togo, Kenya and Congo, political power has been passed down from father to son with the sons largely reaching those feet due to their parentage.

Inequality is not just a latent concept that goes without repercussions. It is noted by Sen and Foster (1997) that the relationship between inequality and rebellion is a close one. Beyond the common knowledge that a perceived sense of inequality is a common ingredient of rebellion, it is important to recognize that the perception of inequity depend substantially on possibilities of actual rebellion (Sen & Foster, 1997). In Krugman (2013), it is noted that the crucial role of inequality in economic calamity has been political. This goes to underscore Sen's argument that equity, or say, a sense of equity is essential if the political structure is to be stable. This is given support by Nimeh (2012) who invokes the rentier state theory and the level of unemployment among the youth to suggest that inequality could actually have been a contributing factor to the Arab Spring that led to the overthrow of governments and civil wars that has since destabilised the region.

The impact of inequality goes beyond the political. Pickett and Wilkinson (2009) warn of the dire consequences of inequality on crime and mental health of a citizenry irrespective of the level of development and/or wealth. For all this reason, all forms of inequality be it in political, legal or economic rights and opportunities ought to matter. This has triggered several interventions and changes in country specific laws, civil movement campaigns and international accords to tackle inequality with successes in some areas. The suffragist and the civil rights movements in The West and in America for the rights of women to have equal voting rights as their male counterparts and the right of African-Americans to enjoy full rights as citizens of America are some of such measures that have largely been successful.

In Ghana, the North-South divide in terms of infrastructure and development has seen successive governments implement several programs and policies aimed at bridging the developmental gap (Asante & Gyimah-Boadi, 2004). Some of these programs are the several development programs by the Kwame Nkrumah regime[1], the one year development plan by the Busia regime[2], the Ghana Vision 2020[3] by Jerry Rawlings regime among others.

Globally, the United Nations has taken as a priority the fight against poverty and inequality with the adoption of the Sustainable Development Goals (SDGs). The agenda of the sustainable development goals is to achieve some 17 targets called SDGs by 2030. Among these, goal 10 is exclusively on reducing inequality within and among countries. This is captured as a specific measurable goal in section 1 of goal 10 as progressively achieving and sustaining a higher rate of income growth of the bottom 40 per cent of the population than the national average by 2030 (Assembly, 2015).

Despite the hullabaloo of the dangers and how unequal our world has become, Michael Tanner of CATO institute labels the inequality problem as "exaggerated". The supposed increasing trend of inequality as suggested by Thomas Piketty in his famous book; "Capital in the 21st century" (which has been criticised by writers like Vaknin (2014) among others) has been disputed with the argument that, "too much of the debate over economic inequality has been driven by emotions and misinformation" (Tanner, 2016). Another argument against the charged discussions on inequality is that people do not despise inequality as such but rather they despise unfairness (Starmans, Sheskin, & Bloom, 2017). This despise of unfairness should thus not be taken as despise of inequality.

Philosopher, Harry Frankfurt thinks equality has no inherent value whatsoever though he concedes that demands for equality usually have strong rhetorical force and that their impact on our emotions and our thinking are almost irresistible (Frankfurt,

[1] Kwame Nkrumah was the first president of Ghana upon independence. Under his administration, two development programs with the 1963 seven-year development plan, was promulgated to restructure the Ghanaian economy and tackle inequality of the newly formed country.
[2] Kofi Abrefa Busia was the leader of government business from 1969-1972. Under his administration, a one year development plan was promulgated to span from July 1970 to June 1971 to reduce the essential amenities gap of the country.
[3] The Ghana Vision 2020 by the Rawlings administration is a policy document aimed facilitating the socio–economic and human development of Ghana. Among the key highlights was the need to tackle the inequality problem.

1987). But why this irresistibility of our emotions and thinking to the arguments against inequality? This can be thought of as a rational reaction to the hypothetical risk of picking a losing ticket in the lottery of life (Cowell, 2011). The larger the inequality (i.e. the variance across different groups in society), the riskier that picking a losing ticket will be unbearable. Besides, altruism is not as scarce as economist want us to believe and in all aspects of life; economic, political and social, these altruistic instincts will and do strike most people to see extreme inequality in any form as being wrong.

Inequality, particularly economic inequality and its link with poverty has been extensively researched and written about. It is asserted in an Oxfam report authored by Hardoon, Fuentes-Nieva, and Ayele (2016) and titled Economy for the 1% that, the richest 1% now have more wealth than the rest of the world combined. It is further alleged that, the richest use privilege and power to skew the economic system to their advantage further increasing the gap and that, global tax havens aid the richest to hide $7.6 trillion. On poverty, it is claimed that the fight against poverty will only be won if the inequality crises is tackled.

In our era, the most pervasive form of inequality is economic inequality and its relationship with all other forms of inequality is strongly correlated. This has made economic inequality the dominant and most studied aspect of inequality.

1.2 ECONOMIC INEQUALITY

Economic inequality is the variance in individual economic resources, opportunities and outcomes with others having more resources and better opportunities resulting in a better standard of living due to some initial advantage that the rest lacks for no fault of theirs. In other words, economic inequality is the disparities in income, wealth, consumption and in fact, employment opportunities with some class of people being favoured for some other reasons other than based on merit. The diversity in the conception of what amount to economic inequality can be zeroed down to normative judgements regarding what economic arrangement enhance social welfare (Sen & Foster, 1997).

For socialist, inequality arises from private ownership, which result in the investment class benefiting unfairly from the labour of the proletariats. However, it is

argued by Henderson, McNab, and Rózsás (2005) that, the real value of privileges which are immense in a socialist state like the then Soviet Union and corruption among other factors equally fuels inequality in a socialist state with central planning. Meritocrats view equality as a state where individuals' shares of income, wealth, consumption and economic opportunities are as a result of their effort and/or talent rather than by the virtue of race, creed or political influence. This is seen as ingraining inequality by Littler (2017). For even though social justice and fairness like meritocracy requires that riches be spread in such a way as to recognise efforts and talent, pure meritocracy will result in the success of one generation in accumulating wealth meritoriously being hoarded and transferred to their descendants unmeritoriously and that initial head start will create a sequence of rich generations (Giddens, 2005) and by implications poor generations. Social justice requires that inherited wealth and high income be redistributed more aggressively (Giddens, 2005)

In economics, questions that require judgement as to what is right or what enhances social welfare are termed normative questions and answers to such questions are normally controversial and subjective. Suppose three children, Kofi, Elorm, and Dasana are having a scuffle about a straw flute as to who should own it and an adult is called upon to resolve the skirmish. First however, they all must defend their claim. The explanation given by Kofi is that the only one capable of playing the flute is himself and thus he will put the flute to best use. Elorm claim is by the virtue of his labour since he made it and it is argued by Dasana that, among all three, he is the poorest with no toys and playtime stuff and the flute will at least give him something to play with. Under this circumstance, should the focus be on ensuring equality of welfare as in the number of play stuffs each child has, should some inequality arising as a result of extra effort, i.e. with regards to who made it or skill, i.e. the ability to play the flute should be the mainstay in determining the ownership? Under this circumstance, the utilitarian, the economic egalitarian and the no-nonsense libertarian might see a solution they think is quite obvious even though all of them are likely to arrive at different and contradictory solutions (Sen, 2009)[4].

For this, recent economic studies on inequality have stuck to positive studies hoping to establish the trend and/or relationship between inequality and other

[4] The context of this story is adopted from Sen (2009)

economic variables like growth, and stability by using some form of objective measures. Even under the positive studies, there is always the question, inequality of what? As is noted in Sen (1992), there is a plurality of variables (income, wealth, consumption and even opportunities) which can be taken as the focal variables in evaluating interpersonal inequality. This renders the making of hard decisions as to which perspective to adopt necessary. This choice of evaluative space is crucial to analysing inequality. The importance of the choice of a focal point in assessing inequality is due to the fact that inequality assessed based on different focal variables tend to differ due to the pervasive difference in human beings.

1.3 INCOME INEQUALITY

The selection of an evaluative space or focal point for the study of inequality are based on ethical considerations (theories) that are beyond the scope of this study. And as is noted in Sen (1992:19), 'Equality in what is seen as the 'base' is invoked for a reasoned defence of the resulting inequalities in the far-flung 'peripheries'. Thus, rooting for equality in some space permits and at times justifies inequality in some other space. For instance, inequality is defined by McKay (2002) as the variations in living standards across a population. Per this definition, the ultimate result of any distribution regardless of the actual distribution is chosen by McKay as the evaluative space of inequality. These types of definitions are said to be outcome based. These outcome-based definitions do matter even though most people might think the focus of inequality should be on inequality in opportunities which provide unfair playing field (Atkinson, 2015) and ultimately inequality in the outcomes. One variable that falls under these outcome-based definitions of inequality and it is extensively studied is consumption as in Attanasio and Pistaferri (2016), Lise and Seitz (2011), and Aguiar and Bills (2015).

In contrast to the outcome-based definitions of economic inequality like consumption are resource-based definitions which choose as their evaluative space variables like wealth and income. Among consumption, income and wealth, consumption does comply with the economist's notion of utility which is represented by consumption and leisure (Attanasio & Pistaferri, 2016) and since utility is used in measuring welfare, then consumption despite its data limitations should be the benchmark for evaluating any economic inequality.

Consumption is mostly less unequal than both income and wealth due to the possibility of borrowing or relying on saved income, and transfers from family or governments. The most widely used variable for measuring inequality is income though this has been criticized as being inappropriate and does not depict the true disparities in living standards which is supposed to be the focus of any inequality measure (Slesnick, 2001). Supposing the distribution of consumption at a given point in time is less wide than that of income, or if its evolution over time is smoother than that of income, then distinguishing between income and consumption could make a meaningful difference in analysing inequality (Attanasio & Pistaferri, 2016).

Intuitively, income inequality will result in wealth inequality since a high income household is likely to save more and increase the wealth stock. Income inequality and wealth inequality will then result in consumption inequality. This study thus uses income inequality as a synonym to economic inequality.

1.4 MEASURES OF INEQUALITY

Measurement in the broadest sense is the assignment of numerals to objects or events according to some rules (Stevens, 1946). Generally, a measure is either a ratio, cardinal, ordinal or nominal measure. The ratio measure is the strictest and highest scale of measurement (Sen & Foster, 1997) and arises if and only if there exist operations for determining all the four relations of equality, rank-order, equality of intervals and equality of ratios (Stevens, 1946).

The cardinal scale which is also termed the interval scale is a type of measure with defined intervals and arbitrary zero as the scale form remains invariant when a constant is added (Stevens, 1946). The ordinal scale is a ranking scale ranking different states from the lowest to the highest. This does not need any numerical representation whatsoever (Sen & Foster, 1997). This implies any order-preserving transformation will leave the ordinal scale unchanged and thus has the structure of the isotonic or order-preserving group (Stevens, 1946). The nominal scale which is the lowest scale of measurement merely group data into categories based on unifying qualities like rich and poor, literate and illiterate and the like.

Most measures of inequality have usually assumed high levels of measurement and this is true not only for the supposed objective measures but even for the normative measures (Sen & Foster, 1997). Thus, most measures of inequality employ a single numerical value that is supposed to capture the extent of equality or inequality. In line with this, inequality measure is defined by Cowell (2011p7) as a 'scalar numerical representation of the interpersonal differences in income within a given population' with the term 'income' replaceable by any focal variable of inequality say, wealth or consumption. Recent studies have proven that these scalar numerical representations of inequality can be related with social welfare functions to give these inequality measures explicit ethical connotations to render them more than just measures of dispersion (Fleurbaey, 2016).

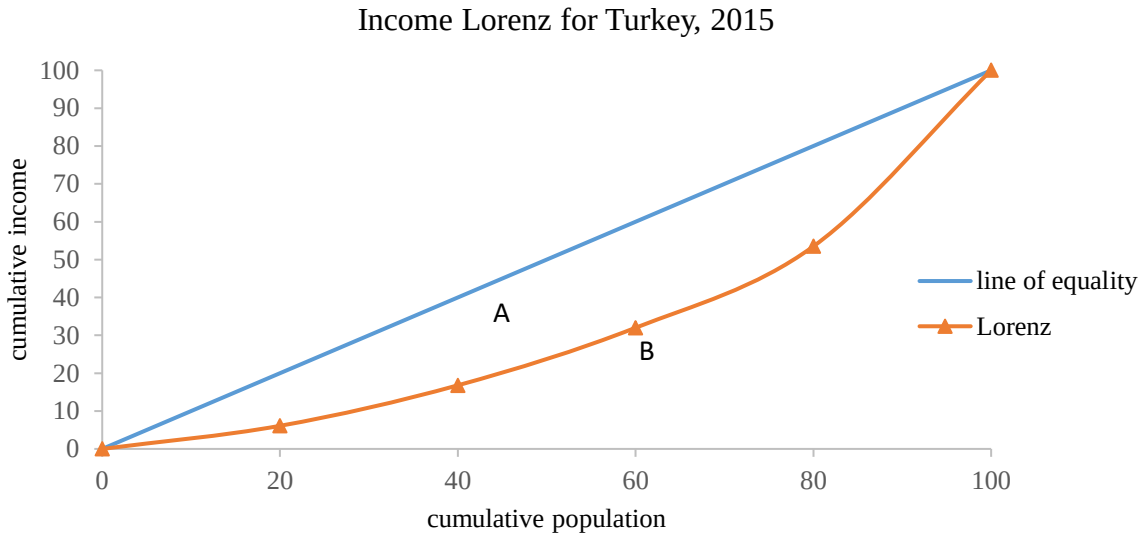
Supposing a basal variable has been chosen and data obtained, they are several measures that can be used to gauge the extent of inequality within or between groups. Some of these measures are; the Gini index, the Atkinson index, the Generalised Entropy class of indices and the Quintile Ratio. However, caution should be taken when interpreting these indices as a measure can hardly be more precise than the concept it measures (Sen & Foster, 1997) and the concept of inequality is quite evasive.

1.4.1 The Gini Index

Inequality in absolute terms is not an achievable goal and perhaps not even ideal. Instead, inequality is better discussed in relative or proportionate terms and if the interest is proportions, then the Lorenz Curve is the most simple and convenient graphical method of determining distributional inequality (Dalton, 1920). The Lorenz curve uses the cumulative share of total income (or any other basal variable for inequality for that matter) earned by a cumulative percentage of the population. In a perfectly equal society, 20% of the population will receive 20% of the income, 40% of the population will receive 40% of the income and so forth. This in the Lorenz Curve is represented by the line $x = y$ or a 45-degree line. In the presence of inequality however, there is a mismatch between the cumulative population and the cumulative income share they receive leading to a deviation of the Lorenz curve from the line of perfect equality. The larger the deviation, the larger the inequality.

The area between the Lorenz Curve and the line of equality divided by the area between the $x - axis$ and the line of equality gives the famous Gini index which depicts the deviation of the distribution from absolute equality. Figure 1.1 shows the distribution of income in Turkey for the year 2015.

Figure 1.1: Lorenz Curve of Turkey for 2015



Data Source; TÜİK- Gelir ve Yaşam Koşulları Araştırması, 2016

From Figure 1.1, the area between the line of equality and the Lorenz Curve is labelled A and the area between the Lorenz Curve and the $x - axis$ is labelled B. The proportion of $\frac{A}{A+B}$ represents the simplest form of the famous Gini index (g) that represents the level of inequality in the distribution. Noting that the entire figure is a unitary square, the area under the line of equality is equal to 0.5, that is $A + B$ is equal to 0.5, then;

$$g = \frac{A}{0.5} = 2A \qquad (1.1)$$

Which means,

$$g = 1 - 2B \qquad (1.2)$$

If the Lorenz curve is represented by the function $y = f(x)$ and noting that the Lorenz curve $y = f(x)$ is bounded by $x = 0$ in the lower bound and $x = 1$ in the upper bound since 0 of the population receive 0% of the income and 100% of the

population receive 100% of the income, Then, integrating over the space from 0 to 1 gives the Gini to be

$$g = 1 - 2\int_0^1 f(x)dx \tag{1.3}$$

If one is dealing with discrete data, it is shown in Xu (2003) that, the area B can be defined as

$$B = \frac{1}{2}\sum_{i=0}^{n-1}(F_{i+1} - F_i)(L_{i+1} + L_i) \tag{1.4}$$

Where F_i represents the discrete cumulative distribution function and L_i represent the cumulative income shares of the population from the lowest to the individual whose income y, is ranked i^{th} and are defined as;

$$F_i = \frac{i}{n} \tag{1.5}$$

$$L_i = \frac{1}{n\mu_y}\sum_{j=1}^{i} y_j \tag{1.6}$$

For $i = 1,2,\ldots\ldots n$ and $j = 1,2,\ldots . i$.
Substituting equation (1.4) into equation (1.2) yields

$$g = 1 - \sum_{i=0}^{n-1}(F_{i+1} - F_i)(L_{i+1} + L_i) \tag{1.7}$$

Sen and Foster (1997) on the other hand defines the Gini to be;

$$g = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2\mu}\right)[y_1 + 2y_2 + \cdots + ny_n] \tag{1.8}$$

Where $y_1 \geq y_2 \geq \cdots . \geq y_n$
Which is equal to

$$g = \frac{n+1}{n} - \frac{2}{n^2\mu_y}\sum_{i=1}^{n}(n + 1 - i)y_i. \tag{1.9}$$

Equation 1.9 has been proven by Xu (2003) to be equal to equation 1.7 after some algebraic manipulations with the implication being that the income-rank-based weights are inversely associated with the sizes of incomes. That is, in the index the richer incomes get lower weights while the poorer incomes get higher weights. This is

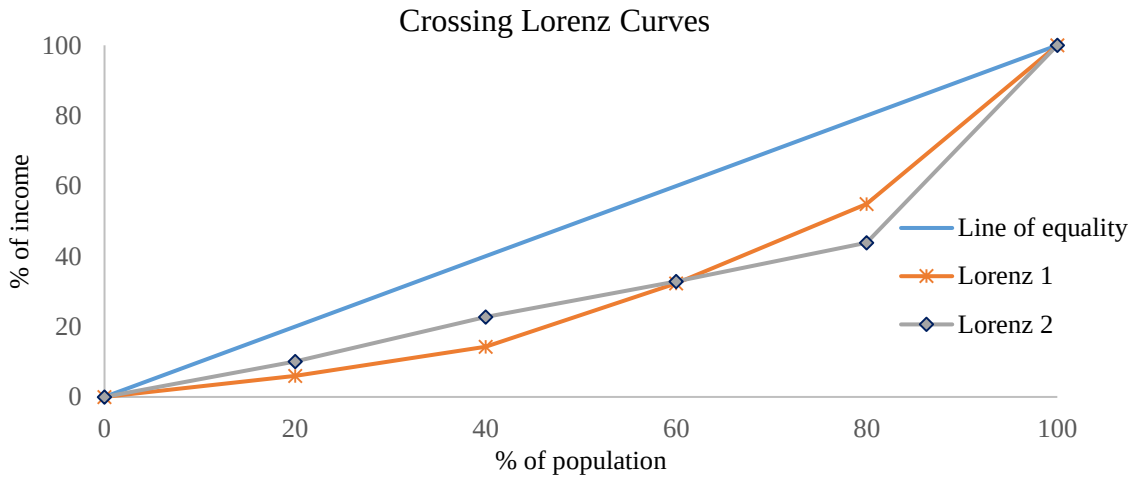
a desirable feature of any inequality measure because earners at the lower extreme of any income distribution can easily drift into poverty which every society should prevent.

Beyond the desirable feature of giving higher weights to incomes at the lower part of the distribution, the Gini is also quite representative as it takes note of differences between every pair of incomes. The Gini index is equally simple to calculate and interpret and it is comparable between countries and over time to see the trend of inequality. Whether it is increasing or decreasing and thus, can be used in assessing distributional policies.

The Gini Index equally satisfies some important distributional principles among which is the Pigou-Dalton transfer principle which requires that a transfer (less than the difference) from a richer person to a poorer person should lead to a decrease in inequality. The other principles are anonymity, scale independence and population independence which requires that the index should be indifferent as to who the low or high earners are, it should not matter the size of the economy and it should not matter how large or small the population is respectively.

The Gini is however not perfect, and some shortfalls of the index include the arbitrariness of the concept income. For instance, it could be defined as income of the household weighted by the household size or individual earnings any of which will result in different Gini indices. Also, most income statistics rely heavily on data from the formal sector with little coverage of the informal and subsistence sector which can be enormous especially in developing countries. Also, most income data are pre-tax incomes which does not capture the redistributive effort of the tax regime. All these will lead to an incomplete income data and thus unreliable Gini index. Again, as in Figure 1.2, Lorenz Curves can cross resulting in different distribution at different levels yet result in the same Gini index. This can lead to inconclusive judgements as to which distributive policy to pursue.

Figure 1.2: Crossing Lorenz curves



As is obvious from Figure 1.2, at lower levels of the distribution, Lorenz Curve 2 is more equal but tend to be more unequal than Lorenz Curve 1 at the higher level of the distribution, but since the Gini is always reported as a single numerical index, these two distributions will be reported as being equally unequal. As a result, ranking the two distributions will most certainly be subjective.

The Gini index was first introduced by Corrado Gini in his book "Variabilità e Mutabilità (1912)" which translates to "variability and mutability" (Ceriani & Verme, 2012). This original masterpiece is divided into two parts. In the first part, indices of variability, in particular, measurement of quantitative phenomenon including various forms of the Gini Index is discussed. The second part is devoted to indices of mutability which discusses measurements of qualitative phenomenon (Ceriani & Verme, 2012). The Gini Index is defined as "the mean difference from all observed quantities" with Corrado Gini presenting 77 formulations of the index in "Variabilità e Mutabilità (1912)" (Ceriani & Verme, 2012).

1.4.2 The Atkinson Index

A distinguishing feature of the Atkinson index is its ability to assign different weights to different incomes in the income spectrum which he termed the inequality aversion parameter ϵ. Mathematically, the Atkinson index is computed as in equation 1.10.

$$A_\epsilon = 1 - [\frac{1}{n}\sum_{i=1}^{n}[\frac{y_i}{\hat{y}}]^{1-\epsilon}]^{1/1-\epsilon} \qquad (1.10)$$

For a discrete distribution and as in equation 1.11 for a continuous distribution

$$A_{\epsilon} = 1 - [\int [\frac{y}{\hat{y}}]^{1-\epsilon} dF]^{1/1-\epsilon} \quad (1.11)$$

With n being the population size, y_i representing the income of individual i and $\hat{y}$ being the arithmetic mean. Theoretically, this index has a highest value of 1 and a lowest value of 0 with more inequality said to exist the higher the index is. It is argued by Atkinson that, the index incorporates Rawls' conception of social justice (De Maio, 2007).

1.4.3 Quintile Ratio

This is one of the most widely used measure of economic inequality. The quintile ratio (QR) of inequality is the ratio of the top 20% of income earners (or wealth or consumption) to that of the bottom 20%. The ratio is thus computed as in equation 1.12.

$$QR = \frac{Top\ 20\%\ of\ earners}{Bottom\ 20\%\ of\ earners} \quad (1.12)$$

The higher the quintile ratio, QR, the higher the inequality. From the inequality data of Turkey for the year 2015 as presented in the Lorenz Curve in Figure 1.1, the Quantile ratio, QR, can be computed by noting that the income shares of the top 20% i.e. earners from 80%-100% is 46.7% and that of the bottom 20% of income earners is 6.1%. Thus equation 1.10 can be solved for as in equation 1.13.

$$QR = \frac{46.7}{6.1} = 7.65 \quad (1.13)$$

This implies that, the average income of a person in the top income quintile is 7.65 times the average income of person in the bottom income quintile.

1.5 THEORIES OF INEQUALITY

One of the early theoreticians to have made bold predictions about the trend of future inequality is Kuznets. In Kuznets (1955), an attempt was made to explain the character and causes of long- term changes in the distribution of income. It was postulated that, inequality is low at the early stages of development, rises with

development and subsequently fall at higher income and/or economically advanced stages. This conclusion was based on the thesis that, at the initial stages of development, a lot of investment opportunities in industry exist affording the upper class with savings to invest thereby disproportionately benefiting from the economic expansion. At this stage however, the lower class who are mostly wage earners experience a stagnation or even a fall in wages due to the influx of cheap labour from the country-side further worsening the income gap. At the later stage of development, labour becomes relatively scarce and the entrenchment of the welfare state will lead to a reduction in inequality.

However, this hypothesis has largely been dispelled due to the rising inequality in the developed world contrary to Kuznets hypothesis. For example, Deininger and Squire (1998), Bruno, Ravallion, and Squire (1996) and Ram (1997) could not establish the existence of the Kuznets curve. However, Barro (2000) concludes that Kuznets curve holds as an empirical regularity if other factors affecting income distribution are controlled for. Piketty (2014) concludes that income inequality is always on the rise since in the long run since the return on capital is always greater than economic grow leading to an unfettered growth in the income of owners of capital. Piketty's conclusion and methodology however has been questioned.

A rather pessimistic view of inequality was proposed by Durlauf (1996). In Durlauf, the influence of parents on the conditional probability distribution of their children's income was modelled as an economic stratification based on the choice of the neighbourhood parents decide to live in. The idea is that local public finance of education and the sociological effects leads to a strong neighbourhood wide feedback loop that helps transmit economic status across generations leading to persistent income inequality.

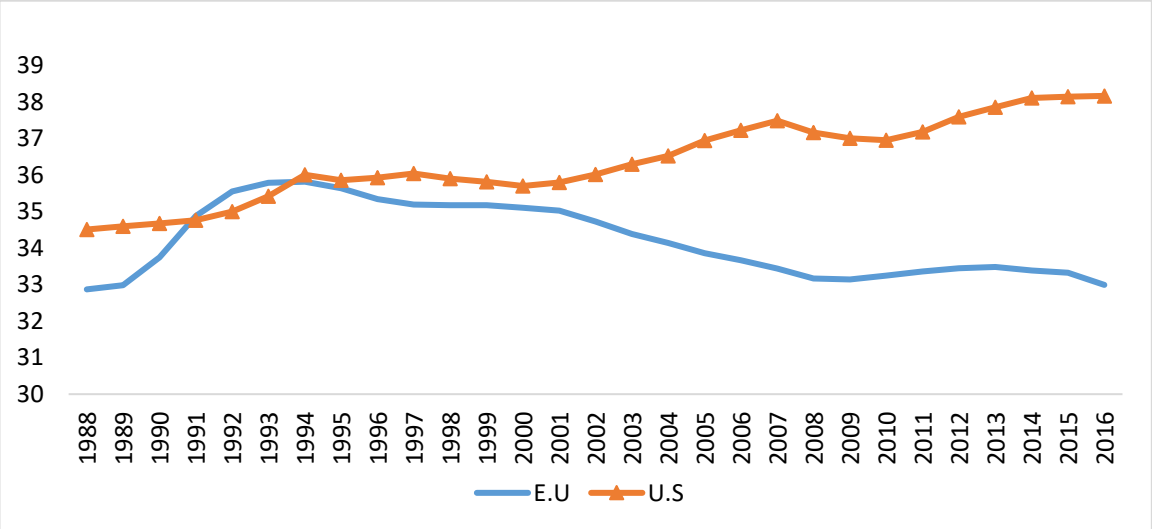
In Milanovic (2016), it is pointed out that, looking back at the distribution for the UK, and the US for the period 1850-1980, the observed inequality is consistent with Kuznet's hypothesis and the data after 1980 seems to confirm Piketty's hypothesis. Milanovic (2016) then formulated what he calls Kuznets' Waves to coherently explain the historical phenomenon of inequality since the 19th century.

1.6 GLOBAL INEQUALITY

Recently, there has been an increased interest in economic inequality which has resulted in a substantial rise in research hoping to determine the trends and magnitude of mostly within-country inequalities. It is alleged by Alvaredo, Chancel, Piketty, Saez, and Zucman (2018) that, inequality of regions across the world varies greatly with the Middle East having the highest and Europe having the lowest disparities in income. In Pinkovskiy and Sala-i-Martin (2009) globally income inequality was found to have fallen between 1970 and 2006. Similarly, It is concluded in Lakner and Milanovic (2016) that, global inequality declined marginally from 1988 to 2008 from 72.2 to 70.5.

In Europe, inequality seem to have been stable until the early 2000s and then started to fall until the global financial crises in 2008. From then, it started a brief increase and since 2015 has started to fall. The income Gini of the US started out much higher than Europe in 1988 and briefly fell below that of Europe in the early 1990s and has since been either stable or rising above the 35 mark as can be seen in Figure 1.3.

Figure 1.3: Inequality in E.U and the U.S from 1988 to 2016

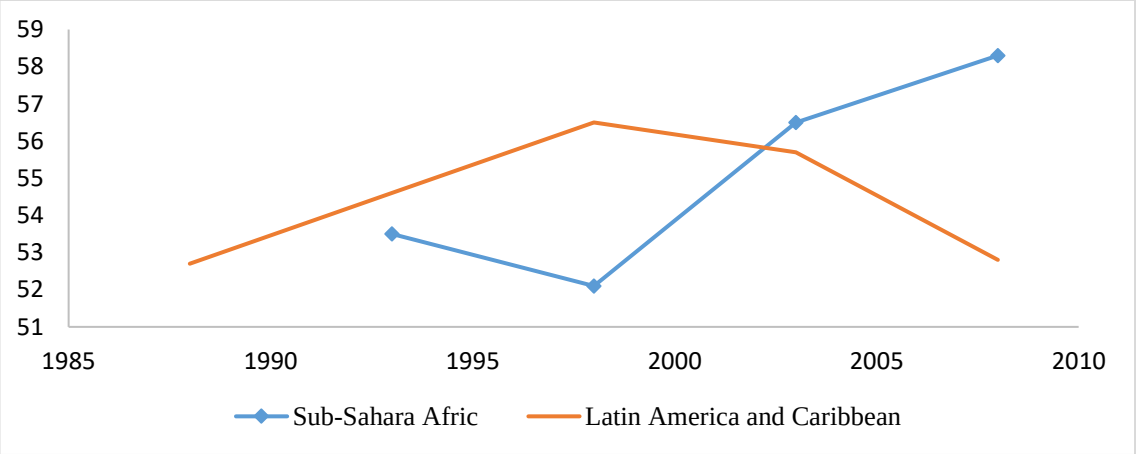


Source: Darvas (2018) EU Gini: Bruegel dataset using the version based on the log-normal distribution; US Gini: 6.2 version of the Standardized World Income Inequality Database. Note: disposable income (after taxes and transfers) is considered.

According to Lakner and Milanovic (2016), Inequality in China and India was also found to have increased and that of the Middle East and the Old Soviet States

appeared to have fallen based on their analysis using 1988, 1993, 998, 2003 and 2008 as benchmark years. Per their analysis the regions with the highest Gini indices are Sub-Sahara Africa and Latin America and Caribbean with the Gini index for sub-Sahara Africa rising by close to 5 points from 53.5 to 58.3. That of Latin America and the Caribbean started out at 52.7 in 1988 peaked at 56.5 in 1998 before falling to 52.8 as in Figure 1.4.

Figure 1.4: Inequality in Sub-Sahara Africa and Latin America and Caribbean



Source: Lakner and Milanovic (2016)

The high and increasing inequality in Africa contrasts with the remarkable annual economic growth of 4.5% since 1990s especially when contrasted with the continuous decline during the 1970s and 1980s (Beegle, Christiaensen, Dabalen, & Gaddis, 2016). This rise in the African-wide inequality is due to the increase in between-country inequalities rather rising within country inequalities (Lakner & Milanovic, 2016).

Like most of Sub-Sahara Africa, Ghana's economic performance in the last decade has been impressive with an average growth of about 7.2% between 2000 and 2013 leading to a tremendous reduction in poverty by almost half (Osei-Assibey, 2014a). Whiles the solid economic growth over the years have reduced the incidence of income poverty in general, income distribution has widened. An analysis of the last three rounds of Ghana Living Standard Surveys[5] (i.e., GLSS in1991/1992, 1998/1999, 2005/2006) indicates that the Gini index has witnessed an upward trending over the

[5]The Ghana Living Standards Survey (GLSS) is a nation-wide survey to collect demographic information on the populace with topics on education, health, employment, migration, housing and household agriculture among others. This survey has been conducted in 6 rounds for the years 1991/1992,1998/1999,2005/2006 and 2012/2013

period. Within this period, the income of the poorest quintile reduced from 6.9 in the early 1990s to 5.2 in the mid-2000s (Osei-Assibey, 2014b).

Pre-colonial Ghana was considerable equal (Aboagye & Bolt, 2018). However, economic inequality sharply rose during colonialism. This assertion is supported by Aboagye and Bolt (2018) who used social tables computed from the Colonial Blue Book[6] and some other primary and secondary sources to compute the Gini Index for Ghana from 1891 to 1960. The Gini Index was found to be below 0.30 in 1891 and rising to 0.55 in 1960 just after independence. This rise in inequality has been assigned different explanations.

It is noted in Osei-Assibey (2014b) that the rise in inequality during colonialism could have been as a result of the differing priorities that was given to differing parts of the colony by the colonial administration. During colonialism, the then Gold Coast was partitioned into three territories; the Colony (The Coastal territory), the Asante and the Northern territories with the Coastal and Asante territories given priority in terms of infrastructure and development for the fact that they were suitable for cash crop farming, endowed with minerals and their proximity to the seaports were desirable. The introduction of cash crop farming particularly cocoa in the forest belt within this period that improved incomes with no commensurate increase in incomes of subsistence farmers of the Northern Territory also contributed to the increased inequality and the extant North-South developmental dichotomy (Aboagye & Bolt, 2018). Also, Boateng, Okoye, Amoyaw, and Luginaah (2017) have explained the observed differences in regional inequality in Ghana as resulting from the intensity and concentration of colonial missionaries and missionary activities.

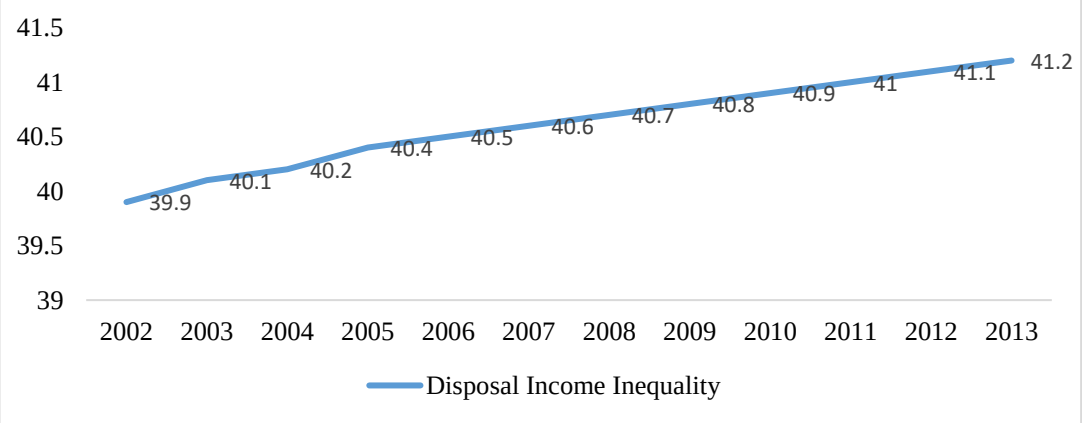
Generally, spatial inequalities usually stem from differences in resource endowment with climate, weather, and physical resources being an important factor (Tsikata & Seini, 2004). Thus, the dichotomy in development with The South decidedly more developed than The North is attributed to the uneven distribution of natural resources within Ghana. This trend of the north-south dichotomy in terms of development and standards of living is not peculiar to Ghana but is the norm in West

[6]This was a book printed by the Colonial Office of the British Government that provided information on colonial economies and administration of colonial territories.

Africa with a more developed southern, coastal area and an underdeveloped periphery in the Sahelian North (Tsikata & Seini, 2004). Despite this initial inequality largely created by the colonial regime ethnic structures, governance and political power also appear to have taken a toll on inequality in Ghana, though available evidence appears to be divided in support of this claim (Osei-Assibey, 2014b).

It is also concluded in Obeng-Odoom (2012) that the sustained increase in urban economic inequality in Ghana is attributable to the increased neo-liberal economic policies. These neo-liberal economic policies in the financial and monetary sector started with the Financial Sector Adjustment Program (FINSAP) in 1989 and culminated in the Bank of Ghana Act 2002 that declares the Bank of Ghana an inflation targeting central bank in 2002 (Quartey & Afful Mensah, 2014). The income inequality trend in Ghana since 2002 has been upward trending as can be seen from Figure 1.5.

Figure 1.5: Income Inequality in Ghana from 2002 to 2013



Source: Standardised Income Inequality Database 7.1

Recently, a body of literature have emerged studying inequality and its decomposition analysis. In Senadza (2011) for instance, the 2006 Ghana living Standards Survey (GLSS) was used to show that aggregate non-farm income had an increasing effect on total income inequality in Ghana. Using both the 2005/2006 and 2012/2013 GLSS data in a trend and pattern analysis and inequality decomposition analysis for all household income, Novignon (2017) found general household income inequality slightly increased over the period 2006-2013. Urban areas were also found to be more unequal than rural areas and in both rural and urban areas.

1.7 DETERMINANTS OF INEQUALITY

Several studies have been conducted to determine the factors that cause or influence economic inequality. In that regard, several factors have been found with the direction and magnitude of the factors differing depending on the country and regional specific features. Broadly however, economic growth, natural resource endowment, education, technology, level of globalisation i.e. the extent to which an economy is connected to the international economy, the welfare state and recently monetary policy have been found to impact on economic inequality. Colonial structures and agricultural sector output are also found to be significant in determining inequality in developing countries, especially of Sub-Sahara Africa.

In a study by Odedokun and Round (2001) using data for 35 African countries, it was concluded that the level of economic development attained, regional factors, size of government budget and the amount of it devoted to subsidies and transfers, phase of economic cycle, share of agricultural sector in total labour force, and human and land resources endowment are the key determinants of income inequality. Evidence in support of the negative impact of inequality on economic growth was also found to exist.

In a study of 25 high-income OECD countries by Tridico (2017), financialisation, retrenchment of the welfare state, weakening of trade unions and deepening of labour flexibility were identified as the main causes of the recent rise in inequality. In Duman (2008), educational opportunities and access to schooling were found to be related to income inequality in Turkey. Ucal, Haug, and Bilgin (2016) upon analysing the effect of Foreign Direct Investment (FDI) on income inequality in Turkey using data from 1970-2008 detected both short and long-run effects of FDI on inequality. Also, GDP growth, gross domestic capital formation, population growth and literacy were found to have minor effects on inequality.

In an unpublished study of 53 countries, Cloninger (2016) concluded that the mean age of the population, percentage of GDP devoted to investment in capital goods, percentage of the population engaged in agriculture, economic growth, unemployment and taxes as a percentage of GDP accounted for 77% of the variation in inequality. This though enormous still leaves close to 25% unexplained variation in inequality.

Using descriptive and regression methods to study the determinants of intra-southern and intra-northern inequalities in Ghana, Danquah and Ohemeng (2017) found urban location, education, public and private formal economic activities, and migration of young people from the North to the South as the main determinants of inequality.

In Ghana, trend and pattern analysis and inequality decomposition analysis have found non-farm wage employment, self-employment and remittance to be the most unequally distributed (Novignon, 2017) implying their rise or fall will impact on inequality in Ghana. Citing the Participatory Development Associates (2011), Osei-Assibey (2014a) explained the North-South development gap as resulting from the increasingly discordant climate - with extremes of droughts, flooding and windstorms in The North making even the ones yearly farming season unreliable contrasted with the double seasonal farming of the South. These often result from perverse coping strategies which the poor are compelled to employ and include unregulated bush-burning, inappropriate forms of child labour and a range of social and life-course factors (e.g. expensive death rites and high fertility rates) that are more prevalent in the north further widening the gap. Bourguignon (2002) found that the percentage change in poverty can be decomposed into the per capita growth rate, the distributional change (inequality) and a marginal residual. This implies, if Africa is to meet the SDG two of eradicating poverty, then the focus should not only be on achieving economic growth but also the reduction of inequality.

Since the great recession of 2008, there has been a substantial rise in the literature attempting to establish possible effects of monetary policy on inequality. Theoretically, since monetary policy through the monetary transmission mechanism affects the real economy and thus output and income, a monetary policy action that results in a change in the production pattern will affect income distribution with gainers and losers. If the rich gain relatively more as a result, then inequality can be expected to increase and the vice versa.

CHAPTER 2

MONETARY THEORY AND MONETARY POLICY EFFECTS ON INCOME INEQUALITY

The importance of money in modern economies and why monetary policy is important in economic policy are discussed in the first section of this chapter. The structure and conduct of monetary policy termed the monetary policy regimes are discussed next followed by some basic monetary theories. The channels of monetary transmission to economic activity and distribution are discussed. Finally, a theoretical and empirical review of the impact monetary policy has on income inequality is discussed.

2.1 WHY MONETARY POLICY MATTER

The history of money is as intricate as the concept of money itself. In its modern form, money could be regarded as "a numeraire, a medium of exchange, a store of value, a means of payment, a unit of account, a measure of wealth, a simple debt, a delayed form of reciprocal altruism, a reference point in accumulation, an institution, or some combination of these" (Bell, 1998). However, there are two main competing theories of money. These are the metallist and the chartalist theories. In the metallist theory, money is thought as being both a commodity and money and thus should have an intrinsic value that will make money wanted for the sake of the stuff it is made of. The chartalist however view money as being primarily a means of payment and a unit of account. In that regard, universal acceptability is the most important condition for an item to be used as money irrespective of the intrinsic value of the item (Lau & Smithin, 2002).

The market economy and capitalism, for the chartalist, are premised on the existence of money and price is not the same as a relative ratio of goods' values. The reason as advanced by the chartalist theory is that price is a transformation of subjective and unstable preferences into an intersubjective and stable scale of values expressed in pecuniary units (Lau & Smithin, 2002) which is not the same as barter. In Keynes (1973), a distinction is made between a real-exchange economy and a monetary economy. In the real economy, only real economic output is relevant and the

value of money is of no importance in making economic decisions. In a monetary economy however, money plays its own distinct role and the behaviour of it is essential in predicting economic events. From this, modern economies can best be described as monetary economies. The reason being that, in all modern economies, decisions and motives are affected by money such that the knowledge of the behaviour of money is essential in predicting either long-run or short-run economic events. This conviction, which is rightly so, accounts for the pervasiveness of money and the extensive study of it; how it is regulated and the impact it has on real variables and the business cycle.

The regulation and manipulation of money to achieve some desired economic goals is termed monetary policy which is believed to be one of the main tools a government can use to influence an economy (Wong & Chong, 2014). This regulation and manipulation are usually done through a monetary authority, called a central bank, to meet some monetary targets. It is noted in Goodhart (1989) that, generally the target of monetary policy is to compress the rate of growth of nominal incomes to a rate in line with the underlying potential rate of real economic growth, thus ensuring price stability.

The monetary policy target and the instruments used in reaching this target depends on the monetary policy framework which in turn largely depends on the ultimate economic goal monetary authorities aim to achieve with monetary policy. Price stability has generally been the main monetary policy goal (Yellen, 1996) with some monetary authorities also having output stability or growth as complementary goals. To achieve this main monetary policy goal of price stability, several instruments and intermediate targets are used based on the monetary policy regime.

2.2 MONETARY POLICY REGIMES

Monetary policy regime is the structure that provides some intermediate goals, policy tools and indicators that guide monetary policy makers' decisions and the general public as to the stance of monetary policy.

In general, monetary policy regimes since the early 20th century can be broadly categorised into three headings. These regimes are exchange rate targeting, monetary targeting, and inflation targeting.

2.2.1 Exchange Rate Targeting

Under an exchange rate targeting monetary regime, the central bank's main goal is to intervene in the money market to maintain a specific exchange rate ratio with a predetermined product, currency or a basket of currencies. From 1816, Britain had been on full gold standard (Cooper, Dornbusch, & Hall, 1982) allowing for the currency to be converted into gold. The adoption of the gold standard by major European powers in the 1870s (Hopkins, 1970) meant the currencies of these countries were convertible at a predetermined exchange rate from the 1870s with the base of conversion being gold. The exclusive mandate of the central banks of these economies was therefore to intervene to maintain the predetermined exchange rate.

The demise of the gold standard after World War I ushered in another international monetary system, the Bretton Woods system. This system introduced the "pegged-rate" or "adjustable-peg" regime where the dollar was convertible to gold and all other currencies were pegged to the dollar. Member countries intervened in the exchange rate market to limit fluctuations and declaring a par value for their currencies though members had the right to alter the par values to amend for "fundamental disequilibrium" found in their balance of payments (Igwe). This, just as during the gold standard, effectively limited monetary authorities of member countries to the use of various tools towards maintaining the pegged or fixed exchange rate system except under extra-ordinary circumstances. Under the Bretton Woods system, being part of the global monetary system was dependent on maintaining the pegged or fixed exchange regime. This was aimed at achieving price and currency stability with the nominal exchange rate as the intermediate target and an anchor to inflation.

Even after the collapse of the Bretton Woods pegged/fixed exchange system in March, 1973, some governments and monetary authorities continued to maintain a fixed exchange regime. Unlike during the hegemony of the Bretton-Woods system however, central banks are not tied to the pegged or fixed rate and could adopt a crawling target that allowed the local currency to depreciate at a steady rate so that its inflation can be higher than that of the anchor-country (Cuhal, Starițeîna, & Basistîi, 2014) implying a crawling nominal exchange rate but a fixed real exchange rate.

The reason for the continuous operation of the fixed exchange regime by some central banks and thus governments could be to import low inflation (Bodea, 2010) by acquiring credibility from a more disciplined central bank as a way of restricting itself from launching inflationist policies (Garber & Svensson, 1995).

In the case of Ghana, a fixed exchange rate regime characterised by surrender laws, foreign exchange rationing and currency inconvertibility was adopted from independence in 1957 to 1982 with the cedi being fixed to the British Pound from 1957 to 1966 and to the American dollar to 1982 by decree. Under this regime exporters were required to surrender all their foreign exchange earnings to the Bank of Ghana at the fixed official rate and it was illegal to purchase foreign exchange for capital transactions (Sanusi, 2010). From 1983 onwards, a successive devaluation of the cedi paved way for the introduction of the interbank exchange rate system which was initiated in April 1992 (Sanusi, 2010) and the managed float exchange rate regime currently in place.

One of the biggest disadvantages of the exchange rate targeting regime is that the ability of the central bank to manipulate monetary policy to cope with domestic shocks is lost. This weakness in particular led to its abandonment in favour of alternative monetary policy regimes like the monetary targeting regime.

2.2.2 Monetary Targeting

As already noted, the general aim of monetary policy is to combat inflation which is equivalent to compressing nominal income growth to match with the growth of the real economy (Goodhart, 1989). The reason being that growth in nominal incomes as a result of growth in money in excess of growth in real output will result in more money chasing fewer goods resulting in an increase in nominal prices and thus inflation. In the 1970s, monetary authorities thought that an explicit control of the quantity of money in the system was the best way to control monetary growth and stabilise prices. In Von Hagen (1999) however, the adoption of money growth targeting by the Bundesbank is explained as a political economic strategy that had been announced to mark the beginning of a new regime after the demise of the Bretton Woods system. It is asserted that the Bretton Woods' fixed exchange system had been viewed as a 'rival monetary government' leading to intolerable imported inflation and

currency crises. This idea showed that the loss of monetary control was not only viewed as a threat to monetary stability but as a threat to the institutional identity of the Bundesbank and the adoption of monetary targeting as a way to announce and reassert the recapture of monetary control (Von Hagen, 1999).

According to Mishkin (2001), monetary targeting is based on three elements. These include;

- Reliance on monetary aggregates (e.g. M1) to conduct monetary policy
- Announcing targets for monetary aggregate
- Some accountability mechanism to prevent large and systematic deviations from the monetary targets.

The effectiveness of monetary targeting however crucially depends on the identification of a stable money demand function since a stable money demand function is a prerequisite to predict the impact money supply will have on economic variables like inflation and national income (Bawumia, Amoah, & Mumuni, 2008).

It has been claimed that monetary control is simply not achievable or not ideal. The reasons being that, an attempt to control money stock if successful will result in interest rate volatility. Also, the irregular but rapid development and deregulation in payment technology makes it practically impossible to control money stock (McCallum, 1985). On the positive sides though, monetary targeting has the advantage of allowing monetary policy makers to change the targets to cope with domestic shocks (Cuhal et al., 2014).

But even when the stock is able to be targeted and brought to its targeted level, it has not been very successful in reducing inflation at least in most countries. In Mishkin (2001), it is noted that, even though the money targets for the late 1970s was mostly close to target, inflation did not abate. This assertion is confirmed by Bawumia et al. (2008) who claimed that the weak relationship between monetary aggregates and inflation made it impossible to target monetary aggregates with the view to controlling inflation and thus led to the monetary targeting framework being abandoned.

2.2.3 Inflation Targeting

It is noted in Martínez (2008) that the main role of monetary policy is to provide a nominal anchor that can be used to stabilise prices and to ensure monetary authorities resist the temptation or the political pressure to pursue expansionary policies that will be detrimental to long-run price stability. In that regard, the main purpose of inflation targeting is to provide a strong nominal anchor which can be used to tie down the price level by anchoring not just the price level but also the expected rate of price increases (Martínez, 2008).

Regarding the rational for inflation targeting and citing Ramos-Francia (2008), it is noted in Martínez (2008) that, an aggregate economy described by labour, goods and external markets with three relative prices of the labour market being the real wage rate ($^{W}/_{P}$), the goods market represented by the real money balance ($^{M}/_{P}$) and the external market represented by the real exchange rate by ($^{E}/_{P}$). Determining the nominal scale under this economy is quite tricky since it could be either the price level (P), the wage rate (W), the money supply (M) or the exchange rate (E). If one of these variables is chosen as the numeraire in the economy, one additional variable must be fixed to anchor such an economy (Martínez, 2008). In the past, attempts have been made to fix the exchange rate and the money supply in the past with little success. Thus, the main rationale for inflation targeting is to avoid the necessity of achieving several nominal equilibria and to get rid of high inflation equilibria.

Inflation targeting involves five elements. These are a public announcement of a numerical medium term inflation target, commitment to price stability as the primary long-run goal of monetary policy, using many variables and not just monetary aggregates in making decisions about monetary policy, increased transparency through communicating the plans and objective of the monetary authorities to the public and increased accountability of the central bank for attaining the inflation objectives (Mishkin, 2001). Under inflation targeting, the public announcement of a numerical target of inflation in particular minimizes the problem of inflation bias arising as a result of economic agents' uncertainty with regards to the credibility of the central bank's commitment to price stability (Bawumia et al., 2008).

Inflation targeting according to (Mishkin, 2001) is generally considered successful in light of the fact that it has been able to reduce inflation, reduce the effects of inflationary shocks and promote economic growth without resulting in large output fluctuations. This has led to inflation targeting becoming increasingly popular with a sizeable number of central banks of developed, emerging and developing economies adopting same. In particular, Turkey adopted the inflation targeting framework in 2006 and Ghana adopted same in 2007 though unofficially, the inflation targeting framework has been pursued in both countries since the early 2000s.

It is has been argued in Bawumia et al. (2008) that, the adoption of the inflation targeting regime in Ghana kick-started a disinflationary period and improved monetary policy transparency and communication in Ghana. This is corroborated by Puni, Osei, and Barnor (2014) who found the adoption of inflation targeting in Ghana to have led to a significant reduction in the mean inflation rate with no significant impact on economic growth.

Inflation targeting however has received its share of criticisms. One of such criticisms is that inflation target tend to ignore financial stability by exclusively focusing on inflation. This criticism has been countered by Woodford (2012) who argues that though monetary policy may affect the severity of the risk to financial stability, it is possible to generalise an inflation targeting framework to account for financial stability alongside the price stabilization mandate.

2.3 MONETARY THEORIES

In choosing monetary policy regimes, the dominant theories regarding money, the perceived best tools for achieving the desired outcome and practical considerations about say, transaction technologies play important roles. The successes of these regimes in achieving the monetary policy targets are thus dependent on how realistic the theories on which the monetary policy regime, tools and instruments are based on.

Generally, monetary theory can be categorised under the schools of economic thought. These schools of economic thought and thus of monetary thought are the classical, the Keynesian and the monetarist schools.

2.3.1. Classical Monetary Theory

The quantity theory of money is arguable the oldest surviving theory in economics (Glasner, 2000) and perhaps the most well-known monetary theory that defines the monetary theory of the classical school of economics. The quantity theory during its heydays was however more of an approach than a rigorous theory (Handa, 2009).

The quantity theory of money and in particular that of Fisher starts as an identity postulating that in nominal terms, the product of the quantity of nominal money (M) balances and the velocity (V) of money circulation is equal to the product of the general price (P) level and the number of transactions (T) as represented in the equation of exchange in equation 2.1.

$$M.V = P.T. \tag{2.1}$$

To transform this identity into a theory, Fisher made two postulations about the workings of the economy. These were that the velocity of circulation is dependent on technical (Handa, 2009) and structural factors like the frequency of wage payment, degree of vertical integration of firms, and number of stages goods go through from raw products to finished goods (Keyder, 1992) which hardly change and thus can be said to be constant. Also, that unless during transition periods, the volume of trade, T, will be independent of the quantity of money (Handa, 2009) in the economy. From this postulations, the equation of exchange was transformed into a quantity theory that argues that, increase in the money supply, M, will result in increase in prices, p, and thus inflation since both V and T are constant.

In a different formulation, the left hand side of the equation of exchange in equation 2.1, i.e. the nominal money quantity and the velocity is further divided into legal tender money (M) and credit money (M') and the legal tender velocity (V) and credit money velocity (V') resulting in equation 2.2.

$$MV + M'V' = PT \tag{2.2}$$

Fisher's inclusion of credit money and the credit money velocity in equation 2.2 enabled the theory to be extended to deal with short-run fluctuations where

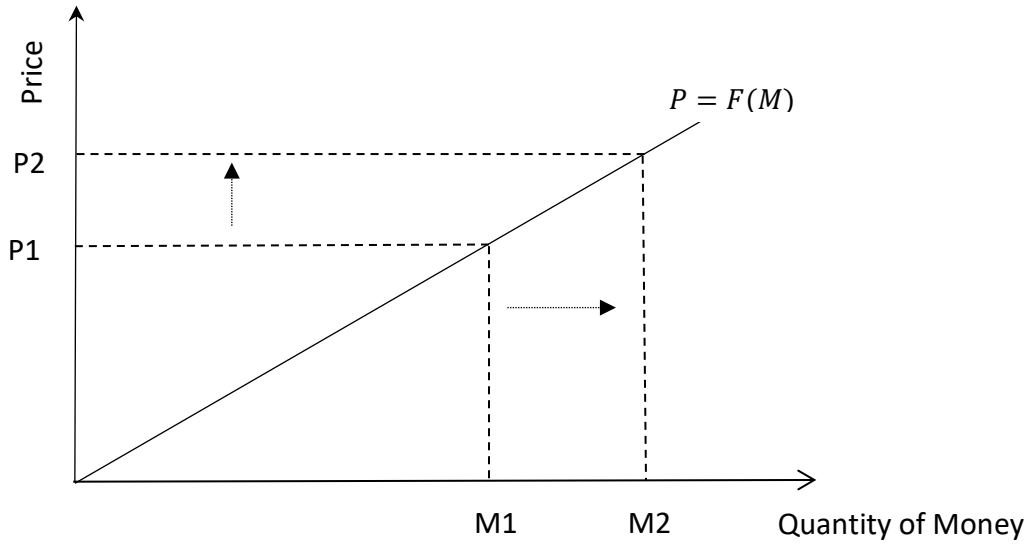
causation evidently ran not just from deposits to prices but through the workings of the banking system bi-directionally (Laidler, 2013).

Expressing this in terms of demand for real money balances, the quantity theory can be explained as follows. Economic agents keep a specific proportion, k, of their intended transactions, T, which is equivalent to the level of output or income, Y, as real money balances ($^{M}/_{P}$) and velocity (V) is the reciprocal of k. Thus equation 2.1 can be formulated alternatively as equation 2.3.

$$(^{M}/_{P})^{d} = kY \qquad (2.3)$$

From this simple but forceful equation, in the long-run, increase in nominal money balances does not have any real effect in the economy but simple leads to increase in the general price level (i.e. price is a function of the money supply and links the two through the function $P = f(M)$) as in Figure 2.1.

Figure 2.1: Money and Price under the Quantity Theory of Money



From Figure 2.1, an increase in the money supply from $M1$ to $M2$ leads to an increase in the price level from $P1$ to $P2$.

The Fisherian Quantity theory has however not been without criticisms. One of such criticism has been on empirical grounds as prices do sometimes change without a change in monetary supply or prices remain constant even when money supply is

increased (Keyder, 1992). Also, its neglect of interest rate in the formulation, the ceteris paribus assumption, and its failure to measure the value of money are some of the criticisms that have been levelled against it.

Another formulation of the quantity theory by Pigou and other Cambridge economists is termed the Cash balance approach. In the Cambridge formulation of the quantity equation, money is not merely demanded for transactional purposes but as part of the asset holdings of economic agents (Keyder, 1992) thus the store of value function of money is stressed. In Pigou, the quantity theory was formulated to illustrate how a purchasing power of a unit of currency could be determined by factors other than the quantity of money (McLure, 2013).

In Pigou (1917) it is noted that, obligations and claims in favour of and against economic agents rarely exactly balance out necessitating the difference to be met by the transfer of titles to legal tender which may include but not exclusive to bank notes and bank balances. A person's inability to meet maturing obligations against them will render them bankrupt. In that regard, everyone is anxious to hold enough resources in the form of titles to legal tender. In reformulating the quantity equation, Pigou measures the value of money in terms of the quantity of wheat a unit of money can afford and notes that, the total resources of the community, (R), expressed in terms of wheat, the proportion, (k), of these resources that the community chooses to keep in the form of titles to legal tender, (m), the number of units of legal tender and (p), the value or price per unit of these titles in terms of wheat, then the demand for money is represented as in equation 2.4 which represents the real price of a unit of legal tender (McLure, 2013).

$$P = \frac{Rk}{M} \tag{2.4}$$

With simple algebra, equation 2.4 can be transformed into equation 2.5.

$$M = \frac{Rk}{P} \tag{2.5}$$

As stated already, Since R is the total resources of the community and k the proportion of that total resources economic agents decide to keep as titles to legal tender which is based on the convenience obtained and the risk avoided through the

possession of such titles (Pigou, 1917), all other things being equal, the higher the total economic resources available to the community, the higher the money balances that will be demanded. Also, the higher the proportion, k, of total resources held as titles to legal tender, the less attractive is the production use of resources compared to the money use of resources.

From the foregoing, it is clear that the demand for money will increase if the general price level is expected to fall and the opposite effect is expected if the general price level is expected to fall. Thus, in the Cambridge cash balances approach, demand for money depends not exclusively on the volume of transactions but also on the level of total resources, cost of holding money and the risk and uncertainty about the future. This uncertainty about the future formed the bases for Keynes' speculative motive of money demand (Keyder, 1992).

Owing to the generally accepted classical ideas on the determination of long-run real output and real interest rates, the conclusions arrived were similar to that of the traditional quantity theory (Handa, 2009) which disputed the possibility of monetary manipulation influencing real output and real interest rates in the long-run.

Knuts Wicksell, writing within the classical tradition (Handa, 2009), opined that even if the quantity theory of money is false, then there is thus far only a false theory of money and no true theory (Ebeling, 1999) and tend his attention to issues that the traditional treatment of the quantity theory had been silent about. In particular, the time span of analysis in Wicksell's pure credit economy was on the short-run where the economy could be in disequilibrium rather than the long-run (Handa, 2009). Also, in contrast to the traditional treatment of the quantity theory of money, Wicksell considered the interest rate to be exogenously determined and the money supply adjusting to equilibrium rather than taking the money supply to be exogenously determined.

In Wicksell's analysis, three types of interest were identified. There are the interest rate at which banks offer loans, that is the market rate of interest, the natural rate which is the marginal return on capital of companies which is used as a benchmark by companies to decide whether to take more debt or not, and the normal interest rate, the rate at which savings will equal investment (Handa, 2009). The relationship

between the market interest rate, the natural rate and the normal rate of interest will determine whether or not the cumulative process of rising or falling general prices will be set in motion (Ebeling, 1999).

Under Wicksell analysis, decreases in the loan interest rate will result in a positive difference between the natural rate of interest that is the rate of return on capital and the loan interest rate encouraging companies to take more loans for investment. This rise in investment will result in rise in expenditure and thus output temporarily due to the fact that the rise in the loan demand will push the loan interest rate to close the gap that stimulated the loan demand.

Inflation need not occur during the transient disequilibrium state if net investment is positive and constantly increasing from period to period and if the cumulative process also generates enough voluntary savings. At full employment however, a differential between the market rate and the natural rate will result in inflation since the economy is at its potential with no possibility of output increment through investment. If inflation thus occurs, it can be checked by ensuring the bank rate is at a level that insures investment does not exceed savings (Blaug, 1985).

In Fontana (2011), Hick's terminology of strong classics (S-Classic) and weak classics (W-Classic) is invoked to differentiate between the classical economist who propose central banks exclusively target money supply with the aim of controlling inflation for their strong believe in monetary neutrality and those who subscribe to monetary neutrality but admit money's ability to influence employment and output in the short-run.

In conclusion, most classical monetary theories subscribe to some form of money neutrality and propose the targeting of the money supply with the aim of maintaining price stability. Also, the main transmission mechanism subscribed to by the classics is the direct transmission mechanism where money directly impacts on prices and thus inflation with no meaningful impact on output. Wicksell however proposes the targeting of the interest rate and subscribes to a weak form of monetary neutrality where in the short-run, money is likely to have an impact on real variables like output.

2.3.2. Keynesian Monetary theory

In can be said that, the disparity between the Cambridge cash balance theory started by Pigou and that of Keynes is in the role played by interest rate and expectations in their theories. In the Cambridge approach, interest rate and expectations are handled under the ceteris paribus assumption whiles in Keynes, the role of interest rate and expectations are explicitly included in determining the velocity of money (Keyder, 1992).

Keynes own discussion of money demand and monetary theory was under the **Liquidity Preference Theory.** As in Pigou, Keynes formulation is started with the reasons why money is demanded which are termed motives. These reasons or motives of money demand are the transactional motive (M_t), the precautionary motive (M_p), and the speculative motive (M_s) resulting in transactional demand, precautionary demand and speculative demand for money. These demands are further divided into active money demand and idle money demand by Thorn (1974) with the active money demand being the transactional demand and the idle money demand the speculative and precautionary demands.

The transactional demand for money is proportional to the level of income (Y) and it is meant to offset any difference in receipts and payments of an economic agent. The precautionary demand for money is the demand for money arising from the unpredictable nature of the flows of income and outlay (Weinrobe, 1972). Essentially, the precautionary demand for money is the demand for money balances to cater for unforeseen events requiring sudden expenditures (Bitrus, 2011). The precautionary demand is dependent on income (Y) and interest (i) even though Keynes argues that the impact of interest rate is minute compared to the impact of income (Bitrus, 2011).

For the asset or the speculative demand for money, Keynes sees it as the demand for money with the motive of profiting from having a better knowledge than the market with regards to the future direction of the market. Thus, if an investor thinks future interest will be higher, they will prefer to hold to liquid cash and lend it out after interests have risen otherwise, they will invest it in an interest bearing asset like a bond (Handa, 2009). From these reasons, the speculative demand for money is an inverse

function of the interest rate (i) (Keyder, 1992). Algebraically, these are represented in equation 2.6 to equation 2.8

$$M_t = f(Y) \quad (2.6)$$

$$M_p = f(i, Y) \quad (2.7)$$

$$M_s = f(i) \quad (2.8)$$

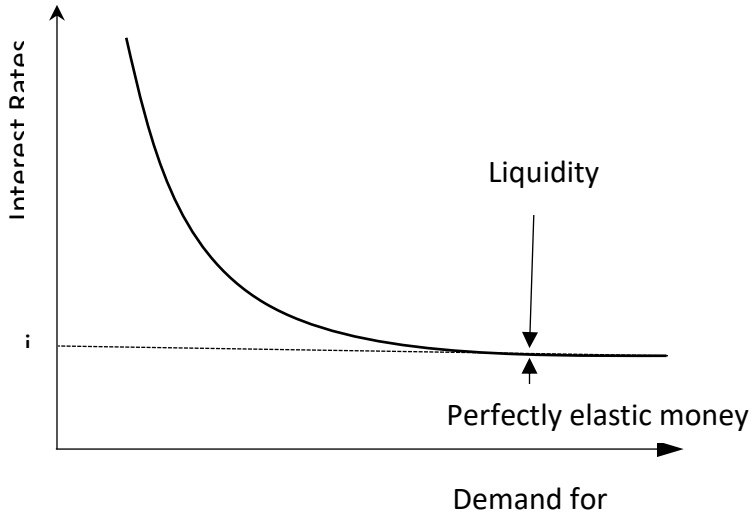
Combining these results in the total demand for money function as in equation 2.9

$$MD = M_t + M_p + M_s \quad (2.9)$$

In Tobin (1958), it is suggested that interest rate may play a role in the transaction demand for money if the composition of this balance is not entirely made of legal tender. Some agents have transaction balances that are significant so that investing them in earning assets particularly, assets with short maturities, will be worth the inconveniences and the financial transactions involved. This will result in, as in the speculative demand for money, an inverse relationship between the transaction demand for money and the interest rate (Tobin, 1958).

The total demand for money under the liquidity preference theory is thus downward sloping due to the inverse relationship between the demand for money and the interest rate. However, the negative slopping money demand curve turns horizontal and thus perfectly elastic beyond the interest rate floor as in figure 2.2. This interest rate floor is what is termed the liquidity trap which indicates the absolute liquidity preference of economic agents.

Figure 2.2: Demand for Money under Liquidity Preference



Much of the explanations on which the liquidity preference as propounded by Keynes is based on is the fixed expectation of future interest. That is, investors expect interest at the end of the year to be i_e. This expectation is held with certainty and is independent of the current rate of interest i. The interest differential is the capital gain (cg) as in equation 2.10

$$cg = \frac{i}{i_e} - 1 \tag{2.10}$$

The rate of return (r) is then computed as the sum of the capital gain cg, and the current rate of interest i. If the sum is less than zero as in equation 2.11, all of the investment balances is kept in legal tender i.e. as cash balances

$$cg + i < 0 \tag{2.11}$$

However, if the sum of the capital gain and interest is greater than 0 as in equation 2.12, all of the investment balances are kept in the interest bearing asset, bond.

$$cg + i > 0 \tag{2.12}$$

Thus the division of an investors investment balances into proportions between cash and bonds is a simple all or nothing choice (Tobin, 1958). That is, the investor is either a bull or a bear in the parlance of bond markets (Handa, 2009).

The exclusivity of the asset held by an agent, i.e. either only money or only bonds in Keynes' liquidity preference theory of money demand is an obvious weakness. To counter this weakness, Tobin (1958) reformulated Keynes' liquidity preference theory of money into the **Portfolio Balance Theory** (Gonda, 2003) by making the need for the assumption of fixed interest expectations redundant.

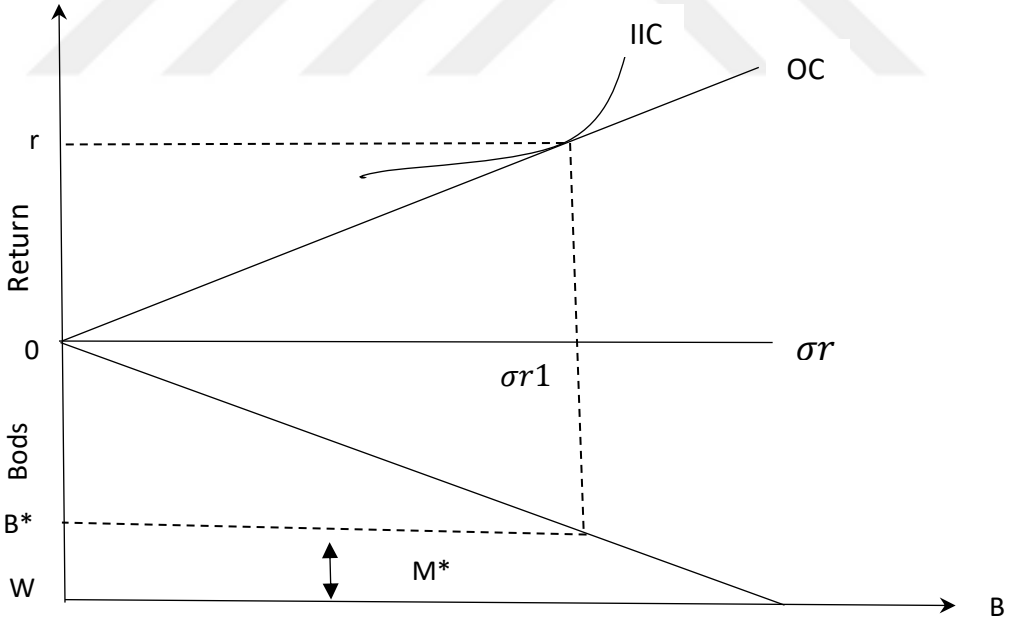
Under the portfolio balance theory, the possibility of economic agents holding wealth (W) in money (M) and in bonds (B) concurrently is allowed. This is intuitively logical since in the event of uncertainty in the return of bonds, which will likely be so, investors being concerned with risk as well as return would be better off holding bonds and money concurrently (Keyder, 1992). This implies that total wealth will be divided so as to create a portfolio of money and bonds the sum of which will equal total wealth as in equation 2.13.

$$W = M + B \tag{2.13}$$

Unlike under the liquidity preference theory where the investor is assumed to expect with certainty the future interest rates,i_e, and by implication the capital gain, cg, under the portfolio balance theory, the investor is assumed to be uncertain about the capital gain with investment decisions based on estimate of its probability distributions. This probability distribution is assumed to have an expected value of zero (Tobin, 1958).

The risk of the bond is taken to be the standard deviation (σr) of its return r. A high standard deviation (σr) means high risk and a possible high return. A low standard deviation (σr) means low risk and a low return. The investor then invests a portion of the available wealth taking into consideration the return (r) on the asset, bond, and its associated risk at each investment opportunity curve (OC) and investment indifference curve (IIC) as in figure 2.3.

Figure 2.3: Determination of the Optimal Portfolio



As can be seen from figure 2.3, OW, i.e. the lower quadrant represents the total wealth available to the investor who must decide what proportion to invest in bonds and what to hold in cash. The upper quadrant OR represent the rate of returns on the interest bearing asset bonds. The horizontal line at O is the risk (σr) associated with holding bonds. Line OC in the upper quadrant is the opportunity locus indicating the

terms under which the investor can increase the returns if more risk is accepted. Line OB in the lower quadrant indicates the proportion of wealth invested in bonds at each level of risk. As can be expected, the proportion of bond holdings is proportional to the level of risk. At zero return, all the investment balance is kept in cash with the associated risk being zero, however, as the returns increases to r, the associated risk rises to $\sigma r1$. At this rate of return and associated risk, the investor is willing to invest $OB*$ in bonds keeping on to $B*W$ in cash.

2.3.3. Monetarist Monetary Theory

The monetarist economics school pioneered largely by Friedman and Karl Brunner (Eric, 1989) is a school of macroeconomic and monetary economic thought that emphasises monetary neutrality in the long-run but not in the short-run, the distinction between real and nominal interest rates and a greater role in monetary policy for monetary aggregates (McCallum, Feb. 2018).

The crux of Friedman's monetary theory is his **re-statement of the quantity theory of money**. In his restatement, the quantity theory was restricted to being a theory of demand for money balances (Handa, 2009) where money is considered as an asset. Unlike a normal asset though, money is special in the theory of capital because it combines a piece from each side of the capital market, the demand side and the supply side (Friedman, 1956). It is opined further that money demand is determined by total wealth, yield on money and the taste and preferences of economic agents. In Friedman, the lifetime wealth of economic agents are allocated over commodities and the liquidity services of real balances. The lifetime wealth can be categorised into human (H) and non-human (NH) wealth and the non-human wealth further categorised into financial and physical assets. Demand for real balances is then taken to be a function of real wealth, the yields on other assets like bonds, inflation, and the ratio of human to non-human wealth. Symbolically, this can be written as (Handa, 2009) in equation 2.14.

$$M^d = \left(M^d/_p\right) = f(r_1, r_{2,\ldots\ldots} r_{n,} inf, w, \left(H/_{NH}\right)) \qquad (2.14)$$

Where

$\left(M^d/_p\right) =$ Demand for real money balances

$r_i =$ The rate of return on asset i,

$inf =$ The rate of inflation

$w =$ The total wealth and

$\left(H/_{NH}\right) =$ The ratio of human to non-human wealth

In this formulation, the demand for real money balances will be lower if inflation is high and/or wealth is low. On the other hand, demand for real money balances will be higher if the returns on other assets are lower and/or the human to non-human wealth, i.e. taken as the proxy for uncertainty, is higher (Handa, 2009).

It is noted in Keyder (1992) that, Friedman's analysis in the 'restatement of the quantity theory is quite Keynesian with his treatment of money demand as part of the asset portfolio and the importance assigned to expectations.

To obtain the money velocity, which is the total output or income over the money balances and since at equilibrium, money supply equals money demand, the velocity can be computed as in equation 2.15

$$V = \frac{Y}{\left(M^d/_p\right)} \tag{2.15}$$

Where V is the velocity and Y, the income. If current income is used for Y in equation 2.15, the velocity becomes similar to the Keynesian formulation. However, Friedman used permanent income for Y rendering V stable (Handa, 2009). With the stability of money velocity, an increase in money supply leads to an increase in the price level, output or both. However, since price tends to increase at a faster pace than output, inflation can be prevented by moderating the rate of growth of money to the rate of growth in output.

The two other leading monetarist, Karl Brunner and Allan Meltzer analysed the demand for money similar to the portfolio theory by Tobin but focuses on the wealth adjustment process underlying the demand for money balances.

Unlike the quantity theory and the liquidity preference theories of money demand that use income as the constraint variable, the **Wealth Adjustment Approach**

like the portfolio approach to money demand use wealth as the constraint (Keyder, 1992). In Brunner and Meltzer (1963), it is argued that, the role of interest rate in the transmission of monetary impulses to the pace of economic activity will differ if the system is analysed in terms of a set of interrelated flow magnitudes or stock dominated system of stock-flow relations. Even though the wealth adjustment approach is an extension of the portfolio approach as it also employs the relative yields of alternative assets in the analysis (Keyder, 1992), the wealth adjustments analysis of money demand amalgamates the flow and stock components by factoring how agents adjust their money demand in relation to the relative yields of alternative assets and their total wealth. Thus, the composition of the balance sheet of agents is adjusted in response to the relative prices- including interest rates to achieve a desired balance sheet position. Therefore, the interrelation of money with current activity appears as part of a general wealth adjustment process (Brunner & Meltzer, 1963).

In espousing the wealth adjustment and money demand theory, Meltzer (1963) re-expressed the quantity theory to reflect wealth and substitution effects on the desired cash balances economic units hold at any point in time. The demand for money balances is defined to be determined by the returns on financial assets, $(r*)$, the returns on physical assets, (ρ), the returns on human wealth, (d), and the return on non- human wealth (W_n), resulting in equation 2.16.

$$M = f(r*, \rho, d, W_n) \tag{2.16}$$

Equation 2.16 is further transformed into equation 2.17 where the yields on financial, physical and human assets are replaced by a single yield rate (r).

$$M = g(r)W \tag{2.17}$$

Where W is the non-human wealth, and r is a proxy interest rate for all the yields since over long periods, interest rates move together (Keyder, 1992). From equation 2.17, the Cambridge cash balance equation of the quantity theory of money can be obtain (Meltzer, 1963). Using time series data, it is further noted in Meltzer (1963) that there is substantial evidence in support of the quantity theory of money with the principal arguments being interest rates and non-human wealth. The stability

of the money demand and the velocity functions as postulated by Friedman (Handa, 2009) are also confirmed.

In the wealth adjustment approach, an increase in the base money will lead to a change in the existing portfolio allocations since the increase in the base money will result in increase in nominal wealth (Keyder, 1992). The increase in nominal wealth will result in the divergence of the actual and desired reserve ratios of commercial banks and the public portfolio allocations since both the banks and the public attempt to adjust their portfolios to achieve the most desirable outcome in light of prevailing market conditions. The adjustment in portfolios affects demand and supply in the credit markets and a further readjustment between the financial and nonfinancial assets within the portfolio. Since interest rates modifies the proportion of financial and nonfinancial wealth in the public's desired portfolio, this modification operates via changes in total wealth in response to variations in relative prices-yield rates on financial assets and the asset prices of real capital and changes in the income expected from human wealth (Brunner & Meltzer, 1963).

It is noted in McCallum (1981) that, the critical conclusions that can be drawn from monetarist monetary theory is their believe in the lack of permanent of trade-off between inflation and unemployment as postulated in the Phillips Curve, and the strong relationship between cyclical and secular movement in nominal incomes and the movement in money stock.

The primary role played by interest rate in influencing money demand by economic agents has been emphasised by the both the Keynesian and Monetarist theories. This is a corollary for the pervasive use of interest rate in the conduct of monetary policy with, if at all, minimal regard for quantitative monetary targets. Even when interest rate is not the primary instrument of monetary policy, it is always affected by monetary policy changes and thus can be used as an indicator of monetary policy stance (Obstfeld, Shambaugh, & Taylor, 2005).

From the ensuing, it is obvious that all the monetary theories are intended to explain the reasons money is demanded, how stable it is and the velocity of money circulation and how it impacts on inflation and real economic activity. Somehow, most

of them allude to the impact interest rates has on money demand and in the transmission of monetary shocks to the real economy in the short-run.

2.4. MONETARY TRANSMISSION

Money is at the core of all modern-day economies and the ability to influence the supply of money is indispensable to a functioning sovereign state because any shock or jerk on money reflects on the real economy. To this end, several actions are undertaken by Central Banks aimed at influencing money. These actions always lead to sequences of shocks and jerks of different economic variables that reverberate throughout the real economy. The mechanism through which monetary policy shocks affects the real economy is the monetary transmission mechanism. Also, monetary policy actions can and do affect income distribution and thus inequality. One of the studies that provided evidence in support of the impact of monetary policy on inequality through its effects on interest rates, debt to income ratios, and interest income is Niggle (1989).

The impact of monetary policy on output/income and/or distribution can be evaluated structurally or in a reduced form. This implies studies on monetary transmission can be analysed using a reduced-form model a structural model.

Reduced form models take as the focus of investigation the degree of correlation that exist between two variables to mean causality with little regards for the path through which the variables impact each other (Mishkin, 2003 p. 635). This essentially imposes no a prior restrictions (Mishkin, 2003) and has no structural parameters on the model (Funk, 2011). Monetarists, who are more inclined to reduced-form analysis of monetary transmission argue that the channels of monetary transmission are diverse and always changing making at best difficult to identify all the transmission mechanism of monetary policy. This, they contend that the full effect of monetary shocks on say Y is likely to be spotted by looking at the degree of correlation (Mishkin, 2003) rather than some presumptuous theoretical and structural parameters. This results in monetarists being long term focus (Özcan, 2016) and subscribing to the direct transmission of monetary policy.

The reduced-form models of monetary transmission have however been criticised on a number of fronts. One of the most universal criticisms of these class of

models is the basic principle of correlation not necessarily implying causation which reduced-form models implicitly and misleadingly suggests (Mishkin, 2003). Reduced-form models are also limited in providing information on how the variables interact. Also, it is noted in Timmins and Schlenker (2009) that though reduced-form models may not rely on theoritical structural assumptions, there entail their own assumptions which has to do with the required (quasi) randmomness requirment of reduced-form models.

Structural model analysis of monetary transmission is based on theory and studies the paths through which monetary policy affect the variables of interest which usually include unobservable parameters that help describe the transmission at a deeper level (Funk, 2011). Implicitly, structural models usually assume a complete knowledge of a very detailed information (Jarrow & Protter, 2004). Keynesians normally evaluate the impact of monetary policy using structural models with detailed descriptions of the behaviours of the various economic agents in various sectors and how this behaviours transmit to output and spending (Mishkin, 2003).

Structural modelling is best if the true structure of the model is known and fully understood less failing to include one or more relevant transmission mechanisms might result in an understatement of the money's impact on say, income (Mishkin, 2003). On the positive side, knowing how monetary policy interact with the targeted real variable may be helpful in predicting the effects of money and monetary policy on such a real activity more accurately. Also, changes in institutional factors will normally render reduced-form estimates non reliable. However, structural models are able to trace out and predict the effects institutional changes might have on the link between money and the real variable of interest (Mishkin, 2003). Structural links of monetary policy and income and output and on income distribution are presented in the following sections.

2.4.1. Channels of Monetary Transmission to Real Economic Activity

It is noted in Mishkin (1995) that, a successful monetary policy operation is dependent on the extent of knowledge and accuracy of the effects of monetary policy on the economy by the monetary authorities and of course timing. Otherwise, benign

monetary policy actions could have unwanted consequences inimical to the health of the economy.

In the literature, monetary policy is thought to affect the economy through several channels. These channels include the interest rate channel, exchange rate channel, asset price channel and credit channel.

2.4.1.1 Interest Rate Channel

The transmission of monetary policy through interest rate mechanisms have been a standard feature in the economic literature for over 50 years (Mishkin, 1995). Per this channel, a monetary policy tightening ($M \downarrow$) will normally lead to an increase in interest rates ($i \uparrow$) resulting in a reduction in investment spending ($I \downarrow$) and to some extent consumption which will ultimately lead to a reduction in output($Y \downarrow$). Schematically, this can be represented as

$$M \downarrow \rightarrow i \uparrow \rightarrow I \downarrow \rightarrow Y \downarrow$$

Monetary policy actions also influence the short-term nominal interest rates which, due to sticky prices and rational expectations, affect the long term real interest rate at least temporary. These changes in real rates then have a short-run effect on real net exports, real consumption and real investment and thereby on real GDP (Taylor, 1995).

In effect, the interest rate channel emphasises the effects of interest rate on the cost of capital. This position however, has been questioned by Bernanke and Gertler (1995) with the assertion that empirical studies have not been able to identify quantitatively significant effects of interest rates on real output through the cost of capital (Mishkin, 1995).

2.4.1.2 Credit Channel

In the Credit channel, the role of banks as financial mediators for certain borrowers and the impact monetary policy may have on the balance sheets of firms is emphasised. The bank lending channel presupposes that banks normally lend to small firms and individuals with whom the problems of asymmetric information can be a serious issue. In that regard, a contractionary monetary policy that leads to a decrease in bank reserves and bank deposits will lead to a reduction in bank loans. The fall in bank loans

will result in low investment by these small firms and lead to a reduction in output. That is,

$$M \downarrow \rightarrow bank\ reserves\ and\ deposits \downarrow \rightarrow bank\ loans \downarrow \rightarrow I \downarrow \rightarrow Y \downarrow$$

Questions have however been raised regarding the importance of this type of channel in the literature (see (Edwards & Mishkin, 1995); (Bernanke & Gertler, 1995))

The other type of credit channel postulates that, monetary actions impact the balance sheet balances of firms. A monetary contraction($M \downarrow$) will result in a fall in equity prices ($P_e \downarrow$), reducing the net worth of firms. Lower net worth means low collateral and raises the adverse selection problem resulting in lower lending to firms for investment (Mishkin, 1995).

$$M \downarrow \rightarrow P_e \downarrow \rightarrow collateral \downarrow \rightarrow lending \downarrow \rightarrow I \downarrow \rightarrow Y \downarrow$$

In Bernanke and Gertler (1995), it is noted that, the credit channel of monetary transmission is a misnomer because it is not a distinct channel by itself but it's a magnification of the conventional interest rate channels.

2.4.1.3 Exchange Rate Channel

With globalisation and its accompanying internationalisation of money and financial markets and the advent of flexible exchange rate regimes, more attention is given to *exchange rate* and its impact on foreign trade as a *channel* through which monetary policy affects the real economy.

Per this channel, a monetary policy tightening ($M \downarrow$) will lead to an increase in interest rates ($i \uparrow$). An increase in the domestic real interest rates makes deposits in the domestic currency more attractive leading to an increase demand for the local currency and thus an exchange rate appreciation ($E \uparrow$). This make imports cheaper and exports expensive resulting in a decrease in net exports ($X \downarrow - M \uparrow = NX \downarrow$) and consequently a decrease in output ($Y \downarrow$). Schematically, it can be represented schematically as

$$M \downarrow \rightarrow i \uparrow \rightarrow E \uparrow \rightarrow NX \downarrow \rightarrow Y \downarrow$$

2.4.1.4 Wealth Channel

The complex structure of the *asset price transmission channel* also deserves central bankers' attention, as its efficient and effective use is crucial for the accomplishment of macroeconomic objectives (Dan, 2013). It is observed in Mishkin (1995) that, however uneasy it might be, monetarist emphasise on two channels through which monetary policy influence other asset price and by extension the entirety of the economy. This includes how monetary policy affects the economy through equity prices as hypothesised by Tobin's q theory of investment and the impact of wealth on consumption expenditure.

In Tobin (1969), it is hypothesized that, if for anything, the rate of investment that is the speed at which investors wish to increase the capital stock should be related to q, the value of capital relative to its replacement cost. Thus, if q increases, the price of the firm (P_e) is high relative to its replacement cost of capital making new plants and equipment cheaper relative to the market value of the firms. The company will then be able to issue equity at a premium. Thus, general investment spending will rise because firms can buy a lot of new investment goods with only a small issue of equity (Mishkin, 1995). On the contrary, when q is low, firms will not purchase new investment goods because the market value of firms is low relative to the cost of capital leading to less investment spending and thus low output (Y). Schematically, this can be represented as

$$M \downarrow \rightarrow P_e \downarrow \rightarrow q \downarrow \rightarrow I \downarrow \rightarrow Y \downarrow$$

Also, a monetary contraction will lead to an increase in interest rates which will make bonds more attractive than equity leading to a fall in the price of equity($P_e \downarrow$), and then ($q \downarrow$) resulting in a reduction in investment ($I \downarrow$) spending and then output($Y \downarrow$).

Another channel for the transmission of monetary policy through equity prices occurs through wealth effects on consumption. This presupposes that, consumption spending is determined by the lifetime resources of consumers as in the permanent consumption hypothesis of Friedman (1957). These lifetime resources include human capital, real capital and financial wealth a major component of which is equity shares.

When equity share prices fall (P_e), the lifetime economic resource of consumers fall leading to a decrease in consumption (Mishkin, 1995). A decrease in consumption will invariably lead to a decrease in output.

$$M \downarrow \rightarrow P_e \rightarrow wealth \downarrow \rightarrow consumption \downarrow \rightarrow Y \downarrow$$

2.4.2. Monetary Transmission to Real Activity; Review of Empirical Literature

Empirically, there is a difference in the strength and effectiveness among the various monetary transmission mechanisms and knowledge of this is crucial in evaluating what the stance of monetary policy is at a particular point in time and to decide what policy instruments to use (Boivin, Kiley, & Mishkin, 2010). In Turkey, the structural reforms that were implemented after the 2001 crises improved the effectiveness of the traditional monetary transmission mechanisms. Also, financial integration and the EU accession process appear to be the leading factors in the changing dynamics of monetary transmission in Turkey (Başçı, Özel, & Sarıkaya, 2007). These collectively have made exchange rate dynamics key determinant in the monetary transmission process (Başçı et al., 2007). Upon analysing the bank lending channel in Turkey since the liberalisation of capital markets in 1988, it was concluded by Ozsuca and Akbostanci (2012) that, the bank lending channel; that is the credit channel worked well in Turkey with increased efficacy after the structural reforms in 2001. Evidence in support of the exchange rate, interest rate and credit channels have also been found in Erdoğan and Yildirim (2011), Erdogan and Yildirim (2010) and Erdoğan and Beşballı (2009) for Turkey. According to Turhan and Gumus (2014) however, the most effective channel in the case of Turkey is the exchange rate channel.

In an empirical study of the Euro Area by Sousa (2009) sought to quantify the wealth effects on consumption in the Euro Area, it was found that financial wealth effects were relatively large and statistically significant. Also, upon disaggregating financial wealth into its major components, wealth effects were particularly large for currency and deposits, shares and mutual funds and consumption seemed equally responsive to financial liabilities and mortgage loans.

Using structural vector autoregressive model that includes bank loans and uses sign restrictions to identify monetary policy shocks, the relative importance of different transmission channels via counterfactual analysis in the US were quantified

by Endut et al. (2018). The results suggested a nontrivial role for the bank-lending channel at the aggregate level though it has experience a downtrend.

Regarding the transmission process in developing countries with underdeveloped and shallow financial markets, the transmission process will be dominated by the bank lending channel as found in Kovanen (2011) with the structure of financial markets playing an important role (Mishra, Montiel, & Spilimbergo, 2010).

The interest rate channel in Ghana was analysed using time series and bank-specific data for the periods 2005-2010 in Kovanen (2011). It was found that, market interest response to the policy rate is gradual and incomplete. This was confirmed by Akosah (2015) who alluded to the incompleteness of the response of long and short-run interest rates to the monetary policy rate though the policy rate was considered an effective signal. In Sakyi, Osei Mensah, and Obeng (2017), monthly data from January 2002 to March 2016 was used to establish the short and long run rate of transmission of the policy rate to interest rates. A complete pass-through to the 91-day Treasury bill rates but a partial pass-through of the policy rate to long-run bank lending and deposit rates were found.

This sluggishness in the response of interest rates to the policy rate possess challenges to monetary policy makers and may be the result of the weak institutional framework and imperfect competition in the banking sector. With the financial system not intermediating funds properly, the traditional monetary transmission channels (interest rate, bank lending, and asset price) are impaired. The exchange rate channel, on the other hand, tends to be undermined by central bank intervention in the foreign exchange market (Mishra et al., 2010).

2.4.3. Channels of Monetary Transmission to Income Distribution

Since the market deregulations of the 1980s, the role and importance of monetary policy has been on the rise as deregulation limits the government to fiscal and monetary policy as the only tools with which to moderate the economy. While fiscal policy has received substantial attention as a contributing factor to inequality (Heshmati & Kim,2013), the role of monetary policy is yet to be decided.

However, to the extent that household characteristics—like age, type of income, and portfolio composition—are correlated with income or wealth levels and interact with monetary policy changes, they create channels through which monetary policy may affect inequality (Amaral, 2017).

It was observed in Galbraith (1998) that the over emphasis of monetary policy on inflation especially with the rise of inflation targeting and the accompanying high interest rates caused a series of recessions. These recessions translated into high unemployment rates that produced a rise in inequality. These supposed effects of monetary policy both conventional and unconventional on inequality have resulted in movements like the occupy Wall Street movement with their famous chant, 'we are the 99%'.

Admittedly, monetary policy is blunt in its ability to affect distribution of income and wealth. However, should the inequality and the lack of social mobility be a priority in the conduct of monetary policy? Doubtful. The reason being that, the uncertain distributional impact monetary policy may have on inequality should not a central bank (Fed) from pursuing its mandate which is usually to maintain price stability and issues of inequality are better addressed by other policies other than monetary policy (Bernanke, 2015).

In effect, the debate on the impact, direction and magnitude of any impact of monetary policy on inequality is still not conclusive with several theories being proposed. Coibion, Gorodnichenko, Kueng, and Silvia (2017) outlined several channels through which monetary policy may affect inequality. These channels include the portfolio channel, the income composition channel, the financial segmentation channel, the savings redistribution channel, and the earnings heterogeneity channel.

2.4.3.1 The portfolio channel

The portfolio channel postulates that, since low income households relatively hold and use more of their income in cash than high income households. An inflationary action by the central bank amounts to a form of regressive consumption

tax which is a transfer from low income households to high income households which is inequality increasing.

2.4.3.2 The income composition channel

The income composition channel is premised on the fact that there is heterogeneity across households in terms of their main sources of income. As most low-income households receive most of their incomes from labour earnings, wealthy households usually receive a larger share of their income from business and financial income. If monetary policy results in an economic expansion that leads to an increase in profits and interest income more than in wages, then those in the business and financial class will benefit disproportionately leading to an increase in inequality since they are usually the wealthy.

2.4.3.3 Financial Segmentation Channel

The other channel that is presumed to also be inequality increasing in the face of expansionary policy is the financial segmentation channel. This channel correctly observes that, different households have different exposure to financial markets where the impact of monetary policy affects the first and the hardest. An expansionary monetary policy that leads to an increase in the money supply will take time before it reflects on inflation and the real economy. To the extent that those closely link to the financial markets can act to forestall any negative impact monetary policy might have on them prior to the rest, then an increase in money supply will redistribute wealth towards these financial markets connected agents. However, since the agents who actively trade in the financial markets are the higher income class on the average, an expansionary monetary policy will be inequality increasing.

2.4.3.4 Savings Redistribution Channel

On the contrary, the saving redistribution and the earnings heterogeneity channel presupposes a decrease in inequality in the face of expansionary monetary policy. Increases in unexpected inflation lower the real value of nominal assets and liabilities, making borrowers better off at the expense of lenders, as the real value of nominal debts decreases (Amaral, 2017). To the extent that lenders are usually the high-income earners and borrowers the low-income earners, an unexpected decrease

in real interest rates and/or unexpected increase in inflation amounts to a redistribution of savings from high income households to low income households.

2.4.3.5 Earnings Heterogeneity Channel

The other channel through which monetary policy affects inequality is the earnings heterogeneity channel. Some central banks like the Federal Reserve have full employment as a complementary monetary policy target. But monetary policy affects employment and earnings differently for different categories of the labour force. As Heathcote, Perri, and Violante (2010) showed, earnings in the high-income groups are usually affected by hourly wages and that of the lower-income groups affected by hours worked and the unemployment rate. To the extent that monetary policy affects hourly wages and unemployment differently, it will produce redistributive income effects (Amaral, 2017). In this regard, an expansionary monetary policy could lead to a reduction in the unemployment rate and increase in the value of transfer payments. A contractionary monetary policy will have the opposite effect. If unemployment disproportionately fall on low income households as is believed to, then expansionary monetary policy will be inequality alleviating.

2.4.4. Evidence of Monetary Policy Impact on Income Inequality

Per the current literature, the impact of monetary policy on economic inequality is empirically contradictory. In a study using three different measures of inequality and monetary policy shocks for data spanning 1980Q1 to 2008Q4 by Coibion et al. (2017) with the impact of monetary policy shocks on inequality being estimated as a regression of various forms of equation 2.18.

$$x_t = c + \sum_{j=1}^{J} \alpha_j x_{t-j} + \sum_{i=0}^{I} \beta_i \varepsilon_{t-i} + v_t \qquad (2.18)$$

With x_t being the inequality measure, and ε being the estimated monetary policy shock, monetary policy was found to statistically affect income and labour earnings significantly. Consumption and expenditure inequality were found to be even more responsive to monetary policy shocks and they concluded that, contractionary monetary policy leads to higher inequality.

Mumtaz and Theophilopoulou (2017) used micro-level data to construct inequality measures from 1968 to 2008. Like Coibion et al. (2017), they used three measures of inequality; the Gini index, the cross-sectional standard deviation and the difference between the 90th and 10th percentiles. To study whether monetary policy shocks played a significant role in determining the level of inequality in the pre and post 1993 period, the benchmark estimation of the form in equation 2.19 was used

$$Z_t = c + \sum_{j=1}^{P} \beta_j Z_{t-j} + v_t \quad (2.19)$$

Where $Z_t = (E_t, Y_t)$ and $E_t$is the quarterly inequality measure of focus and Y_t is a matrix of quarterly GDP, CPI, short-term interest rates and the effective exchange rate. Contractionary monetary policy was found to result in deterioration in earnings and income inequality in the UK.

Using data from the Standardised World Inequality Database (SWIID) by Solt (2019), 32 developed and emerging market economies studied by Davide Furceri, Loungani, and Zdzienicka (2018). They estimated impulse response functions (IRFs) of the form in equation 2.20 directly from local projections using the methodology proposed by Jordà (2005).

$$y_{i,t+k} - y_{i,k} = \propto_i^k + v_t^k + \beta^k MP_{i,t} + \pi^k X_{i,t} + \varepsilon_{i,t}^k \quad (2.20)$$

With y being the log of the income inequality measure, $\propto_i$ being the country fixed effects, v_t being time fixed effects, MP being the monetary policy shock and X being a control matrix that includes the lagged monetary policy shocks and lagged inequality measures. The estimated results found contractionary monetary policy to increase inequality with the magnitude and transience determined by the type of monetary policy action (whether expansionary or contractionary), the time of the business cycle, the country and redistribution policies. It was however noted that, changes in policy rate as a result of changes in real growth could not be found to affect inequality.

In Erosa and Ventura (2002), a monetary growth model was constructed with key features of cross-sectional household data to study the distributional impact of inflation. It was concluded that, inflation is effectively a regressive tax and that the

burden is not evenly distributed and does increases inequality and to the extent that inflation is accelerated by expansionary monetary policy, same increases inequality. A quantitative assessment of the effect of moderate inflation on nominal wealth holdings was conducted by Doepke and Schneider (2006). It was found that, in the face of moderate inflation, rich, old households are the main losers and young and middle-income households with fixed-rate mortgage debts the main winners. This presupposes a moderate expansionary monetary policy to be inequality decreasing.

In a study using Mexico Labour Force Survey data and estimated monetary policy shocks for the period 1995Q1 to 2012Q4, Villarreal (2014) first estimated a reduced form VAR as in equation 2.21 and then inverted the coefficient matrix to compute the impulse response functions by Jordà (2005).

$$Y_{t+1} = \beta(L)Y_t + u_{t+1} \tag{2.21}$$

With $Y_t' = [\Delta y, inf, i, \Delta e]$ which is a vector of GDP growth (Δy), inflation (inf), interest Rate (i) and the exchange rate variations (Δe), $\beta(L)$ being a lag polynomial of order p, and $u_t$being the covariance matrix of innovations. It was that, unexpected contractionary monetary policy to lead to reduction in household inequality in Mexico in the short-run which dissipates within a two-year period.

Williamson (2008) showed the existence of the financial segmentation channel by constructing a monetary model of heterogeneous households to show the uneven impact of monetary policy on households. In such a model it was showed that, some households will benefit disproportionately from monetary injection triggered by monetary policy expansion while others do not get to benefit, and yet would have to bear its impact through inflation.

In an economic model of social network that link agents in terms of how much they transact with each other constructed by Ledoit (2011), it was demonstrated that, the agents closest to the location where money is injected following an increase in money supply benefit more than the agents furthest from the location of the monetary injection. Per this, it was concluded that since the cumulative effect of monetary policy actions in the long run is to increase the money supply, it is appropriate to say that monetary policy redistributes consumption goods from the agents who are furthest

from the central bank to those who are closest to the central bank and since the agents most closest to the central bank are the agents in the financial sector who are mostly the upper and upper middle classes, it is safe to say monetary policy increases inequality.

A recursive VARs and ADL model was used by Carpenter and Rodgers III (2004) to estimate the impact of the federal reserve disinflationary policies on labour market outcomes of teenagers and minorities. It was found that the employment-population ratio of minorities particularly African-Americans is more sensitive to disinflationary monetary policy than White-Americans. Since White-Americans are on average economically well off than Black-Americans and other minorities, a contractionary monetary policy that leads to a rise in unemployment in general will likely affect minorities more resulting in a rise in inequality.

CHAPTER 3

DATA AND EMPIRICAL METHODOLOGY

The purpose of this study is to determine the impact monetary policy has on inequality in Ghana. In this regard, the empirical specification of the study is presented in section 3.1. In section 3.2, the variables considered and the data and data sources are discussed with the mathematical and statistical transformations used to align the data frequencies where necessary explained in section 3.3. The general description of the econometric methodology followed to test the empirical relationship between monetary policy and inequality is explained in section 3.4. In section 3.5, to 3.7, the stationarity of the data, the steps followed to conduct the baseline estimates are explained. This include VAR and lag selection, cointegration and the Vector Error Correction Model (VECM). Section 3.8 discusses the diagnostic tests to be conducted to ascertain the whiteness of the residuals and thus the reliability of the model. The chapter is concluded with a robustness estimate in section 3.9.

3.1. VARIABLES AND EMPIRICAL SPECIFICATION

This study is a time series study with the purpose of using time series regressions to test for possible causality that might run from monetary policy to inequality as in Coibion et al. (2017); Mumtaz and Theophilopoulou (2017) and Villarreal (2014). Following the lead of Villarreal, disposable income inequality (henceforth refered to as income inequality) is modelled as a funciton of lags of inequality, monetary policy, economic growth, inflation, and exchange rate. In addition to these variables, financial development is added to control for the possible impact of financial frictions on income inquality as in Khan and Ssnhadji (2001) and Shahbaz and Islam (2011). Thus, the functional form of the model is as in equation 3.1.

$$g = f(g_{t-i}, mpr_{t-i}, inf_{t-i}, reer_{t-i}, find_{t-i}, gdp_{t-i}) \quad (3.1)$$

Where the income inequality and its lags are represented by g and g_{t-i}, the lags of the monetary policy rate by mpr_{t-i}, that of the financial development by $find_{t-i}$, inflation by inf_{t-i}, real exchange rate by $reer_{t-i}$ and the lags of the GDP growth rate by gdp_{t-i}.

3.2 DATA AND DATA SOURCES

To test the empirical model, quarterly Monetary Policy Rate (mpr)[7] of the Bank of Ghana (BoG) is used as the measure of monetary policy in Ghana. The quarterly year on year inflation[8] is used as the measure of inflation. The quarterly Monetary Policy Rate (mpr) and the quarterly year on year inflation are sourced from the Bank of Ghana monetary time series data in the Bank of Ghana (BoG) website as in Table 3.1. As a measure of income inequality in Ghana, annual Disposable Income Gini for Ghana sourced from the Standardised World Income Inequality Database (SWIID 7.1) is used. The SWIID 7.1 includes inequality data for 192 countries from 1960 to present with as many yearly data as possible. It incorporates data from several sources (United Nations University's World Income Inequality Database, the OECD Income Distribution Database, World Bank, Eurostat, and the Luxembourg Income Study) and standardizes it using Luxembourg Incom e Study data as the standard (Davide Furceri et al., 2018). In SWIID 7.1, the disposable income inequality is defined as the post-tax and post-transfer income inequality (Solt, 2019).

For the level of economic activity, the annual Real GDP Growth Rate[9] from the World Bank's World Development Indicators (WDI) is used. The Financial Development Index[10] and the Real Exchange Rate as reported by the International Monetary Fund's (IMF) International Financial Statistics (IFS) is used as measures of financial development and exchange rate respectively. All data sourced are of the period 2002Q1 to 2013Q4. The data and data sources and the frequency at which the data is reported are presented in table 3.1.

[7]This is the Bank of Ghana monetary anchoring rate. It is defined as rate signalling as a reference cap for all other rates in the Economy.

[8] The year-on-year inflation is an annualized percentage change in the general price level. This is the overall inflation measure of the Bank of Ghana

[9]The World Bank Development Indicators computes the GDP growth rate as the annual percentage growth of GDP at market prices based on constant local currency i.e. the Ghana Cedi.

[10]The Financial Development Index is a comprehensive measure of the financial development of an economy taking into account the efficiency, access and depth of financial markets and financial institutions.

Table 3.1: Variables and Data Sources

Variable	Representation	Data source	Data Frequency	Data Points
Disposable Income Gini Index	g	SWIID 7.1	Yearly	2002-2013
Monetary policy rate	mpr	BoG website[11]	Quarterly	2002Q1-2013Q4
Inflation	inf	BoG website[11]	Quarterly	2002Q1-2013Q4
Real Exchange Rate	$reer$	IFS[12]	Quarterly	2002Q1-2013Q4
Financial Development Index	$find$	IFS[12]	Yearly	2002-2013
GDP Growth	gdp	WDI[13]	Yearly	2002-2013

From table 3.1, the data which is available in quarterly frequency have 48 data points and those in annual frequency have 12 data points resulting in data frequency incompatibility.

3.3. DATA TRANSFORMATIONS

As is always the case in any econometric study with data frequency incompatibility, various interpolation and disaggregation techniques are used to transform all data of variables not reported on quarterly frequency to quarterly frequency. Like Pinkovskiy and Sala-i-Martin (2009), who used the Piece-Wise Cubic Hermite Interpolation Procedure (PCHIP) to interpolate the Gini indices for years without reported data, the Piece-Wise Cubic Hermite Interpolation Procedure (PCHIP) is used to interpolate the annual Gini indices into quarterly Gini indices. The PCHIP is a piecewise cubic polynomial that satisfies Hermite interpolation conditions. That is, the function values and derivatives are specified at each nodal point. Piecewise cubic Hermite interpolants are in general not twice continuously differentiable (Bindel, 2012).

Also, as the GDP growth (gdp) and the Financial Development Index ($find$) are reported on annual frequency, the Denton temporal disaggregation procedure is used to transform them from the annual frequency to a quarterly frequency. Sax and Steiner (2013) explains that, the Denton process first identify a preliminary quarterly

[11]Bank of Ghana, Monetary Time Series. Retrieved from https://www.bog.gov.gh/statistics/time-series-data on 20/11/2017.

[12] International Monetary Fund, International Financial Statistics: retrieved from http://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1409151240976 on 05/11/2018

[13] World Bank, World Development Indicators retrieved from https://datacatalog.worldbank.org/search/datasets?sort_by=field_wbddh_modified_date&sort_order=DESC&search_api_views_fulltext_op=AND&f%5B0%5D=field_wbddh_data_type%3A293&f%5B1%5D=type%3Adataset&f%5B2%5D=field_wbddh_country%3A116 on 05/11/2018

series ρ. The difference between the annual values of the preliminary series and the annual values of the observed series is then distributed among the preliminary quarterly series. The sum of the preliminary quarterly series and the distributed annual residuals yields the final estimation of the quarterly series y. Formally, this can be written as in equation 3.2

$$y = \rho + Du_l \tag{3.2}$$

From equation 3.2, D is a $n \times n_l$ distribution matrix, with n and n_l denoting the number of quarterly and annual observations respectively, u_l is a vector of length n_l and contains the differences between the annualized values of ρ and the actual annual values, y_l as in equation 3.3.

$$u_l = y_l - C\rho \tag{3.3}$$

The method of Denton uses a single indicator as the preliminary series. i.e.

$$\rho = X \tag{3.4}$$

Where in equation 3.4, X is a $n \times 1$ matrix. In a situation where there is no related quarterly preliminary series, the $n \times 1$ vector can be replaced with 1s in each quarter. This procedure is conducted using E-Views 10.

From the data, a log-log model is estimated by converting all the quarterly series into a quarterly log series. A log-log series is estimated if the percentage changes are of interest rather than unit changes (Dranove, 2012). This implies that the GDP growth rate in particular is interpreted as a 1% change in the GDP growth rate results in say, β_1 percent change in Gini Index.

3.4 METHODOLOGY

As a baseline estimation in this study, the Vector Auto-regression (VAR) Model/Vector Error Correction Model (VECM) is used to test the possible causality among the variables. The VAR/VECM methodology is considered one of the most user friendly, flexible and successful models in the analysis of time series (Zivot & Wang, 2006) and its chosen for this study due to those qualities. Three steps are

observed in conducting the baseline estimation. The first step, details of which is explained in section 3.5 will include investigating the level of integration of the data. Specifically, the stationarity of the variables are determined using the Augmented Dickey Fuller (ADF) test and the Phillip-Perron (PP) test for stationarity.

In step two, the VAR/VECM methodology is used to estimate the causality among the variables. This will constitute the Baseline estimation of the study. The VAR methodology and how the optimal lag length of the system is chosen are explained in section 3.6. In section 3.7, cointegration that is when it exists and the VECM methodology is discussed. The baseline estimate system diagnostics is explained in section 3.8. That is, the specific diagnostic test to ensure the appropriateness of the model estimates.

In step 3, an alternative estimate that is more robust to misspecification is presented in section 3.9. This is done by using the Impulse Response Functions (IRFs) by local projections as proposed by Jordà (2005). In case there is a disagreement between the baseline estimation and the robustness check estimation, the robustness check estimation will be preferred.

3.5 DATA STATIONARITY

Time series econometrics is interested in using current and past data to understand the behaviour of an economic variable and perhaps to be able to predict the future trend of the said variable using its past behaviour and/or the past behaviour of other related series. To do this, some level of assurance is needed about the appropriateness of the statistical properties of the data. In particular, the stationarity of the data is key. Stationarity is the stability over time of the mean and variance of an economic variable. Non-stationarity of a time series means that the series does not have a constant variance and lacks a fix long-term mean. Stated positively, the mean tends to move farther away from any given initial state as time goes on (Nelson & Plosser, 1982). Stationarity ensures that all parts of the series are like the other parts, and since at any given time, stationarity is a prerequisite if the estimated parameters are going to be reliable. In general, non-stationary time series have a slowly decreasing Auto Correlation Function (ACF) whereas stationary time series' ACFs decrease at a very fast pace.

Even though stationarity may be a desirable statistical property in economic time series data, it is the exception instead of the norm since most macroeconomic time series data fluctuate with no tendency to return to a deterministic path (Nelson & Plosser, 1982). This usually calls for the transformation of the data by differencing the raw-data or the log forms of the raw-data. Also, the data may be de-trended and/or an intercept added to distinguish dependent component of the series and the generally stochastic component. This will normally result in a stationary time series.

Libanio (2005) notes that, unit roots have come to be associated with stationarity. If a series has no unit roots, it is characterized as stationary, and therefore exhibits mean reversion in that it fluctuates around a constant long run mean. Also, the absence of unit roots implies that the series has a finite variance which does not depend on time, and that the effects of shocks dissipate over time.

To illustrate stationarity using unit roots, suppose an Autoregressive time series of lag 1 (AR (1)) with no trend and intercept is represented by equation 3.5

$$y_t = \beta y_{t-1} + \varepsilon_t \tag{3.5}$$

Using the time series lag operator L, the above AR (1) series can be rewritten as in equation 3.6.

$$y_t = \beta L y_t + \varepsilon_t \tag{3.6}$$

With simple algebra, equation 3.6 can be transformed to equation 3.7 and 3.8.

$$y_t - \beta L y_t = \varepsilon_t \tag{3.7}$$

$$(1 - \beta L) y_t = \varepsilon_t \tag{3.8}$$

In equation 3.8, if $|\beta| = 1$, then the series is said to have a unit root and thus non-stationary. However, if $|\beta| < 1$, the data is said to be stationary. In the case where $|\beta| > 1$ which is unlikely (Dickey, Bell, & Miller, 1986), the series is said to be explosive.

This AR(1) can be generalized to an AR(p) process. Assuming an AR(p) data generating process with no trend and constant, such a process can be written as in equation 3.9.

$$y_t = \partial_1 y_{t-1} + \partial_2 y_{t-2} + \cdots . + \partial_p y_{t-p} + \varepsilon_t \quad (3.9)$$

Noting that if the error term is made the subject, equation 3.9 will be transformed into equation 3.10.

$$y_t - \partial_1 y_{t-1} - \partial_2 y_{t-2} - \cdots . - \partial_p y_{t-p} = \varepsilon_t \quad (3.10)$$

This can be written using the backshift lag operator L so that equation 3.10 become equation 3.11.

$$\varepsilon_t = (1 - \partial_1 L - \partial_2 L^2 - .. - \partial_p L^p) y_t \quad (3.11)$$

This gives the characteristic polynomial in equation 3.12.

$$f(L) = 1 - \partial_1 L - \partial_2 L^2 - .. - \partial_p L^p \quad (3.12)$$

If the inverse roots of all this characteristic polynomial lie within the unit circle, then the series is said to be stationary. Said differently, the existence of a unit root amount to $L = 1$ in equation (3.12) which will result in equation 3.13.

$$f(1) = 1 - \partial_1 - \partial_2 - .. - \partial_p \quad (3.13)$$

If we take the sum of the ∂_i to be γ, then equation 3.13 can be rewritten as equation 3.14

$$\partial_1 + \partial_2 + \cdots . + \partial_p = \gamma = 1 \quad (3.14)$$

Thus, when there is a unit root, the sum of the coefficients of the lag operators in the characteristic polynomial will be equal to 1.

More succinctly, equation (3.9) can be rewritten as in equation 3.15

$$\Delta y_t = (1 - \gamma) y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t \quad (3.15)$$

If we then take $1 - \gamma = \delta$, then testing for unit roots amounts to testing the null of $\delta = 0$ against the alternative of $\delta < 0$.

To test for unit roots and thus, stationarity, the Augmented Dickey Fuller (ADF) test and the Philip Peron test of stationarity are used allowing for different deterministic values as intercept or trend to settle on the optimal model.

The ADF test statistic is computed as in equation 3.16.

$$T = \frac{(\delta - 1)}{(SE(\delta))} \tag{3.16}$$

Where δ is the estimate of δ from the fitting of equation 3.15 and SE is the standard error (Papana, Kyrtsou, Kugiumtzis, & Diks, 2014).

In equation 3.15, the term $\sum_{i=1}^{p} \beta_i \Delta y_{t-i}$ is an augmentation of lag p to the basic AR(1) model. The augmentation of Δy_t is essential if the error term ε_t is auto-correlated at lag 1. If there is autocorrelation, the test would be 'oversized', implying that the rate at which a null hypothesis is incorrectly rejected would be higher (Brooks, 2014). The null hypothesis of the ADF test is that there is a unit root, i.e. the data is not stationary, and the alternative hypothesis is that the data has no unit roots thus, is stationary. The estimated ADF statistic is compared with critical values of the DF distribution which follows a non-standard distribution to determine if the data generating process is stationary or not.

The Phillips-Perron (PP) test is useful in the case of weakly dependent errors. It deals with serial correlation by employing a nonparametric serial correlation correction factor (Del Barrio Castro, Rodrigues, & Taylor, 2013). The PP test is generally an extension of the ADF test that have been made robust to serial correlation.

In testing for the stationarity, the ADF and the PP test are computed with intercept, intercept and trend and with no deterministic term.

3.6 VECTOR AUTO-REGRESSIONS (VARS), AND LAG LENGTHS

Modern econometrics is commonly regarded as being laid out by and formalized by the Cowles Commission (henceforth, CC) during the 1940s (Qin, 2013).

It is noted in Qin that, though the CC research was an intellectual success that consolidated mainstream econometrics, it was an empirical failure which the research community was very aware of. To remedy the empirical failure of the mainstream econometric models at the time, several alternatives to the CC methodology were advocated among which included the Vector Autoregressive (VAR) methodology that is viewed by Qin (2013) as a fusion of the CC tradition and time series statistical analysis catalysed by the Rational Expectation movement.

In advancing the VAR model as a more robust and realistic approach to macroeconomic modelling, it is argued in Sims (1980) that, though extant macroeconomic models at the time were to some extent successful, the connections of these models and reality, the style in which identification is achieved for these models were inappropriate due to the incredibility of a priori restrictions due to the likely vagueness of theories. Using such theories in determining which variables to deem exogenous and which to deem endogenous are therefore most likely to be invalid. In VAR analysis, restrictions are imposed to a large extent by statistical tools rather than a priori theoretical considerations that could be controversial (Lütkepohl, 2005). This is one of the major advantages of the VAR methodology (Brooks, 2014).

The most basic form of a VAR system is the bivariate model of lag 1. As a system of linear equations, these can be written as 3.17

$$\begin{aligned} y_{1t} &= \beta_{10} + \beta_{11} y_{1t-1} + \alpha_{11} y_{2t-1} + \epsilon_{1t} \\ y_{2t} &= \beta_{20} + \alpha_{21} y_{1t-1} + \beta_{21} y_{2t-1} + \epsilon_{2t} \end{aligned} \tag{3.17}$$

Where the y_{it} stands for variable i at time t, the αs and βs being coefficients of the various lags of the endogenous variables and ϵ_{it} is the error term i at time t.
This can be represented in a matrix form as in equation 3.18

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix} \tag{3.18}$$

And as a reduced form VAR as in equation 3.19;

$$y_t = c + \beta_1 y_{t-1} + \epsilon_{1t} \tag{3.19}$$

Extending this to lag-p and the 6-variable system of the disposable Gini index (g), monetary policy rate (mpr), financial development index ($find$), exchange rate ($reer$), inflation (inf) and GDP growth (gdp), the VAR system can be formulated using summations as in equations 3.20.

$$
\begin{aligned}
lg_t &= c_1 + \sum_{i=1}^{p} \alpha_{1i} lg_{t-i} + \sum_{i=1}^{p} \alpha_{1i} lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{1i} lfind_{t-i} + \sum_{i=1}^{p} \alpha_{1i} lgdp_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{1i} lreer_{t-i} + \sum_{i=1}^{p} \alpha_{1i} linf_{t-i} + \varepsilon_{1t} \\
lmpr_t &= c_2 + \sum_{i=1}^{p} \alpha_{2i} lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{2i} lg_{t-i} + \sum_{i=1}^{p} \alpha_{2i} lfind_{t-i} + \sum_{i=1}^{p} \alpha_{2i} lgdp_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{2i} lreer_{t-i} + \sum_{i=1}^{p} \alpha_{2i} linf_{t-i} + \varepsilon_{2t} \\
lfind_t &= c_3 + \sum_{i=1}^{p} \alpha_{3i} lfind_{t-i} + \sum_{i=1}^{p} \alpha_{3i} lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{3i} lg_{t-i} + \sum_{i=1}^{p} \alpha_{3i} lgdp_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{3i} lreer_{t-i} + \sum_{i=1}^{p} \alpha_{3i} linf_{t-i} + \varepsilon_{3t} \\
lgdp_t &= c_4 + \sum_{i=1}^{p} \alpha_{4i} lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{4i} lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{4i} lfind_{t-i} + \sum_{i=1}^{p} \alpha_{4i} lg_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{4i} lreer_{t-i} + \sum_{i=1}^{p} \alpha_{4i} linf_{t-i} + \varepsilon_{4t} \\
lreer_t &= c_5 + \sum_{i=1}^{p} \alpha_{5i} lreer_{t-i} + \sum_{i=1}^{p} \alpha_{5i} lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{5i} lfind_{t-i} + \sum_{i=1}^{p} \alpha_{5i} lgdp_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{5i} lg_{t-i} + \sum_{i=1}^{p} \alpha_{5i} linf_{t-i} + \varepsilon_{5t} \\
linf_t &= c_6 + \sum_{i=1}^{p} \alpha_{6i} linf_{t-i} + \sum_{i=1}^{p} \alpha_{6i} lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{6i} lfind_{t-i} + \sum_{i=1}^{p} \alpha_{6i} lgdp_{t-i} \\
&\quad + \sum_{i=1}^{p} \alpha_{6i} lreer_{t-i} + \sum_{i=1}^{p} \alpha_{6i} lg_{t-i} + \varepsilon_{6t}
\end{aligned}
\tag{3.20}
$$

Where ε_{it} is an error term with its expectation and covariance equalling zero (i.e $E(u_{it}) = 0$ and $E(u_{1t}u_{2t}) = 0$). The corresponding reduced form VAR of the 6-variable model of this study can then be written as in equation 3.21

$$y_t = c + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + .. + \alpha_k y_{t-p} + \varepsilon_t \quad (3.21)$$

Where y_t is a 6×1 vector of the logs of the Gini index, monetary policy rate, inflation, financial development, GDP and exchange rate, c is a 6×1 vector of constants, α_i for $i = 1,2, \ldots . k$ are 6x6 vectors of the coefficients of the lagged terms and y_{t-i} are 6×1 vectors of the lagged terms of the variables.

With regards to the lag length p, Hatemi-J and Hacker (2009) note that the VAR model, being a dynamic model accords with economic theory. However economic theory is not helpful in determining the length of the dynamic process. In determining the length of the dynamic process, the three most widely used criterions are the Akaike (1969) information criterion, (AIC), the Schwarz (1978) Bayesian criterion (SBC) and the Hannan and Quinn (1979) criterion (HQC). In their Monte Carlo simulation study, Hatemi-J and Hacker (2009) proved that, combining the Likelihood Ratio (LR) test with the SBC and HQC can result in significant improvement in the optimal lag length chosen compared to when only the SBC or HQC are used. It is argued there that, this improvement is irrespective of homoscedasticity or conditional heteroscedasticity.

With the paucity of data points and the purpose of the study in mind, consistency is preferred and thus, the SBC over the AIC in line with Lütkepohl (2005) who notes that, if consistency is the yardstick for evaluating the criteria, under certain conditions (refer to Lütkepohl (2005: 149)), the SBC and HQC are superior. The reason being that the SBC and HQC will identify the correct model with few lags on average than the AIC.

A normal VAR will not be appropriate in the presence of cointegration, an error correction term (ect) could be added to the VAR to transform it into a VECM. The conditions and the procedure in transforming a VAR into a VECM are detailed in sub-section 3.7.

3.7 COINTEGRATION AND THE VECTOR ERROR CORRECTION MODEL (VECM)

If the data is non-stationary, stationarity can be achieved by differencing the series until they become stationary and then use the differenced series to run the regressions. However, if the variables prove to be cointegrated, differencing may not suffice.

Normally, if two series say, y_t and x_t which are integrated of order d and d_i respectively are linearly combined, the resultant series z_t will usually be integrated of the higher of d and d_i (Granger, 1981). However, when z_t is integrated of a lesser order or is stationary, then the variables are said to be cointegrated and although the series may diverge in the short term, they are tied together in the long run (Granger, 1981).

In this study, the variables are said to be cointegrated if the time series data of the variables turn out to be I(1) and the residuals from the estimation of the VAR is I(0). Explicitly, if z_t in equation 3.22 is stationary even though some of the variables are non-stationary, then the variables are cointegrated and exhibit a sign that in the long-run, the variables move together.

$$lg_t - (c_1 + \sum_{i=1}^{p} \alpha_{1i} lg_{t-i} + \sum_{i=1}^{p} \alpha_{1i} lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{1i} lfind_{t-i} + \sum_{i=1}^{p} \alpha_{1i} lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{1i} lreer_{t-i} + \sum_{i=1}^{p} \alpha_{1i} linf_{t-i}) = z_t \quad (3.22)$$

In the case of cointegration, a Vector Error Correction Model (VECM) ought to be formulated instead. A VECM is a special formulation of the VAR with the ability to examine both the short term and long-term relations of non-stationary cointegrated variables.

The VECM is a formulation of a VAR in difference with an additional term known as the ECT (Error Correction Term) the coefficient of which indicates the rate at which deviations from the long-term equilibrium are corrected.

The VECM formulation of the system this study is presented in equation 3.23.

$$\Delta lg_t = c_1 + \sum_{i=1}^{p} \alpha_{1i}\Delta lg_{t-i} + \sum_{i=1}^{p} \alpha_{1i}\Delta lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{1i}\Delta lfind_{t-i} + \sum_{i=1}^{p} \alpha_{1i}\Delta lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{1i}\Delta lreer_{t-i} + \sum_{i=1}^{p} \alpha_{1i}\Delta linf_{t-i} + \emptyset_1 w_{t-1} + \varepsilon_{1t}$$

$$\Delta lmpr_t = c_2 + \sum_{i=1}^{p} \alpha_{2i}\Delta lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{2i}\Delta lg_{t-i} + \sum_{i=1}^{p} \alpha_{2i}\Delta lfind_{t-i} + \sum_{i=1}^{p} \alpha_{2i}\Delta lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{2i}\Delta lreer_{t-i} + \sum_{i=1}^{p} \alpha_{2i}\Delta linf_{t-i} + \emptyset_2 w_{2t-1} + \varepsilon_{2t}$$

$$\Delta lfind_t = c_3 + \sum_{i=1}^{p} \alpha_{3i}\Delta lfind_{t-i} + \sum_{i=1}^{p} \alpha_{3i}\Delta lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{3i}\Delta lg_{t-i} + \sum_{i=1}^{p} \alpha_{3i}\Delta lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{3i}\Delta lreer_{t-i} + \sum_{i=1}^{p} \alpha_{3i}\Delta linf_{t-i} + \emptyset_3 w_{3t-1} + \varepsilon_{3t}$$

$$\Delta lgdp_t = c_4 + \sum_{i=1}^{p} \alpha_{4i}\Delta lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{4i}\Delta lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{4i}\Delta lfind_{t-i} + \sum_{i=1}^{p} \alpha_{4i}\Delta lg_{t-i} + \sum_{i=1}^{p} \alpha_{4i}\Delta lreer_{t-i} + \sum_{i=1}^{p} \alpha_{4i}\Delta linf_{t-i} + \emptyset_4 w_{4t-1} + \varepsilon_{4t}$$

$$\Delta lreer_t = c_5 + \sum_{i=1}^{p} \alpha_{5i}\Delta lreer_{t-i} + \sum_{i=1}^{p} \alpha_{5i}\Delta lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{5i}\Delta lfind_{t-i} + \sum_{i=1}^{p} \alpha_{5i}\Delta lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{5i}\Delta lg_{t-i} + \sum_{i=1}^{p} \alpha_{5i}\Delta linf_{t-i} + \emptyset_5 w_{5t-1} + \varepsilon_{5t}$$

$$\Delta linf_t = c_6 + \sum_{i=1}^{p} \alpha_{6i}\Delta linf_{t-i} + \sum_{i=1}^{p} \alpha_{6i}\Delta lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{6i}\Delta lfind_{t-i} + \sum_{i=1}^{p} \alpha_{6i}\Delta lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{6i}\Delta lreer_{t-i} + \sum_{i=1}^{p} \alpha_{6i}\Delta lg_{t-i} + \emptyset_6 w_{6t-1} + \varepsilon_{6t} \quad (3.23)$$

Where w_{t-1} is the error correction term (ect) and the coefficient, $\emptyset$ is the speed of adjustment which measures the speed at which the system returns to equilibrium after a shock.

Since the purpose of this study is to determine the impact of monetary policy on inequality, the main equation of interest among the group of equation in 3.23 is the equation with Δg_t on the LHS which is extracted as in equation 3.24.

$$\Delta lg_t = c_1 + \sum_{i=1}^{p} \alpha_{1i} \Delta lg_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lmpr_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lfind_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lgdp_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lreer_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta linf_{t-i} + \emptyset_1 w_{t-1} + \varepsilon_{1t} \quad (3.24)$$

In a reduced form, the VECM system in 3.23 can be represented as in equation 3.25.

$$\Delta y_t = c + \Pi y_{t-1} + \alpha_1 \Delta y_{t-1} + \alpha_2 \Delta y_{t-2} + \cdots + \alpha_{p-1} \Delta y_{t-(p-1)} + e_t \quad (3.25)$$

Which is a transformation of equation (3.21) by taking the first-difference of the vectors of variables and adding the vector of the cointegrating residuals, Πy_{t-1}.

Cointegration is widely tested for using the Johansen (1988) Cointegration approach. This approach uses maximum likelihood estimators of the cointegration vectors for an autoregressive process with independent Gaussian errors and derives a likelihood ratio test for the hypothesis. The Johansen Cointegration methodology is widely used due to its applicability to multiple time series variables and its ability to detect more than one cointegrating equations in the system. This makes it better than the estimated regression residuals methodology by Engle and Granger (1987) since it takes into account the error structure of the underlying process (Johansen, 1988).

To illustrate the Johansen (1988) methodology using the reduced form VECM in equation 3.24, the long-run static equilibrium associated with the system is $\Pi y = 0$ where the long-run coefficient matrix, Π, is the long-run cointegrating $n \times n$ matrix (Irandoust & Ericsson, 2004).

The rank (r), that is the number of independent vectors present in the long-run coefficient matrix, Π, is then analysed. If the matrix Π turns out to be of full rank, i.e $r = n$, when n is the number of variables, then it implies that all the variables are stationary and thus a normal VAR in levels can be run. If the rank is $r = 0$, it means

the variables are not cointegrated and a VAR in difference is the answer. However, if the rank is $n > r > 0$, then there is said to be r independent cointegrating equations in the system. The rank (r) of the matrix Π is solved for by using its eigenvalues with the eigenvalues ordered in descending order of $\lambda_1 \geq \lambda_2 \geq .. \geq \lambda_n$. The number of cointegrating equations, r, present in the system is then tested for using either the trace statistic or the maximum eigenvalue statistic which are of the form as presented in equations 3.25 and 3.26 respectively (Brooks, 2014).

$$\lambda_{trace}(r) = -T(\sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \quad (3.25)$$

And

$$\lambda_{max}(r, r+1) = -Tln(1 - \hat{\lambda}_i) \quad (3.26)$$

From equations 3.25 and 3.26, T is the sample size and ln is the natural logarithm. The trace statistic is used to test the null of at most r cointegrating vectors against the alternative of more than r cointegrating vectors and the maximum eigenvalues test statistic is used to test the null of r cointegrating vector against the alternative of $r + 1$.

Granger (1988) notes that, in the presence of cointegration by non-stationary data, the VECM is estimated with the cointegrating vector capturing the long-run relationship present in the system. Causality, that is, an interaction is significant in the long-run, if the coefficient of the error correction term, the $\emptyset_1$ of equation 3.24, is negative and significant (Papana et al., 2014). In the reduced form VECM as in equation 3.25, Lütkepohl (2005) notes that, the cointegrating matrix Π is not unique and thus need to be normalised to ensure a unique cointegration matrix. It is also stressed by Lütkepohl that, the normalisation does not imply a loss of generality and that it is only assumed that the variables can be arranged so as to make normalisation feasible.

Short-run causality is said to exist if the corresponding coefficients α_i of specific variables in equation 3.23 are significant (Papana et al., 2014). However, since the α_i are coefficients of several lags of variables, it will be challenging to see which sets of variables have significant effects on each dependent variable and which do not (Brooks, 2014). To overcome this challenge, the VEC Granger/Block Exogeneity Wald test is used to determine the short-run causal relations in the system.

To help with interpretation, the VAR/VECM Impulse Response Functions (IRFs) are computed. With the IRFs, a one standard deviation positive shock is applied to the endogenous variable and the reaction of the exogenous variable is observed.

3.8 BASELINE ESTIMATION DIAGNOSTICS

The validity of a VAR/VECM model in capturing the dynamic relationship among a set of variables is largely dependent on the appropriateness of the assumptions underlying the variables and the error term (Gujarati, 2009). Whiles the presence of serial correlation may not result in inconsistency or biasness in the estimated output, it does affect the efficiency and thus its appropriateness (Williams, 2015). To ensure that the estimated VAR/VECM is efficient, the Breusch-Godfrey Serial Correlation LM test is used. This is more powerful than the Durbin-Watson test of serial correlation (Gujarati, 2009).

Also, the error term represents large number of variables not explicitly introduced in the system and it is hoped that the influence of these omitted variables is small and random(Gujarati, 2009). This amount to the error terms having a zero mean and a constant variance, that is, normality in the error terms. This guarantees that the coefficient estimates will be well behaved in statistical hypothesis testing. The skewness of the error terms implies a systematic impact of the error terms on the estimated results making the results invalid. To determine the normality of the residuals, the Jarque-Bera test of normality is used.

Even though much of the analysis in VAR can be done in the presence of conditional heteroscedasticity, it may still be useful to check for conditional heteroscedasticity so as to better understand the properties of the underlying data and to improve interpretation (Lütkepohl, 2011). In this regard, the heteroscedasticity of the system is checked with the Breusch-Pagan-Godfrey Test for Heteroskedasticity.

3.9 ROBUSTNESS ESTIMATION-IMPULSE RESPONSE FUNCTIONS BY LOCAL PROJECTIONS

The standard way of estimating the Impulse Response Functions (IRFs) involves estimating a VAR and then transforming the VAR system into a Moving Average representation by using the Wold Decomposition theorem. This two-step

procedure is fine and justifiable if the model coincides with the data generating process (Jordà, 2005). Also, the VAR that will ensure the data generating process is captured will mostly require a very large VAR order much larger than is feasible in a typical empirical study and thus is not particularly suited when the sample size is small (Brugnolini, 2018; Haug & Smith, 2007). The IRFs by local projections proposed by Jordà (2005) however is immune to both these weaknesses. This makes the IRFs by local projections robust to misspecification errors (Brugnolini, 2018; Jordà, 2005; Villarreal, 2014). Due to this, the IRFs by local projections is used to estimate the response of the dependent variables matrix on income inequality in Ghana.

An impulse response is differential of two forecast of the same horizon (Villarreal, 2014). The IRFs by local projections linearly projects the vector of variables at time $t + k$ onto the linear space generated using the information available at time t (Haug & Smith, 2007; Jordà, 2005; Villarreal, 2014). Specifically, if vector $Y_t = (g, mpr, find, reer, inf, gdp)$, then the k step ahead vector Y_{t+k} is estimated as in equation 3.27.

$$Y_{t+k} = \alpha^k + \beta_1^{k+1} Y_{t-1} + \cdots + \beta_p^{k+1} Y_{t-p} + \varepsilon_{t+k}^k \quad (3.27)$$

With the β_i^{k+1} being the coefficient matrices at lag i at horizon $t + k$ and ε_{t+k}^k the error term. From equation 4, the IRF from local linear projections is then defined as a function of the coefficient matrices and the experimental shock d_i as in equation 3.28.

$$IRF(t, k, d_i) = \beta_1^k d_i \quad (3.28)$$

The IRFs by local projections are computed using the E-views add-inn "localirfs" written by Ocakverdi (2016).

The "localirfs" add-inn is designed to be implemented on an existing VAR (Ocakverdi, 2016). Noting how difficult estimating the IRFs for cointegrated VARs i.e. VECM can be, Jordà (2005) argues the IRFs can be estimated without reference to the data generating process by the local projections method. This implies the existence of cointegration is immaterial to the power of the local projections method estimated IRFs. In this study, the data stationarity test is conducted using the Augmented Dickey Fuller and the Phillips–Perron tests of stationarity to determine the level of integration

of the variables. If the variables are found to be integrated not at level, the cointegration test is conducted using the Johansen test of cointegration. The existence of cointegration will mean the presence of an Error Correction term and thus a VECM will be estimated based on which the IRFs is computed. Less, localirfs will be implemented on a standard VAR.

CHAPTER 4

EMPIRICAL RESULTS

In this chapter, the results of the empirical analysis are reported and discussed. In sections 4.1 and 4.2 respectively, the prerequisites of stationarity and the optimal lag length for the system is reported. This is followed by section 4.3 which reports the results of the baseline estimation. In this section, the findings of the Johansen Cointegration Test and thus the long-run relationship of the variables are presented. This is followed by the results of the VEC Granger Causality/Block Exogeneity Wald Tests which indicate the short-run causality in the system. Also, the graphs of the VECM Impulse Response Functions (IRFs) are analysed. This section concludes with the results of the rudimentary residual diagnoses. In section 4.4, the results of the Robustness Check estimation is presented. Section 4.5 then summarises the results.

4.1. STATIONARITY TEST RESULTS

The first step in modelling time series data is to determine the order at which the variables are integrated which amounts to whether the variables have unit roots at level, first or second difference as explained in chapter three (3). To test for stationarity of the data, the Augmented Dickey-Fuller (ADF) Test and Phillip-Perron (PP) Test are used. The analysis were conducted using the E-Views 10 data analysis program. The results are presented in Table1 4.1.

The results indicate that all the variables are non-stationary at level $I(0)$ irrespective of whether trend and intercept are included or not for the ADF test. Also, all the variables except the income Gini are non-stationary at level using the PP test. The income Gini is stationary at level using the PP test with no intercept and trend, with intercept and with intercept and trend. However, at first difference, all the variables were stationary with no trend and intercept for both the ADF test and the PP test using the *Schwarz Information Criterion* to select the lags. With the inclusion of trend and intercept, all the variables except the log of disposable income Gini for the ADF test and except for the log of Gini and the log of GDP growth were still stationary.

4.2. OPTIMAL LAG SELECTION

After the order of integration is established, the optimal lag of the system with income inequality (g), monetary policy rate (mpr), financial development index ($find$) inflation (inf), real exchange rate ($reer$) GDP growth (gdp) was determined. As stated in the methodology chapter, a VAR in levels is estimated and the lag length criterion test ran. The optimal lag chosen for the system per all the criterions is 4 as presented in table 4.2. Thus, throughout the analysis, the study maintains a lag length of 4 as found by all the lag selection criterions.

4.3 BASELINE ESTIMATION RESULTS

The baseline estimation involved the cointegration results representing the long-run relationship among the variables, Vector Error Correction Regressions and the VEC Granger/Block exogeneity test results and the accompanying IRFs. The results are detailed in the appropriate sub-sections.

4.3.1 Base-Line Results: Long-run Causality

To determine whether a series of non-stationary variables are related in the long-run amounts to determining whether the variables are cointegrated. As has already been explained in the methodology chapter, the Johansen (1988) cointegration test was used to determine if there exist any cointegrating relationship among the variables in the long-run. The results of both the Trace statistic and the Maximum eigenvalue statistic could not reject the null of at most 5 cointegrating equations. The results of the Johansen Cointegration test is presented in table 4.3.

With the system found to be cointegrated as in table 4.3, A VECM with Δlg_t on the LHS is estimated i.e. equation 3.24. At 5 decimal places, this is found to be as in equation 4.1.

Table 4.1: Stationarity

		H_0: Series has a unit root					
		ADF Tests			PP Tests		
Level		None	Intercept	Intercept and trend	None	Intercept	Intercept and trend
	Lg	[2.766234] (0.9982)	[-1.40] (0.5693)	[-2.72017] (0.2339)	[8.120229] (1.0000)	[-4.5146] (0.0007)***	[-5.06743] (0.0008)***
	Lmpr	[-0.773056] (0.3759)	[-2.116291] (0.2394)	[-1.895588] (0.6407)	[-0.861832] (0.3373)	[-1.874514] (0.3411)	[-1.534350] (0.8033)
I(0)	**Lreer**	[-0.618518] (0.4441)	[-1.415186] (0.5670)	[-1.606261] (0.7755)	[-0.654695] (0.4283)	[-1.490413] (0.5297)	[-1.628326] (0.7665)
	linf	[-0.560711] (0.4690)	[-1.829254] (0.3622)	[-2.020406] (0.5752)	[-0.555843] (0.4711)	[-2.030796] (0.2731)	[-2.381337] (0.3841)
	Lfind	[-1.222014] (0.1997)	[-0.118082] (0.9406)	[-2.211855] (0.4707)	[-1.084536] (0.2479)	[-1.914490] (0.3230)	[-2.381168] (0.3842)
	Lgdp	[0.136986] (0.7208)	[-2.071918] (0.2566)	[-2.889982] (0.1753)	[-0.107024] (0.6416)	[-2.252022] (0.1915)	[-2.569714] (0.2953)
	Lg	[-2.328891] (0.0208)**	[-3.444661] (0.0145)**	[-3.103229] (0.1182)	[-2.041490] (0.0407)**	[-2.798927] (0.0663)*	[-2.671325] (0.2527)
	Lmpr	[-5.633960] (0.0000)***	[-4.285271] (0.0014)***	[-4.400929] (0.0054)***	[-5.634002] (0.0000)***	[-4.285271] (0.0014)***	[-4.384793] (0.0056)***
I(1)	**Lreer**	[-3.756859] (0.0004)***	[-5.572378] (0.0000)***	[-5.616935] (0.0002)***	[-6.695556] (0.0000)***	[-5.555081] (0.0000)***	[-6.786324] (0.0000)***
	linf	[-4.111867] (0.0001)***	[-6.350198] (0.000)***	[-6.280217] (0.0000)***	[-2.418746] (0.0166)**	[-6.385202] (0.0000)***	[-6.319985] (0.0000)***
	Lfind	[-6.106775] (0.0000)***	[-4.296611] (0.0015)***	[-4.718510] (0.0028)***	[-2.346806] (0.0198)**	[-2.481005] (0.1266)	[-2.473664] (0.3391)
	Lgdp	[-1.816406] (0.0663)*	[-6.064447] (0.0000)***	[-6.025053] (0.0000)***	[-2.22287] (0.0267)**	[-2.325038] (0.1687)	[-2.310685] (0.4200)

t-statistics in [ ] & prob. ( )

Stationarity at 1%, 5% and 10% level of significance are represented by (***),(**) and (*) respectively

Table 4.2: Lag selection

VAR Lag Order Selection Criteria
Endogenous variables: LG LMPR LFIND LREER LINF LGDP
Exogenous variables: C

Lag	LogL	LR	FPE	AIC	SC	HQ
0	343.2270	NA	8.87e-15	-15.32850	-15.08520	-15.23828
1	658.9896	531.0552	2.71e-20	-28.04498	-26.34189	-27.41339
2	836.6572	250.3498	4.74e-23	-34.48442	-31.32153	-33.31147
3	912.6961	86.40786	9.92e-24	-36.30437	-31.68169	-34.59006
4	1004.239	79.059*	1.38e-24*	-38.829*	-32.746*	-36.5737*

* 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

Table 4.3: Cointegration

Series: LG LMPR LFIND LREER LP LGDP
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.926931	274.4525	95.75366	0.0000
At most 1 *	0.806894	159.3328	69.81889	0.0000
At most 2 *	0.606967	86.97421	47.85613	0.0000
At most 3 *	0.460239	45.88434	29.79707	0.0003
At most 4 *	0.334469	18.75268	15.49471	0.0156
At most 5	0.018848	0.837208	3.841466	0.3602

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.926931	115.1196	40.07757	0.0000
At most 1 *	0.806894	72.35863	33.87687	0.0000
At most 2 *	0.606967	41.08987	27.58434	0.0005
At most 3 *	0.460239	27.13167	21.13162	0.0063
At most 4 *	0.334469	17.91547	14.26460	0.0127
At most 5	0.018848	0.837208	3.841466	0.3602

Trace and Max-eigenvalue tests indicate 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

$$
\begin{aligned}
dlg_t = {} & -0.01128 ect_{t-1} + 1.42522 dlg_{t-1} - 1.05929 dlg_{t-2} + 0.16963 dlg_{t-3} \\
& + 0.00003 dlmpr_{t-1} + 0.00019 dlmpr_{t-2} - 0.00017 dlmpr_{t-3} \\
& - 0.00036 dlfind_{t-1} - 0.00060 dlfind_{t-2} - 0.00071 dlfind_{t-3} \\
& + 0.00013 dlreer_{t-1} + 0.00045 dlreer_{t-2} - 0.00005 dlreer_{t-3} \\
& + 0.00012 dlinf_{t-1} + 0.00011 dlinf_{t-2} + 0.00009 dlinf_{t-3} \\
& + 0.00011 dlgdp_{t-1} - 0.00009 dlgdp_{t-2} + 0.00010 dlgdp_{t-3} \\
& + 0.00035
\end{aligned}
$$

(4.1)

From equation 4.1, the speed of adjustment, -0.01128 is statistically significant with a $p-value$ of 0.0016 implying that 1.12% of deviations from the long run equilibrium in period t are corrected in period $t+1$. The magnitude though small is statistically significant with 0.0016 level of significance.

The normalized cointegration coefficients that indicate the relationship between the variables with the presumed dependent variable normalized to have a coefficient of one with their corresponding standard deviations are presented in table 4.4.

Table 4.4: Normalised cointegrating Coefficients

Normalized cointegrating coefficients (Standard Errors in parentheses)							
Variable	LG	LMPR	LFIND	LREER	LP	LGDP	Constant
Coefficient	1.0	-0.040803	-0.005089	0.022757	0.027680	0.003007	-3.78406
		(0.00577)	(0.01191)	(0.01198)	(0.00210)	(0.00099)	

From the normalized cointegrating coefficients, the Error Correction Term (ect), which is the long-run model can be extracted as in equation 4.2.

$$ect_{t-1} = 1.00lg_{t-1} - 0.040803lmpr_{t-1} - 0.005089lfind_{t-1} + 0.022757lreer_{t-1} + 0.027680linf_{t-1} + 0.003007lgdp_{t-1} - 3.784063 \quad (4.2)$$

Noting that except for the normalised variable, the signs of the remaining variables have been reversed implies that, income Gini in the long is positively related with monetary policy, financial development and negatively related with real exchange rate, inflation and GDP.

4.3.2 Baseline Results: Short-Run Causality

With the multiplicity of the lag terms of the various variables in equation 4.1 however, the collective effects of the lags of a variable will be difficult to ascertain. To ascertain the collective impact of the lags of a variable, the VEC Granger Causality/Block Exogeneity Wald Test is estimated. The results, representing the short-run causality among the variables are presented in table 4.5.

From table 4.5, only financial development is found to have a bi-directional granger causal relationship with income inequality in the short-run.

4.3.3 Baseline Impulse Response Functions (IRFs)

The Impulse Response Functions (IRFs) estimated from the VECM are presented in figure 4.1. From the IRFs, the log of Gini is found to respond positively to innovations in monetary policy up to the 8th quarter after such an innovations, afterwards, it turns negative then stabilising at a little below -0.0001%. Thus, a 1% increase in the monetary policy rate is found to have an initial increasing effect on income inequality. After the 8th quarter however, the effects turn negative permanently reducing income inequality marginally by less than 0.0001%.

Also, income inequality as depicted by the Gini is found to respond negatively to financial development as represented by the financial development index permanently. Interestingly however, the result of the cointegration equation and the impulse response functions for monetary policy and financial development is contradictory implying the existence of systematic issues with the estimation.

A positive innovation in the real exchange rate is found to also have a marginal decreasing effect on income inequality. This effect is permanent with a decreasing effect of about 0.0001% beyond the 12th quarter.

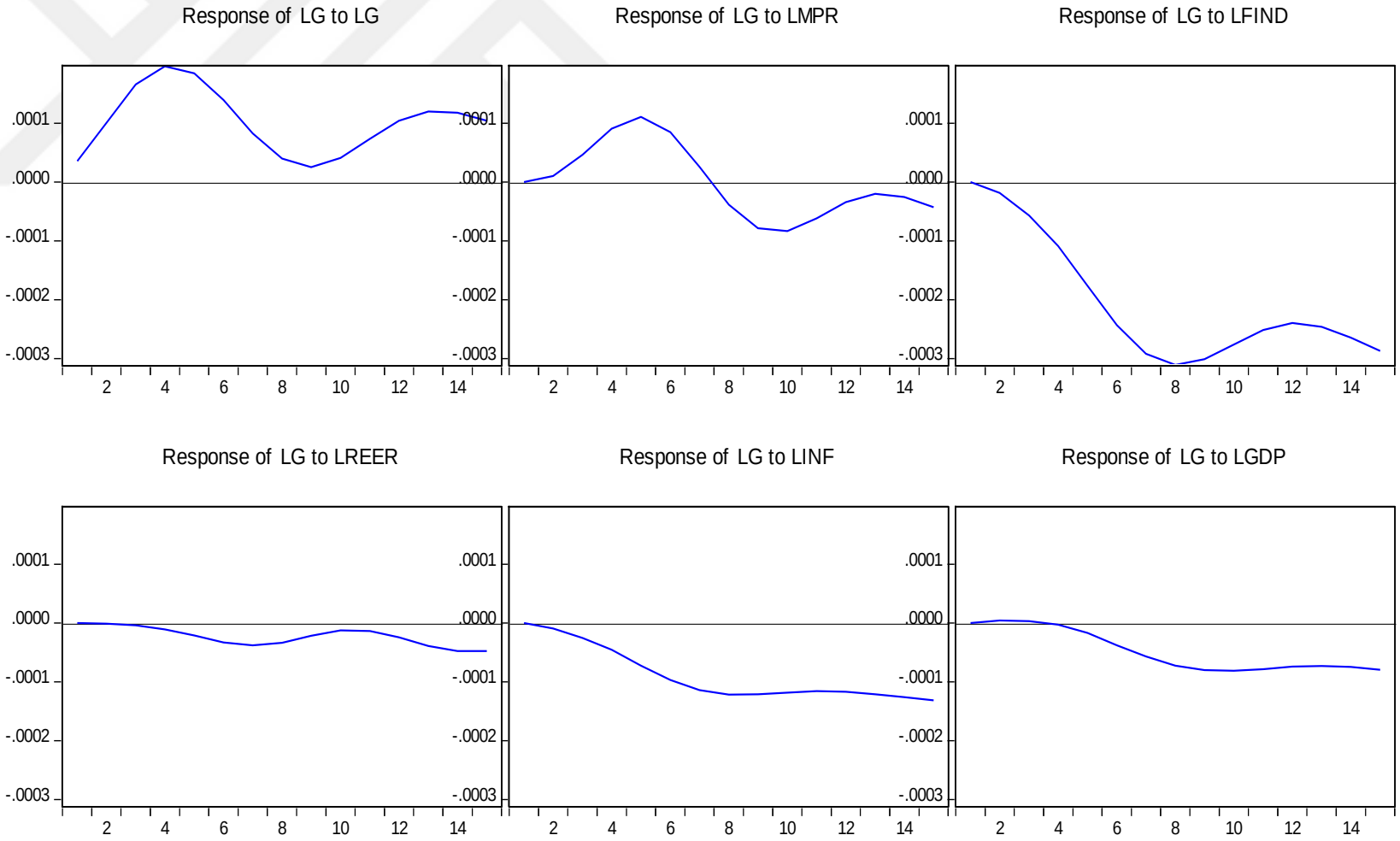
Both the inflation rate and the GDP growth are found to have a decreasing effect on income inequality with inflation impacting on income inequality from around the 2nd quarter after an innovation and GDP growth impacting on the income inequality only after the 4th quarter. The impacts of both the inflation and Growth permanently result in about 0.0001% reduction in income inequality in Ghana. All these are evident in figure 4.1.

Table 4.5: Short Run Causality

VEC Granger Causality/Block Exogeneity Wald Tests			
Date: 02/24/19 Time: 13:43			
Sample: 2002Q1 2013Q4			
Included observations: 44			
Dependent variable: D(LG)			
Excluded	Chi-sq	df	Prob.
D(LMPR)	2.639192	3	0.4507
D(LFIND)	11.67272	3	0.0086***
D(LREER)	3.915490	3	0.2707
D(LINF)	5.625379	3	0.1313
D(LGDP)	2.989919	3	0.3932
All	34.99331	15	0.0025***
Dependent variable: D(LMPR)			
Excluded	Chi-sq	df	Prob.
D(LG)	0.762801	3	0.8583
D(LFIND)	1.607690	3	0.6576
D(LREER)	0.056664	3	0.9965
D(LINF)	2.005916	3	0.5712
D(LGDP)	0.306603	3	0.9588
All	5.308464	15	0.9892
Dependent variable: D(LFIND)			
Excluded	Chi-sq	df	Prob.
D(LG)	11.15212	3	0.0109**
D(LMPR)	1.476723	3	0.6877
D(LREER)	5.195145	3	0.1581
D(LINF)	0.665416	3	0.8813
D(LGDP)	4.261632	3	0.2346
All	27.79148	15	0.0229**
Dependent variable: D(LREER)			
Excluded	Chi-sq	df	Prob.
D(LG)	3.659775	3	0.3006
D(LMPR)	0.823767	3	0.8438
D(LFIND)	5.880747	3	0.1176
D(LINF)	1.718909	3	0.6327
D(LGDP)	3.001196	3	0.3914
All	13.04869	15	0.5985
Dependent variable: D(LINF)			
Excluded	Chi-sq	df	Prob.
D(LG)	2.003632	3	0.5717
D(LMPR)	14.06793	3	0.0028***
D(LFIND)	6.551511	3	0.0877*
D(LREER)	3.976198	3	0.2640
D(LGDP)	3.123896	3	0.3729
All	26.24839	15	0.0355**
Dependent variable: D(LGDP)			
Excluded	Chi-sq	df	Prob.
D(LG)	3.847019	3	0.2785
D(LMPR)	4.284906	3	0.2323
D(LFIND)	0.673640	3	0.8794
D(LREER)	5.033068	3	0.1694
D(LINF)	0.167768	3	0.9826
All	19.24012	15	0.2031
1%, 5% and 10% level of significance are represented by (***), (**) and (*) respectively			

Figure 4.1: Baseline Impulse Response Functions (IRFs)

Response to Cholesky One S.D. (d.f. adjusted) Innovations



4.3.4 Baseline System Diagnostics

To be sure that the results are reliable, some basic system diagnostic test ought to be done. Table 4.6 presents the rudimentary examinations of the residuals for homoscedascity, serial correlation and normality.

Table 4.6: Baseline System Diagnostics

	L-M	J-B Norm	B-P
Test Statistic	14.77711	48.99584	32.00685
P-value	0.0052	0.0000	0.1000

L-M is the serial LM test with Obs R-squared as the test statistic. J-B is the Jarque-Bera normality test. B-P is the Breusch-Pagan-Godfrey Test for Heteroskedasticity with the Obs R-squared as the test statistic.

From the system diagnostics as presented in table 4.7, the system is found to be serially correlated and not normally distributed with the presence of heteroscedasticity narrowly rejected. This indicates that our system may not be well specified and thus, any conclusions drawn from the results may at best be doubtful.

4.4 ROBUSTNESS CHECK ESTIMATION: IRFS BY LOCAL PROJECTIONS

To validate the results of the baseline estimation especially since the baseline model is found to be misspecified considering the presence of serial correlation and the abnormality in the residuals, an alternative estimation robust to misspecification will be ideal. In this regard, the impulse response Functions by local projections which is robust to misspecification (Villarreal, 2014) is used. The IRFs by local projections are presented in figure 4.2. In estimating the IRFs by local projections, the E-views add-ins written by Ocakverdi (2016) is used.

From the IRFs by local projections in figure 4.2, the disposable income Gini response to monetary policy innovations positively with a 1% positive innovation in monetary policy resulting in an increase in income inequality in different rates up until the 12^{th} quarter. From the 12^{th} quarter however, the impact turns permanent at close to 0.0002%. Thus, contractionary monetary policy increases income inequality both in the short-run and in the long-run in Ghana.

Unlike innovations in the monetary policy rate, the disposable income Gini is found to respond to innovations in the financial development index negatively. Beyond

quarter 12th, the spikes die off settling on a permanent negative effect of about 0.0001% on income inequality.

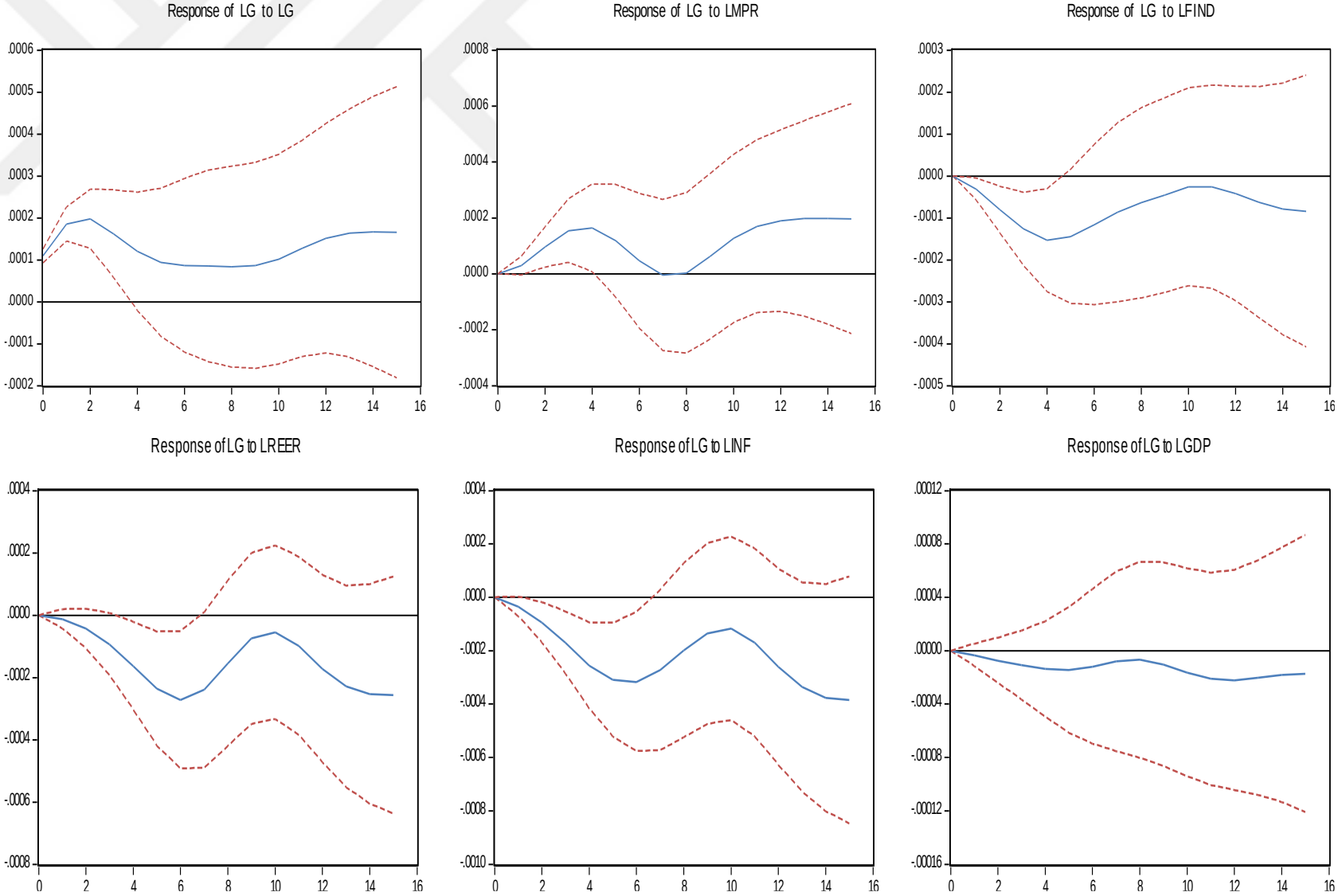
Positive innovations in the real exchange rate, inflation and the GDP growth rate were all found to have a decreasing effect on income inequality in Ghana. This implies income inequality is decreased by a depreciating local currency, increasing inflation and economic growth.

4.5 DISCUSSION OF RESULTS

From the Impulse Response Functions (IRFs) by local projections which is accepted as the correctly specified model, contractionary monetary policy is found to have an increasing effect on income inequality in both the short-run and the long-run. This implies that monetary expansion will have a decreasing effect on income inequality in Ghana. This confirms the findings of Coibion et al. (2017); Davide Furceri et al. (2018); Mumtaz and Theophilopoulou (2017); Romer and Romer (1999) who found monetary contraction detrimental to equality and contrast Davtyan (2016); Dolado, Motyovszki, and Pappa (2018); Ledoit (2011); Villarreal (2014) who found contractionary monetary policy to lead to a reduction in inequality.

This findings could be explained by the savings redistribution hypothesis as explained in Romer and Romer (1999). Per this hypothesis, an unexpected monetary contraction resulting in the increase of the monetary policy rate and thus increase in interest rate will result in real capital gains for households who are net creditors and real capital losses for net debtor households. Since generally those in the lower part of the income ladder are more likely to be net debtors and those in the upper part net creditors, an increase in monetary policy will result in a transfer of capital value from the lower spectrum of the income distribution to the upper resulting in the widening of the income inequality.

Figures 4.2: Robust Impulse Response Functions by Local Projections
Response to Cholesky One S.D. Innovations 95.0% marginal Confidence bands



Also, in Ghana where the central bank is in principle independent, government ability to resort to the 'printing press' and the rate at which government can acquire debt is influenced by the central bank's monetary stance. An overly tight monetary stance might restrict government's redistribution efforts in the form of subsidies, especially of agricultural inputs and transfers which is very crucial for agricultural households in the lower spectrum as noted in Heathcote et al. (2010). As noted in Keyder (1992), the efficacy of fiscal policy, that is the full Keynesian multiplier effect, is dependent on fiscal spending being accompanied by the appropriate monetary stance.

From the IRFs by local projections, financial development triggers a falling income inequality in Ghana. This finding confirms the results of Beck, Demirgüç-Kunt, and Levine (2007); Clarke, Xu, and Zou (2006); Inoue and Hamori (2013) and also the intuitively appealing argument that financial development will result in the reduction of income inequality because it expands economic opportunities for the poor by easing their external financing constraints due to the lack of collateral, credit histories, and connections as in Banerjee and Newman (1993); Chen and Kinkyo (2016); Galor and Zeira (1993).

However, this generic impact is questioned by Kim and Lin (2011) and Law, Tan, and Azman-Saini (2014) who found financial development to only result in the reduction of inequality only after a financial developmental and institutional quality threshold. In Roine, Vlachos, and Waldenström (2009) and also in Gimet and Lagoarde-Segot (2011), financial development was found to result in rising inequality. In Chen and Kinkyo (2016), it is noted that, the impact of financial development on inequality is to a large extent dependent on the quality of governance and susceptibility to crises. Tita and Aziakpono (2016) also found that, the finance and inequality nexus in the 15 African countries studied is largely nonlinear ranging from an inverted u-shape to u-shape. Tita and Aziakpono then suggested that policies aiming at financial development should first focus on financial inclusion.

Also from the IRFs by local projections, the exchange rate is negatively related to inequality with a depreciation of the Ghanaian cedi resulting in a decrease in the income inequality in Ghana. Considering the fact that all forms of foreign exchange inflows help prop the local currency (Addison & Baliamoune-Lutz, 2017), the findings of this study confirm the findings of Ali and Ahmad (2013) who found foreign aid and

foreign direct investment to lead to increasing inequality in Pakistan. Also, in Min, Shin, and McDonald (2015), exchange rate was found to be positively related to income inequality in Pakistan.

Per the IRFs by local projections and the cointegration test, inflation in Ghana is found to result in decreasing income inequality. This finding contradicts that of Albanesi (2007) who found inflation and inequality to be positively related. Also, the results bring to question the potency of the financial segmentation hypothesis of monetary policy impact on inequality as explained in section 2.4.3.3.

Economic growth in Ghana was found to be inequality ameliorating with an increase in GDP leading to a reduction in income inequality very marginally. This shows that growth in Ghana is inclusive contrary to that found by Danquah and Ohemeng (2017) and Aryeetey and Baah-Boateng (2015) who notes that, growth in Ghana is mainly due to growth in the service sector which does not impact on the lives of the lower class of the economic ladder and by implication disproportionately benefit the upper and middle classes.

CONCLUSIONS

Inequality is a global problem which is claimed to have a litany of negative consequences for society. These consequences among other things are; a threat to poverty reduction, increased risk of political instability and possibly negative effects on the psychological health and well-being of society. In Ghana, Inequality has been increasing despite the impressive economic growth performance in the last 20 years. This increase has been attributed to historical, climatic and policy related factors. Also, some people are of the believe that the increase urbanisation and liberalisation since the late 1990s could be a contributory factor to the observed increase in inequality in Ghana.

Globally, the 2008 financial crises triggered a hightened interest in the possible effects of financial and monetary polices on economic inequality with a substantial rise in the literation. However, these studies have largely been on developed and emerging market economies of the OECD to the neglect of financially underdeveloped developing countries of Africa. This study is an attempt to fill this gap in the literature by examining the impact monetary policy has on income inequality for a financially underdeveloped African country, Ghana.

To test for the impact of monetary policy on income inequality, the Bank of Ghana's (BoG) monetary policy rate is used as the monetary policy indicator and the disposable income Gini from the Standardised World Income Inequality Database (SWIID 7.1) used as the inequality measure. To control for the possibility of the effects of some other variables being assigned to monetary policy, inflation, GDP Growth, financial development and the real exchange rate were included as control variables. Thus, the study modelled income inequality as a function of lags of income inequality, monetary policy, financial development, inflation, real exchange rate and the GDP growth rate. The study used quarterly data from 2002Q1-2013Q4.

Two estimates of the impact of monetary policy on income inequality are made. The first, the baseline estimate, used the VECM methodology to estimate the long-run and short-run impact. From the baseline estimate, increase in the monetary policy rate was found to lead to increase in income inequality. However, upon

conducting a diagnostic test on the model, possible misspecification issues were found to exist.

An alternative estimate robust to misspecification, the Impulse Response Functions by local projections, was used. This methodology projects the information at time $t + k$ onto the linear space generated by the information available at time t.

From the IRFs by local projections, it is concluded that a contractionary monetary policy that results in an increase in the monetary policy rate (mpr) results in an increase in income inequality in Ghana marginally. This implies that, strict inflation targeting that gives no monetary allowance will likely result in more inequality in Ghana. It is recommended that light inflation targeting be pursued since a strict inflation targeting that is more aggressive to inflationary pressures will increase volatility and income inequality in Ghana.

Interpreting and generalising of this study should be done with care due to the mathematical extrapolations in estimating the inequality measures by Solt (2019) and the further interpolations conducted to transform the annual data to quarterly data. For future investigation, it is recommended that analysis using different inequality measures are used since that will give a clearer picture and prevent the possible effects of data bias. Also, micro level study of the various components of household income is recommended so as to trace out the differing impact that monetary policy might have on the various components of household income.

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