# A STUDY ON GROWTH, INFLATION AND INEQUALITY


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**By**

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# Abstract

The thesis is a collection of three empirical essays on growth, inflation and income inequality.

The first essay examines the relationship between inflation level, inflation volatility and economic growth for 92 countries for the period 1982 - 2007 using the system GMM estimator. By this approach I am able to deal with the problems of endogeneity and collinearity among the variables. The results suggest that both inflation level and volatility negatively affect economic growth. Surprisingly, their effect on economic growth is very small. Panel VAR approach further certifies these findings. The results also confirm that even in the absence of inflation volatility, inflation level reduces economic growth.

The second essay investigates whether political instability leads to volatile inflation using a panel of 49 African countries and 35 countries from the rest of the world for the period 1985-2009. This study uses novel measures of political instability, particularly the state failure index and state fragility index, and a novel measure of inflation volatility constructed as the conditional variance of inflation estimated from the GARCH (1,1) model. Adopting the system-GMM estimator the study documents a significant positive effect of political instability on inflation volatility. This effect is more pronounced and robust in Africa than in the rest of the world.

Chapter 4 examines the moderating effect of inflation on the financial development-income inequality nexus. Using a panel data of 60 countries over the period 1980-2009 and applying a two-step GMM estimator the study finds that financial development reduces income inequality. Nevertheless, the gains from financial development are offset by inflation. The results are robust to different measures of financial development, different estimators and sample sizes.

# Dedication

I dedicate this thesis to:

- ✓ My loving parents (*Mr. and Mrs.Bategeka*), for your sacrifice;
- ✓ My late beloved little brother *Bingi Henry Titwinondi* who died of Sickle-cell disease. I am glad for the lifetime shared. I miss you so much. May your soul rest in peace.

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My Ph.D. has been a very tough journey full of sickness, stress, fears, to mention but a few. Praise be to the God the most high, the great one, for He smoothed the journey by providing love, healing, wisdom and all kinds of support along this journey. It is not by my strength, nor by my wisdom that I have made it, but it is by God's grace. Believe me, I could not have made it if it wasn't for the Holy Name Jesus.

The success of my Ph.D. is also attributed to my dearest family. My parents (Mr. and Mrs.Bategeka) have been very supportive physically, spiritually and financially during my studies. You have both performed exceedingly well, my true friends. You deserve the best of my love. My late brother Bingi Henry, your journey of life taught me endurance and trust in God. Even in your great pain you could afford to share your very beautiful smile with us. Thank you my brothers and sisters for your encouragement during my studies. The thought of all of you brings me peace and joy.

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# Declaration

A slightly modified and shorter version of chapter 4 entitled: “Financial Development and Income Inequality; Does Inflation Matter?” is a published article in *Applied Economics Quarterly.*

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background and Motivation

This thesis is an empirical study on economic growth, inflation volatility and income inequality. Chapter 2 studies the main and interaction effects of inflation level and inflation volatility on economic growth. Chapter 3 analyses the effect of political instability on inflation volatility with an emphasis on Africa. Finally, Chapter 4 examines the role of inflation in the financial development-income inequality nexus. The rest of this section is a brief introduction to the chapters of this study.

### 1.1.1 Economic Growth, Inflation Level and Inflation Volatility

Explaining the determinants of economic growth has attracted a lot of attention since the work of Adam Smith (An Inquiry into the Nature and Causes of the Wealth of Nations) and continues to be one of the most important topics in economic literature. There is enormous variation in economic performance, with income levels in USA and Western Europe so many times greater than those in sub-Saharan Africa. Hence, it is not surprising why the topic of economic growth is still one of the most active fields of research in economics. Therefore, many researchers have examined the effect of many variables (inflation, financial development, foreign direct investment, institutions, trade openness, geography, etc.) on economic growth.

One of the strongest beliefs held by monetary policy practitioners is that inflation is detrimental to economic growth. Consistent with this belief, Fischer (1993) argues that a stable macroeconomic framework is thought necessary for sustainable economic growth. This view may be supported by evidence in the fast growing countries of East Asia which have generally maintained single-digit inflation. Notwithstanding, although some African countries (those in the franc zone) have experienced low and stable inflation rates since 1980, their economic growth has been very slow. There are also mixed findings on the growth-inflation relationship both in theoretical and empirical studies. In this regard, the evidence documenting the benefits of low and stable inflation is not very persuasive.

Theoretically, Tobin (1965) argues that an increase in inflation ought to cause a substitution away from money to investment in fixed capital, with a consequent positive impact on economic growth. However, Sidrauski (1967) shows that money is super natural, that is the rate of money growth has no effect on the steady state. By contrast, De Gregorio (1993) theoretically proves a negative relationship between inflation and growth since inflation is considered as a tax on investment. Empirically, many researchers find a negative effect of inflation level on growth (Fischer, 1993; Barro, 1995; De Gregorio, 1996; Judson & Orphanides, 1999). Some find no relationship between the two variables (Levine & Renelt, 1992; Levine & Zervos, 1993; Bruno & Easterly, 1998). Nevertheless, there are those that find a positive relation between the two variables (Mallik & Chowdhury, 2001). The mixed findings on growth effect of inflation call for

clarity regarding the relationship between economic growth and inflation. Hence, there is more room to study this subject further. Therefore, the present study focuses attention on the effect of inflation level and volatility on economic growth.

Additionally, most studies focus on inflation level-growth link. Very few studies look at the inflation volatility-growth link, yet both variables are worth investigating. Also, the few studies that look at both inflation level and inflation volatility ignore the collinearity problem that exists between these two variables. The current study solves this problem by using the appropriate methodology (dynamic panel) and appropriated measures of inflation volatility (condition variance of inflation level constructed from GARCH (1, 1)) which lessen the collinearity problem. This enables us to disentangle the growth effect of inflation level from the growth effect of inflation volatility.

Previous studies also ignore the endogeneity of inflation in the growth regression, hence, their results may be biased and inconsistent. To overcome the above problem, the present study employs a dynamic panel with system GMM estimator where the endogeneity problem is addressed by instrumenting these variables with their lagged values. Hence, the results from this study are reliable and unbiased, showing causality from inflation to economic growth.

Another shortcoming in the literature is the use of averaged data to study the growth effect of inflation. This is disadvantageous as it leads to information loss. With data averaging, countries with different inflation experiences may end up with the same average, resulting into much information loss, which leads to biased results. The current study uses annual data that leads to increased inflation experiences necessary for accurately capturing the effect of inflation level and volatility on economic growth.

Furthermore, authors like Judson and Orphanides (1999) argue that if inflation volatility is the sole culprit in the inflation-growth nexus, then high inflation achieved through indexation may not be detrimental to economic growth. Thus, a high but predictably stable level of inflation achieved though indexation may be preferred to low but volatile inflation resulting from an activist disinflation strategy. This study tests this hypothesis by including an interaction term between inflation level and inflation volatility in the growth regression. The marginal effect of inflation level on growth is then evaluated at the minimum of inflation volatility to test this hypothesis.

### 1.1.2 Inflation Volatility and Political Instability

Inflation volatility is the uncertainty about the level of inflation. It is generally accepted that highly volatile inflation is potentially harmful to the general economy. However, given this consensus, it is quite surprising that many countries especially those in Africa and Latin America have experienced high and volatile inflation. Nevertheless, most developed countries have maintained low and stable inflation rates. The great diversity

of inflationary processes across countries is a puzzling phenomenon. One possible explanation offered by political economy models, for example that of Cukierman et al. (1992), relies on different characteristics of the tax systems resulting from differences in the economic structures. These political economy models show that political instability and polarization determine the equilibrium efficiency of a tax system and the resulting combination of tax revenue and seigniorage the governments use. Countries with inefficient tax systems resort more frequently to seigniorage revenues, leading to high and volatile inflation.

Though theoretical political economy models predict that political instability leads to high inflation, empirical research on this topic is scarce. In addition, attention is focused on the determinants of inflation level. Researchers have not yet extensively investigated the causes of inflation volatility. Therefore, the motivation of the second empirical study is based on the fact that there is very little empirical evidence regarding the effect of political instability on inflation volatility. Hence, this present study aims at examining the impact of political instability on inflation volatility by focusing on Africa. Emphasis is put on African countries because, as we are aware, most of them are politically unstable even though they have been independent for decades, and at the same time they have volatile inflation compared to the rest of the world.

The study also uses appropriate measures of political instability suitable for Africa namely: state failure index and state fragility index. The disadvantage of other proxies of political instability that have been used in the literature, such as cabinet changes, is that they are not appropriate for Africa. For example, African countries' cabinets tend to remain unchanged over a long period of time yet most of these countries have experienced political instabilities. The state failure index and state fragility index are more appropriate measures of political instability for Africa since events considered in compiling these indices (revolutionary wars, ethnic wars, genocides and coups) have been more rampant in Africa. Therefore, these measures of political instability might provide accurate estimations for the relationship between inflation volatility and political instability in Africa.

The present study applies a novel measure of inflation volatility. Inflation volatility is measured as the conditional variance of inflation level constructed from the GARCH (1, 1) model. Conditional variance is the true measure of uncertainty about a variable given a model and information set. The standard deviation of inflation level used in the previous literature as the measure of inflation volatility does not adequately measure the uncertainty of inflation, as stated by Barro (1995).

### 1.1.3 Income Inequality, Financial Development and Inflation

Globally income inequality is a major concern as it may be destructive to the economy. According to Tan and Law (2012), income inequality can be interpreted as a sign of injustice, insider privilege, unequal opportunity and social instability. As such, scholars have tried to study the determinants of income inequality and the ways to reduce it. One strand of literature accordingly stresses that financial market imperfections prevent the poor from investing in productive assets. This consequently results in increased income inequality. Therefore, one possible way of reducing income inequality may be by reducing financial market imperfection through financial development. In this regard, Galor and Zeira (1993) show that financial development will provide broader and easier access to credit for the poor agents through alleviating constraints faced by the low-income agents. This will provide more opportunity for the poor to borrow and invest in human capital or high return projects, hence reducing income inequality.

Similarly, Kappel (2010) states that there are basically two ways in which finance can affect inequality and poverty. First, more agents, in particular the poor, are directly involved in the economy via enhanced access to financial services, for example those provided by microfinance institutes. Second, better investment opportunities for firms and entrepreneurs reach the poor indirectly, for example through advanced economic performance, better employment opportunities, etc.

The question of whether all social classes benefit from financial development was first considered and theoretically investigated in the model by Greenwood and Jovanovic (1990), which predicts an inverted U-shaped relationship between financial development and income inequality. The models by Galor and Zeira (1993) instead suggest that income inequality decreases linearly with increasing financial development. Clarke et al. (2006) and Liang (2006) explicitly test the hypothesis. While Clarke et al. (2006) provide weak evidence in favour of the inverted-U-shaped hypothesis, both studies find strong evidence for a linear relationship between financial development and income inequality. In addition many other empirical studies (Beck et al., 2007; Kappel, 2010; Shahbaz & Islam, 2011) find that financial development helps to reduce income inequality.

In another strand of economic literature, authors like Choi et al. (1996) demonstrate a theoretical link between finance and inflation. The authors show how increases in the rate of inflation adversely affect credit market frictions, with negative repercussions for financial sector performance and therefore long-run real activity. Empirically, economists such as Haslag and Koo (1999), Boyd et al. (2001) and Bittencourt (2011), among others, generally find that inflation is detrimental for entire financial development.

Though many economists have shown that financial development is associated with a reduction in income inequality, other researchers find that inflation is detrimental to the entire financial development. Given that inflation reduces the ability of financial intermediaries to improve resource allocation, this will also have implications on income inequality. These two strands of economic literature (finance-income inequality and inflation-finance) have lived apart and there have not been any efforts to bring them together despite their interaction with each other. Therefore, the present study fills this vacuum by examining how inflation affects the financial development-income inequality nexus. This is done by including an interaction term between financial development and inflation in the income-inequality regression. Then the marginal effect of financial development on income inequality is evaluated at various levels of inflation. The study shows that, although financial development reduces income inequality, this positive contribution is offset by inflation.

Additionally, the present study makes a comparison between the effect of financial development on income inequality in developing and developed countries. Besides, given that financial development encompasses quality and quantity of investment, saving, mobilization and management of risk, these functions may not be captured by a single proxy. As an additional contribution and for robustness check, this paper uses a variety of financial development proxies compared to the previous researchers in this field. The study uses both bank-based and market-based financial development indicators in additional to a financial development index constructed from principal

component analysis from all these financial development indicators.

## 1.2 Organization of the Thesis

This thesis consists of three empirical studies in chapters 2, 3 and 4. Also, a review of relevant literature is provided in each of the chapters. Chapter 5 offers the conclusion of the overall study.

Chapter 2 analyses the effect of inflation level and volatility on economic growth for the period 1982-2007 for 92 countries selected according to data availability from World Bank development indicators (2009). The study uses a dynamic panel with system GMM estimator.

Chapter 3 provides an empirical investigation into the determinants of inflation volatility with an emphasis on political instability, focusing mainly on Africa. This is because most African countries are politically unstable compared to the rest of the world even though they have been independent for decades, and at the same time they have more volatile inflation compared to the rest of the world. However, a comparison is made between Africa and a rest of the world sub-sample.

Chapter 4 examines the effect of inflation on the financial development-income inequality nexus. The study applies two-stage least square (2SLS) and two-step optimal GMM with fixed effect estimators. The focus of this chapter is on the interaction term between financial development and inflation. This enables us to study the effect of financial development on income inequality at various levels of inflation.

Chapter 5 is the concluding chapter. It presents the summary of the overall findings of the study and gives policy implications and recommendations.

# CHAPTER 2

# MAIN AND INTERACTION EFFECTS OF INFLATION LEVEL AND VOLATILITY ON ECONOMIC GROWTH

## 2.1 Introduction

The issue of whether inflation is necessary for economic growth or whether it is harmful has generated a significant amount of debate. For example, it has been argued that inflation is costly because it reduces the rate as well as the efficiency of investment, which in turn reduces economic growth (De Gregorio, 1996). However, Tobin (1965) argues that, since inflation lowers return on monetary assets relative to the real assets, people will substitute away from money with lower returns towards capital with higher returns. This will bring about an increase in the rate of capital accumulation which will in turn lead to a high rate of economic growth.

There has not been a clear view on the relationship between inflation and economic growth since both positive and negative relationships between the two variables have been found. However, there is a general consensus that low and stable inflation rates are conducive for growth while volatile and high inflation rates harm growth. Thus, many central banks emphasize price stability. Nevertheless, Rajan (2000) contends that the existing literature does not provide any compelling reasons for expecting low inflation to lead to higher economic growth. Fischer (1993) argues that for a country to grow there should be in place a favourable setting for government policies and private sector

choice. Hence, a stable macroeconomic framework is thought necessary for sustainable economic growth. This view may be supported by evidence in the fast-growing countries of East Asia which have generally maintained single-digit inflation. By contrast, Brazil has experienced both hyperinflation and increase in growth.

Many developed countries like the United Kingdom are seen to maintain low and stable inflation rates. However, despite the fact that some African countries (for example, those in the franc zone) have experienced low and stable inflation since 1980, their economic growth has been very slow. This further raises the question of whether inflation has an effect on economic growth or if its effect on economic growth depends on the particular country. There is also a possibility that the main culprit is inflation volatility and thus stable high inflation achieved through indexation may have no negative effect on economic growth (Judson & Orphanides, 1999).

Given the above, it is evident that the existing literature on inflation and growth has not decisively proved the justification of central banks' emphasis of low and stable inflation rates. This calls for clarity on the relationship between inflation and economic growth. In this regard, the present study will establish whether there exists an empirical relationship between economic growth and inflation level and inflation volatility, both in the short run and the long run. It will also find out whether inflation level in the absence of inflation volatility has no effect on economic growth.

The main contributions of this study are fivefold. To begin with, it is the first study to examine the relationship between inflation and economic growth using dynamic panel method, which is advantageous since it accounts for both short- and long-run relationships. A cross-sectional study faces multicollinearity problems whereas a single country time series study lacks the variety of inflation experience necessary for establishing the relationship between growth and inflation. However, dynamic panel estimation overcomes all those limitations.

Second, the study improves upon other studies as it separates the effect of inflation level and inflation volatility on economic growth. Previous studies have often emphasized inflation level alone, ignoring inflation volatility. Additionally, the few studies that try to study the effect of both inflation level and volatility on growth ignore the collinearity problem that exists between inflation level and inflation volatility. This study employs appropriate measures of inflation volatility to mitigate the collinearity problem. In particular, inflation volatility is constructed from the GARCH (1, 1) model using quarterly data which increases data variability, thereby mitigating collinearity. Besides, the use of panel data also makes it possible to avoid the collinearity due to increased data variability, unlike cross-sectional data.

Third, the study takes into account the endogeneity problem of inflation level and volatility in the growth regression and uses their lagged values as instruments. Therefore, the results from this study are reliable and unbiased, showing causality from

inflation to economic growth.

Fourth, the study avoids data averaging (which leads to information loss) and makes use of annual data to capture more accurately the effect of inflation level and volatility on economic growth. Using data averaging, countries with vastly differing inflation experiences may turn out to have a similar average rate over a lengthy period of time, leading to loss of too much information.

Lastly, it is the first study to test the hypothesis of whether inflation volatility is the sole culprit in the inflation-growth regression, i.e. whether inflation level in the absence of inflation volatility has no effect on economic growth. This is done by including an interaction term between inflation level and inflation volatility in the growth equation and then calculating the marginal effect of inflation level on economic growth at minimum inflation volatility.

The remainder of the chapter is outlined as follows: Section 2.2 reviews the relevant literature; this is followed by the research methodology in Section 2.3. Section 2.4 presents the empirical results and policy implications and Section 2.5 concludes.

## 2.2 Literature Review

### 2.2.1 Channels through Which Inflation Level and Volatility Affect Economic Growth

Inflation causes a variety of distortions. It discourages saving because the nominal interest rate is usually held constant by contracts on saving or time deposit accounts. As a result, this may reduce long-run economic growth since the economy needs a certain level of savings to finance investment projects (Briault, 1992).

Additionally, Briault (1992) argues that cost-push inflation leads to slower growth of company profits. This can then feed through into business investment decisions thus leading to low output. Inflation also induces frequent prices changes, which may be costly. This is referred to as menu costs. Inflation further causes shoe leather costs as it distorts the optimal level of cash holding.

For tax purposes, accounting is based on historical costs other than replacement costs. With inflation the taxable profits of a firm are over-stated. As a result there is an increase in the real corporate tax leading to lower net profitability of investments. Thus, inflation may negatively affect output. However, the tax system treats nominal interest rate payments made by a firm as deductible expenses. Hence, high inflation in this case leads to over-statement of costs and therefore understatement of profits. Thus, in this case there may be a positive relationship between the two variables. Therefore, the overall effect of inflation on profits may be neutralized (Rajan, 2000).

According to Motley (1993), uncertainty about future prices distorts resource allocation, for example it induces firms and households to divert their resources from productive activities to activities that reduce the burden of inflation tax. In addition high inflation levels and volatility raises the pressure on government from vested interest parties to impose control on prices of necessities. This distorts resource allocation in the economy. There is a cost of reducing inflation. This will involve higher interest rates to reduce spending and investment. This reduction in Aggregate Demand will lead to a decline in economic growth and employment.

Furthermore, unexpected inflation leads to income distribution from creditors to debtors. As a result savers and lenders may demand a high risk premium thereby increasing the real cost of borrowing funds. Additionally, inflation volatility makes it more difficult to deduce the real return from investment. Therefore, savers and investors are less willing to enter into long term nominal contracts (Motley, 1993). Such income distortions lead to capital misallocation hence retarding economic growth.

Inflation is damaging to the financial system and thus long-run economic growth. Increase in inflation leads to volatility and lower real returns not just on money, but on all other assets too. The reduction and greater variability of real returns results into intense credit rationing which interferes with the functioning of financial markets and the allocation of investment. Therefore, inflation has a negative effect on economic growth (Choi et al., 1996).

Inflation volatility distorts planning for the business sector. During inflationary periods it becomes very difficult to predict future demand and production costs. Due to this, people may be unwilling to invest, thus affecting growth of business. Low inflation is often seen as harmless or even beneficial because it allows prices to adjust more easily.

Contrary to the above, Tobin (1965) predicts a positive correlation between the rate of inflation and the rate of capital accumulation. This is based on the substitutability between money and capital, where an increase in inflation results into an increase in the cost of holding money and a portfolio shift from money to capital. This increases the rate of capital accumulation which induces a high rate of growth.

### 2.2.2 Empirical Evidence on the Relationship between Inflation and Growth

The literature regarding inflation and growth basically attempts to focus on the relationship between these two variables. Barro (1995) examines the relationship between inflation and growth using data of around 100 countries from 1960 to 1990. He finds that an increase in inflation by 10 percent points per year reduces growth by 0.2 to 0.3 percent points. Though the adverse influence looks small, the long-term effects on the standard of living are substantial.

In line with the above findings, Fischer (1993) presents cross-sectional and panel regressions showing that growth is negatively associated with inflation. The author argues that a stable macroeconomic environment (reasonably low rate of inflation and a small budget deficit) is conducive for sustained economic growth. Surprisingly, the author finds that the negative relationship between inflation and growth is stronger at lower levels of inflation than at higher levels of inflation. However the author does not explain the surprising results. According to De Gregorio (1996), this is not a surprising result, since inflation from 10 to 20 percent should be more damaging for growth than going from 180 to 190 percent.

Ahortor & Adenutsi (2010) investigate the relationship between inflation, capital formation and economic growth in 30 import-dependent countries. They find a negative relationship between inflation and the other two variables using a panel VAR. They also evidence that in the short run the speed of adjustment is so low that it will take a long time for any imbalance to be corrected. Similarly, Ahmed & Mortaza (2005), using co-integration and error correction model, demonstrate that there exists a statistically significant negative long-run relationship between inflation and economic growth in Bangladesh.

Contrary to the above findings, Mallik & Chowdhury (2001) examine the relationship between inflation and GDP growth for south Asia using co-integration and error correction models employing annual time series data from IMF IFS. The authors

evidence a positive long-run relationship between inflation and economic growth and also find significant feedbacks between the two variables. They conclude that their results are very much in line with the structuralist position of inflation and growth relationship. The structuralist view that inflation has a positive effect on growth is based on the contention that inflation is a mechanism which induces forced savings.

Bruno & Easterly (1996) study the relationship between growth and inflation using 26 countries which had experienced inflation crises during the period from 1961 to 1992. Using the inflation rate of 40 Percent as the threshold level for an inflation crisis, they find that there exists no relationship between inflation and growth below the threshold level. However a negative relation between the two variables existed beyond the threshold. Bruno & Easterly (1998) use both cross sectional and panel data which characterized the behaviour of output growth before, during and after decree high inflation crises (using the same threshold of annual inflation above 40 percent). They find that inflation-growth correlation is only present with high frequency data and with extreme inflation observations. They also observe that growth falls sharply during the high inflation crisis and recovers rapidly and strongly after inflation has fallen. They find no evidence for cross section correlation between long-run averages of inflation and growth. One explanation for the lack of correlation in cross sectional regression offered by Bruno & Easterly (1998) is that the decline of growth during inflation crisis is offset by the strong recovery after stabilization. Thus, it is difficult to detect the inflation-growth relationship using cross-sectional data.

Judson and Orphanides (1999) use both cross-sectional and panel data methodology for several countries over a period of 30 years. They report that exploiting the time dimension in panel data reveals that both the level and volatility of inflation are negatively and significantly correlated with growth. When inflation level is contained under double-digit level, it becomes insignificant but inflation volatility remains significant both at high and at low inflation levels. They also find that under the cross-section study, inflation level and volatility were insignificant for all countries, with the exception of the OCED countries. Thus, they conclude that cross-section estimations may be biased and inconsistent. They further argue that a single country time series study simply lacks the variety of inflation experience necessary for establishing the relationship between growth and inflation. Therefore, a panel data estimation gives more reliable results because it increases both the sample and time dimension with more inflation-growth experiences.

Rajan (2000) aims at answering the question of whether it is reasonable to expect low inflation to lead to economic growth. He argues that the existing literature provides no justification for the theory that low inflation boosts economic growth through inflation's effect on the cost for holding money. Given that the overall inflation tax is small and that the response of work effort to investment is inelastic, the potential link between inflation and growth loses its plausibility. He also concludes that there is no compelling evidence both using time series and cross-sectional studies that inflation affects economic growth. He also states that, even though most empirical studies find a

negative relationship between these two variables, their findings are not robust. Similarly, Levine and Zervos (1993) show that the cross-section correlation between inflation and growth depends on extreme inflation observations with high frequency data.

One of the loopholes in empirical analysis of the inflation-growth relationship is the endogeneity problem of inflation. Many researchers view the inflation growth relation as being unidirectional from inflation to growth (Fischer, 1993; Bruno & Easterly, 1998; Judson & Orphanides, 1999). Paul et al. (1997) study the causality between inflation and growth using time series data of 70 countries using the Granger causality method. They find that 40 percent of the countries studied show no causal relationship between inflation and growth, 37.1 percent show uni-directional causality running from either inflation to growth or growth to inflation, and 22.9 percent of the countries show bi-directional causality. If inflation is endogenous, then estimating a regression without accounting for its endogeneity leads to inconsistent results. An example given by De Gregorio (1996) is as follows: consider if an economy is hit by a negative supply shock. This shock will not only reduce output but also result in increased inflation. Hence, the coefficient of inflation cannot be interpreted as the effect of inflation on growth. Also, an inverse relationship between growth and inflation could result if the monetary authorities react to economic slowdowns with expansionary policies which could result in an increase in inflation. The present study takes into account the endogeneity of inflation level and volatility and uses their lags as instruments.

Wilson (2006) finds that increased inflation uncertainty raises average inflation and lowers average growth. However, Barro (1995) finds that, for a given average rate of inflation, the variability of inflation has no significant relationship with economic growth. The author interprets the result as biased, proposing that realized variability of inflation does not adequately measure the uncertainty of inflation.

Using GARCH models, Kontonikas (2004) finds a significant positive correlation between inflation levels and inflation uncertainty. Estimating an equation including both inflation level and inflation volatility will suffer from multicollinearity, thus leading to large standard errors. In addition to using panel data, this study uses appropriate measures of inflation volatility constructed from the GARCH (1, 1) model, which lessen the collinearity problem.

From the literature reviewed above, we can safely conclude that previous studies failed to reach a consensus on the true effects of inflation level and volatility economic growth. There is therefore room to explore the subject further.

## 2.3 Research Methodology

### 2.3.1 Econometric Methodology and Model Identification

The study assesses whether keeping low and stable inflation rates pays off in terms of faster economic growth. In particular this study aims at establishing the short-run and long-run effect of inflation level and inflation volatility on economic growth using the dynamic panel approach by answering the following two questions:

1) Do inflation level and inflation volatility significantly reduce economic growth both in the short run and long run?

2) Does inflation level significantly reduce economic growth only when it is highly volatile?

The first question requires both coefficients of inflation volatility and inflation level to be negative and statistically significant. The second question requires zero or positive marginal effect of inflation level at minimum inflation volatility, but negative marginal effect of inflation level at higher inflation volatility. The second question aims at elaborating the hypothesis that inflation level without inflation volatility does not harm economic growth. Judson and Orphanides (1999) argue that, if inflation volatility is the sole culprit in the inflation-growth relationship, then high but predictable inflation level achieved through indexation may be preferred to low but volatile inflation.

To be able to empirically test the effect of inflation level and inflation volatility on economic growth the study uses a dynamic panel model which takes into account both the time series and the cross-country dimensions. Furthermore, it uses a dynamic panel with system GMM estimator. Dynamic panel is advantageous since it explores both the short-run and long-run relationships. Also, another advantage of dynamic panels is that the coefficient on the lagged dependent variables measures the speed of adjustment. Additionally, dynamic panel methodology takes into account endogeneity problems.

The empirical model is formulated as:

$$Y_{it} = \beta_0 + \gamma Y_{it-1} + \beta_1 lnf_{it} + \beta_2 Vol_{it} + \delta_X + \mu_{it} \quad (2.1)$$

$$Y_{it} = \beta_0 + \gamma Y_{it-1} + \beta_1 lnf_{it} + \beta_2 Vol_{it} + \beta_3 (lnf_{it} \times Vol_{it}) + \delta_X \mu_{it} \quad (2.2)$$

where $Y_{it}$ represents percentage change in real gross domestic product per capita of country $i$ at time $t$, an indicator of economic growth, $lnf_{it}$ is inflation level computed as the percentage change in consumer price index, $Vol_{it}$ is inflation volatility and $\chi$ is a vector of all other variables affecting economic growth. Following Barro (1995), these control variables include: log of initial income per capita, life expectancy, investment, government expenditure, trade openness, average years of schooling, democracy and democracy squared. The interaction term in equation (2.2) aims at shedding light on the second hypothesis. The second hypothesis requires the marginal effect of inflation level to be zero or positive when evaluated at minimum level of inflation volatility.

This is answered by calculating the partial derivative of inflation level at minimum level of inflation volatility within the sample, i.e.

$$\frac{\partial Y_{it}}{\partial lnf_{it}} = \beta_1 + \beta_3 Vol_{it} \quad (2.3)$$

The slope coefficients $\beta_1$, $\beta_2$, and $\beta_3$ represent short-run effects of inflation and inflation volatility. The long-run effects are calculated by dividing these coefficients by $1 - \gamma$.

Country-specific fixed effects are assumed for the error term

$$\mu_{it} = \mu_i + V_{it} \quad (2.4)$$

where $\mu_{it}$ represents the error term. It contains $\mu_i$ which represents country-specific fixed effects that are time invariant such as geographical location, prior colonial status and climate. Whereas $v_{it}$ is assumed to be independent and identically distributed with mean 0 and variance $\sigma^2$ both over time and across countries.

### 2.3.1.1 Generalized Methods of Moments (GMM)

Many of the previous researchers have generally used the OLS methodology to estimate the growth, inflation and income inequality equations. Under OLS, the regressors are assumed to be exogenous, i.e. $Cov(X_{it}, \mu_{it}) = 0$, where X is a vector of regressors and $\mu_{it}$ is a composite error term. However, this assumption is often violated mainly due to omitted variables, simultaneous causality and measurement errors in variables. Also, in dynamic panel, the inclusion of a lagged dependent variable as a regressor violates the above assumption. This is because $Y_{it-1}$ (the lagged dependent variable) depends on $\mu_{it-1}$

which is a function of $\mu_i$. Since $\mu_{it} = \mu_i + v_{it}$, definitely $E(Y_{it-1}\mu_{it}) \neq 0$. If the orthogonality assumption fails to hold, OLS estimates of the parameter coefficients are biased and inconsistent, thus the model statistical inference will be invalid.

In regard to the above, the Instrumental Variable (IV) approach was developed to address the above shortcomings of the OLS estimators. With respect to the growth equation, a potential simultaneity problem exists between inflation and growth, as noted by Barro (1995), De Gregorio (1996) and Paul et al. (1997). Consider if an economy is hit by a negative supply shock, this shock will not only reduce output but also result in increased inflation. Hence, the coefficient of inflation cannot be interpreted as the effect of inflation on growth. Also, an inverse relationship between growth and inflation could result if the monetary authorities react to economic slowdowns with expansionary policies which could result in an increase in inflation.

However, except for Barro (1995), these researchers did not address the endogeneity problem in the inflation-growth nexus. Moreover, all the other researchers in this field have taken inflation to exogenous in the growth equation, which may not be the case. Therefore, their results may be biased and inconsistent. Thus, in this study, an estimation technique requiring the use of instrumental variables is used to correct for a potential endogeneity problem. The generalized method of moments (GMM) estimator is used in preference to the two-stage least squares (2SLS) and the standard instrumental variable (IV) approach. The (IV) and (2SLS) estimators are special cases of

the GMM estimators, and they assume that the errors are homoskedastic. However, the assumption of homoskedasticity is relaxed with the GMM estimator, hence it accounts for heteroskedasticity in the error term of unknown form.

For simplicity, let us write our growth equation as:

$$y_{it} = x'_{it}\beta + \mu_{it} \quad (2.5)$$

where the regressors $x_{it}$ includes both time-varying and time-invariant components and an intercept. By stacking all T observations for the $i^{th}$ individual,

$$y_i = x_i\beta + \mu_i \quad (2.6)$$

Since some of the regressors are endogenous in the growth equation, in particular inflation, the GMM estimator is used. A matrix of instrumental variables defined as $Z_i(T \times f)$ is required, where $f \geq K$. The instruments must be relevant $(Z, X) \neq 0$ and must satisfy the $f$ moment conditions.

$$E = (Z'_i\mu_i) = 0 \quad (2.7)$$

The GMM estimator based on these moment conditions minimizes the associated quadratic form:

$$Q_N\beta = [\sum_{i=1}^{N} Z'_{i=1}\,\mu_i]' W_N [\sum_{i=1}^{N} Z'_i \mu_i] \quad (2.8)$$

Where $W_N$ is ($f \times f$) weighting matrix. Both GMM and 2SLS estimators involve choosing a weighting matrix, but the GMM gives more efficient estimates than

2SLS since GMM uses an optimal weighting matrix. On satisfying the validity condition, a consistent GMM estimator of an over-identified equation can be derived as:

$$\hat{\beta}_{GMM} = [X'ZW_NZ'X]^{-1}X'ZW_NZ'Y \quad (2.9)$$

$\hat{\beta}_{GMM}$ is asymptotically normal. Several GMM estimators exist due to different choices of the weighting matrix. The optimal weighting matrix, as shown by Hansen (1982), chooses $W_N = \hat{S}^{-1}$, where $\hat{S}$ is a consistent estimate for S defined as:

$$S = plim\frac{1}{N}\sum_{i=1}^{N} Z'_i\mu_i\mu'_iZ_i \quad (2.10)$$

Using $W_N = \hat{S}$ yields the two-step GMM estimator:

$$\hat{\beta}_{2SGMM} = \left[X'Z\hat{S}^{-1}Z'X\right]^{-1}X'Z\hat{S}^{-1}Z'Y \quad (2.11)$$

with variance matrix:

$$\hat{V}\left[\hat{\beta}_{2SGMM}\right] = \left[X'Z\left(N\hat{S}\right)^{-1}X\right]^{-1} \quad (2.12)$$

It is called two-step GMM since a first-step consistent estimator of β such as $\hat{\beta}_{2SLS}$ is needed in to form the residuals $\hat{\mu}_i$ used to compute $\hat{S}$.

The study uses a dynamic panel approach with the system GMM estimator. The preference for the dynamic panel method is based upon the fact that it accounts for both short- and long-run relationships. Additionally, a cross-sectional study faces

multicollinearity problems whereas a single country time series study lacks the variety of inflation experience necessary for establishing the relationship between growth and inflation. However, the dynamic panel estimation overcomes all those limitations. Also, with the system GMM estimator we are able to control for endogeneity of inflation in the growth equation. Since it is difficult to find appropriate instruments, system GMM uses lagged values of the endogenous regressors as instruments.

To illustrate the dynamic panel methodology, consider the general form of the empirical model below:

$$y_{it} = \gamma y_{i,t-1} + x'_{it}\beta + \mu_{it} \quad (2.13)$$

$$\mu_{it} = \mu_i + V_{it} \quad (2.14)$$

Because the dynamic panel model includes lagged values of the dependent variable $(y_{i,t-1})$ as regressors, the model suffers from an endogeneity problem since $E(y_{i,t-1}\mu_{it}) \neq 0$. This is because $y_{it-1}$ depends on $\mu_{it-1}$ which is a function of $\mu_i$ and yet $\mu_i$ is a competent in $\mu_{it}$. Due to this correlation, dynamic panel data estimation suffers from Nickell (1981) bias, which disappears only as t tends to infinity. Note that equation (2.13) can be differenced to get rid of the country-specific effect.

$$\Delta y_{it} = \gamma \Delta y_{it-1} + \Delta x'_{it}\beta + \Delta v_{it} \quad (2.15)$$

However, the transformed error ($\Delta v_{it}$) is correlated with $\Delta y_{it-1}$ since both include $v_{it-1}$. In contrast to a static model, OLS on the first differenced data in a dynamic model produces inconsistent parameter estimates because $E(\Delta y_{it-1}\Delta v_{it}) \neq 0$. Note that $E(y_{it-s}\Delta v_{it}) = 0$ for all $s \geq 2$, t= 3,.....T. This opens up the possibility of using IV estimations using the lagged variables as instruments. Following this fact, Anderson and Hsiao (1982) proposed IV

estimation using $y_{it-2}$ as instrument for $\Delta y_{it-1}$ since $E(y_{it-2}\Delta v_{it}) = 0$.

Arellano and Bond (1991) suggested that a more efficient IV estimator can be obtained by using additional lags of the dependent variable as instruments. Hence, the development of the Arellano and Bond (1991) difference GMM estimator. To get rid of the endogeneity of $\Delta y_{it-1}$ and any other endogenous variable, Arellano and Bond (1991) suggested using their lags in levels starting from lag two and beyond as valid instruments. I.e. $E(y_{it-s}\Delta v_{it}) = 0$ for all $s \geq 2$, t= 3,.....T.

However, if the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regression in difference. Asymptotically, the variance of the coefficients will rise and, in a small sample, Monte Carlo experiments show that weak instruments can also produce biased coefficients. To increase efficiency, Arellano and Bover (1995) and Blundell and Bond (1998) proposed the system-GMM estimator. This combines the equation in differences (2.15) with the equation in levels (2.13). The instrument for the regression in differences remains the same as mentioned above. For the levels equation, instead of differencing equation (2.13) to expunge the fixed effect, it differences the instruments to make them exogenous to the fixed effect. This is valid assuming that changes in these variables are uncorrelated with the fixed effect:

$E(\Delta y_{it}\mu_i) = 0$ for all $i$ and $t$

$E(\Delta x_{it}\mu_i) = 0$ for all $i$ and $t$

If this holds, $\Delta y_{it-1}$ and $\Delta x_{it-1}$ are valid instruments for the variables in levels:

$E(\Delta y_{it-1}\mu_{it}) = 0$. $E(\Delta x_{it-1}\mu_{it}) = 0$.

The use of difference and system GMM estimators is only necessary when $N > T$. In large $T$ panels, the Nickell (1981) bias disappears, i.e., the shock to the country's fixed effect, which shows in the error term, will decline with time, hence the correlation of the lagged dependent variable with the error term will be insignificant (Roodman, 2009). In these cases, one does not necessarily have to use difference or system GMM estimators. However, since T in this study is limited to 26 years, the use of the system GMM estimator is necessary.

To test the validity of lagged instrumental variables, the study employed Hansen's (1982) test of over-identifying restrictions where the null hypothesis is that the over-identifying instrumental variables are uncorrelated with the error term. This test has $\chi^2$ distribution with $f - k$ degrees of freedom, where $f$ is the number of instruments and $k$ is the number of regressors.

Too many moment conditions may introduce bias while enhancing efficiency; hence Baltagi (2005) suggests using a subset of moment condition to obtain a balance between reduction in bias and the loss in efficiency. In view of the trade-off between efficiency and bias, the instrument set is restricted up to the first two or three available lagged values in the differenced equation and their once lagged first differences in the level equation. Furthermore, the instrument set is collapsed in order to reduce the number of instruments.

Difference equation = $\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & \cdots \\ y_{i1} & 0 & 0 & 0 & 0 & 0 & \cdots \\ 0 & y_{i2} & y_{i1} & 0 & 0 & 0 & \cdots \\ 0 & 0 & 0 & y_{i3} & y_{i2} & y_{i1} & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix}$, collapsed, $\begin{pmatrix} 0 & 0 & 0 & \cdots \\ y_{i1} & 0 & 0 & \cdots \\ y_{i2} & y_{i1} & 0 & \cdots \\ y_{i3} & y_{i2} & y_{i1} & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{pmatrix}$

System equation = $\begin{pmatrix} 0 & 0 & 0 & 0 & \cdots \\ \Delta y_{i2} & 0 & 0 & 0 & \cdots \\ 0 & \Delta y_{i3} & 0 & 0 & \cdots \\ 0 & 0 & \Delta y_{i4} & 0 & \cdots \\ \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix}$, collapsed, $\begin{pmatrix} 0 \\ \Delta y_{i2} \\ \Delta y_{i3} \\ \Delta y_{i4} \\ \vdots \end{pmatrix}$

*y*

Given that the consistency of the dynamic GMM estimator relies upon the fact that $E(\Delta v_{it}\Delta v_{it-2}) = 0$ , a test for serial correlation of error term is carried out. By construction, the differenced error term is probably first-order serially correlated even if the original error term is not. However, second-order serial correlation should be absent.

In the presence of heteroskedasticity, the two-step system GMM uses a consistent estimate of the weighting matrix, taking the residuals from the one-step estimate. However, two-step GMM presents standard errors that are downward biased. Hence, the present study solves the above problem by using Windmeijer's (2005) robust finite-sample corrected standard errors.

### 2.3.1.2 Weak Instruments

Instruments need to be relevant, i.e., correlated with the endogenous variables. Nevertheless, if they are only weakly correlated with the endogenous variables, this will lead to the weak instrument problem. As pointed out by Bound et al. (1993, 1995), "the cure can be worse than the disease" if the instruments are weak. In such cases, the IV/GMM estimates are biased towards the same direction as OLS and their estimates may not be consistent. Additionally, the tests of significance have incorrect size, and

wrong confidence intervals.

To check for weak instruments, Bound et al. (1995) recommended looking at the $R^2$ of the first-stage regression for excluded instruments. This may also be expressed as the F test of the joint significance of the instruments in the first-stage regression. However, these diagnostics for instrument relevance are only applicable in the cases of a single endogenous regressor. For a model with multiple endogenous variables, Shea's *partial* $R^2$ was proposed. As a rule of thumb, a small value of the Shea measure suggests that the instruments lack sufficient relevance to explain all the endogenous regressors and the model may be essentially unidentified.

According to Staiger and Stock (1997), an F-statistic on the excluded instruments in the first stage less than 10 raises concern about weak instruments. In case of a static model, Stock and Yogo (2005), with assumption of i.i.d. (independently and identically distributed) data, proposed the use of Cragg and Donald's (1993) statistics, which is the first-stage F-statistic, to test for weak instruments. For non-i.i.d. data, the Kleibergen-Paap Wald F statistic is used. The null is that the instruments are weakly correlated with the endogenous regressors. The rule of thumb is that a Kleibergen-Paap Wald F statistic of 10 satisfies the rejection of the null hypothesis (Baum et al., 2003).

A stand test for weak instruments in dynamic panel GMM regressions does not exist; hence, measuring instrument strength empirically is non-trivial (Clemens & Bazzi, 2009). The weak instrument tests proposed above do not carry over to the dynamic GMM setting. Also, Kiviet's (2008) weak instrument test in dynamic panel GMM is only

applicable to Anderson and Hsiao's (1982) estimator, but not to the more complex Arellano-Bond difference GMM and the system GMM estimators. Nevertheless, there is a well-known weak instrument problem in difference GMM. In response to this problem, the system GMM estimator (which augments the difference equation with the levels equation) was developed. Therefore, we would expect that the weak instrument problem is less likely in system GMM. Even though system GMM is generally regarded by many researchers as more robust to the weak instrument problem than difference GMM, Bun and Windmeijer (2010) have shown that system GMM can also suffer from weak instrument biases.

Despite the above shortcomings, Bond et al. (2001) provide a useful insight into the GMM estimation of dynamic growth models. The authors argue that the coefficient of the lagged dependent variable from a good estimator should lie between the within group estimator (lower bound) and the pooled OLS estimator (upper bound). An estimator with a coefficient of the lagged dependent variable close to or lower than that of the within group estimator is a likely sign that the estimator is downward biased, which may be due to a weak instrument problem. Hence, the study also estimates the dynamic panel with these two measures (pooled OLS and within group estimators) as check points as to whether the preferred system GMM is a good estimator.

#### 2.3.1.3 Relevancy of the Collinearity Issue

A statistically robust regression is one where regressors are highly correlated with the dependent variable but correlated most minimally with each other. Friedman (1977), Ball (1992) Golob (1994) and Kontonikas (2004) theoretically and empirically show that inflation level is highly and positively correlated with inflation uncertainty. Since inflation and inflation volatility are highly and positively correlated, separating the effect of these two variables on economic growth is difficult in the time series and cross-sectional contexts. To be able to get the precise estimator for the effect of inflation level and inflation volatility on economic growth, we need to take into account the problem of collinearity.

Though the results are not biased, multicollinearity will lead to large standard errors leading to failure to reject the null hypothesis of no effect. Actually, this may explain why Barro (1995) found inflation uncertainty insignificant upon adding both inflation level and inflation volatility in the growth equation at the same time. However, if the coefficients for inflation level and inflation volatility are both significant, doing nothing is the best option unless the coefficients are insignificant, then action need be taken. We may consider dropping one of the variables but this may lead to inconsistency of all other coefficients in the model due to omitted variable bias.

However, collinearity is less likely to be a problem with panel data. This is because the cross-sectional dimension adds a lot of variability and more informative data (Baltagi, 2005). Therefore, using dynamic panel methods of estimation will lessen the problem of collinearity of inflation level and inflation volatility. In addition, the study uses annual

data and employs an appropriate measure of inflation volatility constructed from the GARCH(1, 1) model, both of which lessen the collinearity problem. Therefore, the study avoids data averaging, cross-sectional methodology and the standard deviation measure of inflation uncertainty, which previous researchers have always used. This is because these methods are plagued with collinearity.

As already mentioned above, if the coefficient for inflation-level and inflation-volatility are both significant, then the researcher would not have to worry about collinearity. To see the extent of the collinearity problem, the study first estimates a growth equation with data averaging and cross-sectional methodology. Later, the growth equation is estimated using the dynamic panel methodology and annual data. Lastly, a comparison between the two methodological differences is made.

### 2.3.2 Data and Sources

The study uses a cross-country panel data of 92 countries covering a period from 1982 to 2007. The data was obtained from IMF, International Financial Statistics, World Bank development indicators, Barro-Lee (2011) and Polity IV database. Countries were selected according to data availability, i.e. only countries that had full data on growth, inflation, schooling and democracy were retained in the sample. The estimation is conducted for three samples: the full sample of 92 countries, the developed countries sub-sample, and the developing countries sub-sample.

The dependent variable is economic growth. Economic growth is measured as the percentage change in the annual real GDP per capita. The independent variables of interest are inflation level and inflation volatility. Inflation level is measured as the percentage change in the annual consumer price index. The study uses quarterly data to calculate inflation volatility as this mitigates the collinearity problem. This is because using quarterly data involves using more data points, which adds a lot of variability and can produce more precise parameter estimates. Using GARCH models the study measures inflation volatility as the conditional variance of inflation.

#### 2.3.2.1 The GARCH(1, 1) Estimation Process for Inflation Volatility

Conditional variance is the true measure of uncertainty about a variable given a model and information set. To obtain conditional variance of inflation the study uses the GARCH(1, 1) specification:

$$\pi_t = \lambda_0 + \sum_{i=1}^{n} \lambda_i \pi_{t-1} + \varepsilon_t \quad (2.16)$$

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \theta \sigma_{t-1}^2 \quad (2.17)$$

Where $\pi_t$ is inflation, $\varepsilon_t$ is the disturbance of equation (2.5) and $\sigma_t^2$ is the one period ahead forecast for the variance of inflation based on past information. The present study models inflation through an autoregressive process (equation 2.5) in which inflation in one period is a function of its lagged values. This is because Cecchetti et al. (2000), using US data, verified that none of the single indicators out of the 19 which are generally believed to be important determinants of inflation are able to improve the forecasts of an autoregressive model clearly and consistently. The present study uses the GARCH(1,

1) specification to model inflation volatility. Lunde and Hansen (2005) find that while comparing the competing models on the basis of their out of sample predictive abilities, they do not have enough evidence to reject the hypothesis that none of the other volatility models are better than GARCH(1, 1). The study uses another measure of inflation volatility for robustness check. Annual inflation volatility is also measured as the standard deviation of inflation from the fourth quarter of the previous year to the fourth quarter of the current year. Thus, two measures of inflation volatility are used.

To get the conditional volatility, I used quarterly time series inflation data for each country from IMF-International Financial statistics. I estimated the GARCH(1, 1) process for each country, thereby getting conditional volatility with a quarterly frequency for each country. To turn the quarterly data into annual data points, I took the average of each of quarterly conditional volatility within each year to be the annual conditional volatility for that year. Note that I do not add up the quarterly conditional volatility in each year to get the annual conditional volatility for that year; instead, I take their average. This is because the quarterly inflation data points are annualized even though the data appears on a quarterly frequency. Hence, adding up would lead to an inflated value of condition volatility but averaging gives a more realistic value. All these processes are done prior to estimating the dynamic equation. The annualized time series data of conditional volatility for each country is later compiled into a panel. This is now included as a variable in the dynamic panel along with other variables and the dynamic equation is thereafter estimated with the system-GMM.

#### 2.3.2.2 Control Variables in the Growth Equation

It is universally acknowledged that economic growth is driven by a variety of factors. However, Levine and Renelt (1992) found that only investment rate and initial level of income per person are robustly correlated with economic growth. On the other hand, De Gregorio (1996) argues that it may be due to the consequence of high correlation among the independent variables which makes it difficult to disentangle the individual effect of each variable. Hence, Levine and Renelt's (1992) results should be interpreted with caution. Following Barro (1995), other variables are added as control variables to the equations (2.1) and (2.2) above. These are:

- Initial income measured as the logarithm of real GDP per capita in 1977. This is included to test for the convergence hypothesis.
- Investment, measured as a ratio of gross fixed capital formation to GDP used as a proxy for capital accumulation.
- Government expenditure, measured as a ratio of general government consumption to GDP.
- Trade openness, measured as total foreign trade relative to GDP; this is used to capture the degree of international openness.
- Life expectancy. This measures the health of human capital.
- Average years of total schooling attained by the adult population aged 15 and over from the Barro-Lee dataset (2010). This variable is available every 5 years. It is transformed into annual data by assuming that the variable remains constant for 5 years and only changes after 5 years. This assumption will not affect the result since average years of schooling attained are more stable over time.

- Democracy, measured by the Vanhanen's democratization index. A low value indicates a low level of democratization and a high value indicates a high level of democratization.
- Squared term of Democracy. This is included because Barro (1996) suggests that there is a non-linear relationship in which more democracy enhances growth at low levels of political freedom but depresses growth when a moderate level of freedom has already been attained.

## 2.4 Results and Discussions

### 2.4.1 Descriptive Statistics

From Table 2.1 it can be seen that the average economic growth rate is 1.8198% with an overall standard deviation of 5.2094%. The average inflation volatility is 24.0357%, the average conditional variance is 44.7743%, and the average inflation level is 56.8012%. These values seems to be too high because the full sample includes many countries which have experienced very high inflation or/and hyperinflation. Excluding high inflated countries (Bolivia, Brazil, Democratic Republic of Congo, Israel, Nicaragua, Peru, Sudan, Turkey, Zambia and Zimbabwe) lowers the average inflation volatility to 2.3113%, the average conditional variance to 6.2648% and the average inflation level to 8.7554%. The average investment is 19.9380% and average consumption is 17.2851%. Summary statistics for other control variables are presented in Table 2.1. From Table 2.1 it can be seen that all the variables have good variation both within and between countries, hence favouring the use of dynamic panel estimation.

From Table 2.3 it is observed that inflation level and the two measures of inflation volatility are negatively correlated with economic growth. It is not surprising that inflation level and inflation volatility (standard deviation of inflation level) have a much bigger correlation (0.551) than the correlation between inflation and conditional variance of inflation (0.203). This may indicate a collinearity problem when using the standard deviation of inflation level as the measure of inflation volatility. This implies that the conditional variance of inflation may be a better measure of inflation volatility. This measure may enable us to disentangle the growth effect of inflation level from that of inflation volatility. The two types of inflation volatility are positively correlated at 0.406 as expected. The rest of the variables are positively correlated with growth. However, government consumption and initial income per capita are wrongly signed. There is high correlation between openness, schooling and democracy. This suggests that it may be more difficult to estimate the effect of openness independently of schooling and democracy.

### 2.4.2 GARCH(1, 1) General Results

It would be interesting to report the estimates for the GARCH model parameters as it would be very revealing for determining the stationarity of the inflation volatility process. However, since I estimate GARCH(1, 1) model for each country in the sample, this is not possible as it would mean reporting results for each of 92 countries in Chapter 2 and 84 countries in Chapter 3. Therefore, there would be too many results tables. However, I provide a general report for the GARCH results for these countries. The results are robust as there is evidence of no serial correlation and heteroskedasticity based on the Ljung-Box Q-statistic conducted on squared standardized residuals, for

most of the countries. In addition, there are no remaining ARCH effects in residuals according to the ARCH LM (F-statistic) test. The normality test (Jarque-Bera), is however not fulfilled in the majority of equations. My results are similar to Fang and Miller's (2009), which also fail the normality test in most cases. Non-normality may result in standard errors that are inappropriate for inference. However, parameter estimates are consistent as long as both conditional mean and variance equations are correctly specified (Brooks, 2008). Consequently, the Bollerslev and Wooldridge (1992) robust standard errors and covariance are employed to give robust standard errors in case of non-normality.

Estimating the conditional volatility needs a moderate to large sample size (N at least 250 observations). This is not possible for my case. This is because a longer time span or higher data frequencies for inflation (e.g. monthly inflation data) is not available for most of the countries. Hence, to avoid limiting ourselves to just a few countries (mostly developed countries, since they are the ones with monthly data and longer time spans), which may lead to biased results, the time span and data frequencies are reduced. The time series period for each country is on a quarterly basis from 1982(Q1) to 2007(Q4), which gives N= 104 observations. In this study, the N (104 observations) is less than preferred N(250 observations), but this does not cause any limitations or problems since the major diagnostics tests are passed and robust standard errors provided in case of non-normality.

### 2.4.3 Main Econometric Results

To begin with, like many previous researchers in this field I run a cross-sectional regression. The results are reported in Table 2.4. Models 1 and 2 represent results where the conditional variance of inflation level is used as a measure of inflation volatility, whereas Models 3 and 4 represent results where the standard deviation of inflation level is used as the measure of inflation volatility. Inflation level and both measures of inflation volatility are insignificant throughout. This confirms Judson and Orphanides' (1999) finding that separating the effect of inflation level and volatility on growth is not possible based on cross-sectional regressions.

The insignificance of inflation level and inflation volatility is of course due to the high correlation between these variables (0.70 - 0.72) in cross-sectional data. The insignificance of these variables may also be as a result of data averaging in the cross-sectional regression which leads to information loss necessary for establishing the inflation-growth relationship. Investment, trade openness, life expectancy and initial GDP level are the only significant variables as evidenced in all the Models. The insignificance of the rest of the variables may also be due to the consequence of high correlation between variables which makes it impossible to disentangle the individual effect of each variable. Given the inability of identifying the inflation-growth relationship in cross-sectional data, I proceed to using the system GMM estimator with panel data. It is expected that panel data increases data variability, which mitigates the collinearity problem. Additionally, the use of annual data (unlike averaged data used in cross-sectional regressions) captures more accurately the effect of inflation on growth due to increased inflation experiences which are lacking in cross-sectional data.

Table 2.5 reports the results using the full sample dataset using different measures of inflation volatility. The estimates are run by system GMM estimator. The robust Windmeijer (2005) finite-sample corrected standard errors are reported in all the Models. The serial correlation test does not reject the absence of 2nd order serial correlation. Using the Hansen test of over-identifying restriction the present study finds that the over-identifying instruments are valid. The present study also finds that the lagged dependent variable is positive, significant and below unity in all the Models, ruling out explosive behaviour.

In addition, the choice of dynamic GMM as a preferred panel estimator is confirmed by the data, suggesting that the results have good statistical properties. The lagged dependent variable, inflation level, inflation volatility and the interaction term are endogenous and are instrumented using their lagged valued in the differenced equation and their once lagged first differences in the level equation. In all the Tables, Models 1 and 2 represent results where conditional variance is used as a measure of inflation volatility, whereas Models 3 and 4 represent results where standard deviation of inflation is used as a measure of inflation volatility.

From Table 2.5 it can be seen that, in all the Models estimated, investment, trade openness, life expectancy and democracy are positively signed and significant as expected. This suggests that an increase in these variables helps to increase economic growth. The inverted U-shaped relationship between growth and democracy is evidenced in all the Models. This implies that democracy leads to increased growth, but beyond a certain level, further increase in democracy lowers economic growth.

The log of initial income per capita is negatively signed and significant in all the Models, implying evidence of convergence; i.e. poor countries tend to growth faster than rich countries, keeping other factors constant. Government consumption and schooling coefficients, though both bear the expected signs, are insignificant in all the Models.

Turning to the major issue of the effect of inflation volatility and inflation level on economic growth, inflation level, as expected, negatively and significantly affects economic growth, as evidenced in Models 1 and 2. However, it is insignificant in Models 3 and 4. This may be as a result of high correlation between inflation level and the standard deviation of inflation level. The coefficients of inflation level are much smaller (-0.0004 to -0.0003) than Barro's (1995) estimates of -0.03 to -0.02. The difference in magnitude may be due to the difference estimation procedure and data frequencies. My results may be more credible than previous studies due to the use of a dynamic panel which accounts for collinearity and endogeneity of inflation level and inflation volatility.

In addition, I use high data frequencies which more accurately capture the relationship between the two variables. Inflation volatility (measured from quarterly data as the conditional variance of inflation) enters with negative and significant coefficients, implying that inflation volatility reduces economic growth. The estimates of inflation volatility range from -0.0004 to -0.0003. However, Barro (1995) found that inflation volatility had no significant relationship with growth. He interpreted his result as being biased, proposing that realized variability of inflation does not adequately measure inflation uncertainty. The superiority of my result is gained through my accurate measure of inflation volatility obtained from using the GARCH(1, 1) model and the use

of dynamic panel regression, which mitigates collinearity between inflation level and inflation volatility as opposed to the data averaging method used by Barro (1995).

Unlike panel regression, data averaging and cross-sectional methods lack the variety of inflation-growth experiences necessary for establishing the inflation-growth relationship. Standard deviation of inflation, another measure of inflation volatility, though it negatively affects economic growth, is only statistically significant in Model 3. Probably this is due to the high correlation between this measure of volatility and inflation level or because this is a poor measure of inflation volatility. This leads to the conclusion that conditional variance of inflation constructed from the GARCH(1, 1) model is a true and better measure of inflation volatility capable of establishing the negative relationship between inflation volatility and growth. The interaction terms between inflation volatility and inflation level are both insignificant with coefficients almost close to zero. From Table 2.5 it can be concluded that both inflation level and inflation volatility have very small effects on economic growth.

Estimating equations (2.1 and 2.2), it is well known that the pooled OLS estimator will give an estimate of $\gamma$ that is biased upwards in the presence of individual specific effects and the Within Groups estimator will give an estimate of $\gamma$ that is biased downwards (Bond et al., 2001). Thus, a consistent estimate of $\gamma$ can be expected to lie between the Within Groups estimates (lower bound) and the pooled OLS estimates (upper bond). Comparing Table 2.5 and Table 2.6, the estimates for the lagged dependent variable using the System GMM estimator (Table 2.5) lies comfortably above the corresponding Within Groups estimator and below the corresponding pooled OLS estimates (Table 2.6).

Therefore, we can conclude that the system GMM estimator is the more appropriate and consistent estimator. As such, all the rest of the regressions are estimated using the system GMM estimator.

Concentrating on the results in Table 2.6, the lagged dependent variable is positive and significant in all the Models. Inflation level is only significant in Models 1 and 2 when the pooled OLS estimator is used. All the measures of inflation volatility are negatively signed and significant, as evidenced in all the Models. Investment, trade openness, life expectancy and democracy accelerate economic growth. There is evidence of an inverted U-shaped relationship between democracy and growth, as seen in all the Models. All in all the results in Table 2.6 are qualitatively similar to the results reported in Table 2.5. This emphasizes robustness of the results to alternative estimation methods. However neither the pooled OLS nor Within Groups estimator are perused any further since these estimators are biased when a lagged dependent variable is present.

### 2.4.4 Robustness Checks

The study has carried out a variety of robustness checks to examine the sensitivity of the estimates described in the last sub-section and the results are reported in Tables 2.7 to 2.12.

The first robustness check involves excluding from the full sample observations of those countries which were at war. This is to check whether the results are primarily driven by such observations. By draining resources, wars are detrimental to economic growth and at the same time often result in an increase in inflation level and volatility. Data for war

years are taken from the Polity IV database. The diagnostics were satisfactory throughout. The results in Table 2.7 are similar to those reported in Table 2.5. All the measures of inflation volatility are negative and significant in all the models, whereas inflation level is significant and negatively signed in Models 1, 2 and 4. This suggests that the results are not driven by incidence of war. The estimates for other variables in Table 2.7 are the same both in sign, magnitude and significance to those reported in Table 2.5. The exception is government consumption which is significant in Models 1 and 2 at 10 percent level of significance.

The present study also divided the data set into two sub-samples, namely, the developing countries sub-sample and the developed countries sub-sample. The results are reported in Table 2.8. The diagnostics were satisfactory throughout. In the developing countries sub-sample, inflation level and condition variance of inflation negatively affect economic growth and the sizes of their coefficients are the same as those reported in Table 2.5. Standard deviation of inflation (another measure of inflation volatility) is still only significant in Model 3. This may be because it is a poor measure of volatility or due to collinearity. Investment, life expectancy and democracy positively and significantly affect economic growth. Initial income and democracy squared negatively and significantly affect economic growth. However, democracy is only significant in Models 1 and 4, whereas the squared term of democracy is only significant in Model 1. Sensitive to sample modification, is trade openness which becomes insignificant.

In the developed countries sub-sample, inflation level and both measures of inflation volatility are insignificant in all the Models. The weakening of results may be due to the fact that developed countries maintain low and stable inflation; hence, the growth effect of inflation level and volatility may be minimized. In addition, dividing the sample into sub-samples leads to information loss on the inflation experiences necessary for establishing the relationship between inflation and growth. Only investment, government consumption, initial GDP per capita and trade openness are significant. Also, investment is only significant in Model 3. The weakening of the results in both sub-samples may be as a result of splitting the data into two sub-samples, which leads to information loss.

### 2.4.5 Marginal Effects of Inflation Level

To further analyse the effect of inflation level on economic growth, the study calculates marginal effects of inflation level on growth at minimum level of inflation volatility. However, the study also reports the marginal effect inflation level evaluated at the mean and at the maximum of inflation volatility. Minimum, Mean and Maximum levels of inflation volatility (condition variance) are obtained from Table 2.1. The results for the marginal effect of inflation level are reported in Table 2.9. Emphasis is put on Model 2 where the condition variance of inflation is used as a measure of inflation volatility. This is because it proved to be a better measure of inflation volatility capable of disentangling the effect of inflation level and inflation volatility on growth. The marginal effect of inflation level at minimum value of inflation volatility allows the study to comment on hypothesis 2. Hypothesis 2 says that inflation level in the absence of inflation volatility does not affect growth. At minimum level of inflation volatility the marginal effect of inflation level is negative and significant. This implies that inflation level even in the

absence of inflation volatility still affects economic growth negatively.

### 2.4.6 Long-run Effect of Inflation Level and Volatility on Growth

Table 2.10 reports the long-run effects of inflation level and inflation volatility on economic growth. The long-run effects are calculated by dividing these coefficients by 1 − $\gamma$. The coefficients of inflation level and inflation volatility increase slightly compared to the results in Table 2.5. Therefore, inflation level and inflation volatility have almost the same impact both in the short run and in the long run, i.e. a unit increase in inflation level reduces economic growth by 0.0004 to 0.0005 units in the long run. Similarly, a unit increase in inflation volatility reduces economic growth by 0.0004 to 0.0009 units in the long run. Both inflation volatility and inflation level have very small effects on economic growth.

### 2.4.7 Panel VAR

The study also contributes to the existing literature on the link between inflation level, inflation volatility and economic growth by using a panel vector auto- regression (panel VAR) approach. The panel VAR approach addresses the endogeneity problem by allowing endogenous interactions between the variables in the system. In our case, the VAR will allow bi-directional causality between inflation level, inflation volatility and economic growth. The use of panel data solves the problem of data limitation and the asymptotic results are easier to derive from the panel. The study estimates a 3-variable panel VAR that includes real GDP per capita growth rate, inflation level and inflation volatility.

The econometric model takes the following reduced form:

$$Y_{it} = \Gamma(L)Y_{it} + \varepsilon_{it} \quad (2.18)$$

Where $Y_{it}$ is a vector of stationary variables, Γ($L$) is a matrix polynomial in the lag operator with Γ($L$) = $\Gamma_1 L^1$ + $\Gamma_2 L^2$ + ..... + $\Gamma_p L^p$ and $\varepsilon_{it}$ is a vector of idiosyncratic errors.

Table 2.11 reports the results of the unit root test for the variables in the system. The study employed the Breitung Test and the Im, Pesaran and Shin (IPS) test for conducting the panel unit root test. The results show that all the variables are stationary in levels. Hence, I proceed to estimate an unrestricted Panel VAR.

Figure 2.1 shows the impulse response functions from the Panel VAR. Impulse response functions describe the response of an endogenous variable over time to a shock in another variable in the system. Correct lag length selection is essential for the VAR. Too few lags fail to capture the system's dynamics, leading to omitted variable bias, while too many lags suffer from a loss of degrees of freedom. Therefore, to determine the optimal lag length to include in the panel VAR I used Akaike's information criteria (AIC). Hence, I estimated a VAR(8) as the optimal VAR. The study uses Cholesky decomposition to compute the impulse response functions. The results for impulse response functions are reported in pictorial form in Figure 2.1.

The impulse response function in Figure 2.1 shows that GDP growth responds negatively to a shock to inflation level. GDP growth also responds negatively to a shock to inflation volatility. However, both of these shocks have very little effect on GDP growth. These

findings are in line with the findings from system GMM estimations that inflation level and inflation volatility have very small effects on GDP growth. Inflation and inflation volatility respond positively to their own and each other's shocks. On the other hand, a shock to GDP growth leads to a fall both in inflation level and inflation volatility, whereas GDP growth responds positively to its own shock. All the results are statistically significant.

To assess the importance of shocks on one variable in explaining fluctuations in other variables, the study performs a variance decomposition. Table 2.12 reports the variance decomposition analysis. The variance decomposition analysis further confirms the results from the system GMM estimator. It shows that inflation level and volatility have very little ability in explaining fluctuations in economic growth. Most of the fluctuations in economic growth are explained by the lagged growth levels.

Inflation level and inflation volatility all together explain only less than 1 percent of the fluctuations in economic growth. In addition, fluctuations in inflation level are mostly explained by its lagged values, whereas fluctuations in inflation volatility are explained by both inflation level and inflation volatility. Around 20 percent of fluctuations of inflation volatility are explained by inflation level. This leads to a conclusion that high inflation tends to be volatile.

## 2.5 Conclusion

This paper investigates the effect of inflation level and inflation volatility on economic growth for 92 countries for the period from 1982 to 2007, with dynamic panel regression using the system GMM estimator. The main conclusion that emerges from this study is that both inflation level and inflation volatility affect economic growth negatively. The surprising finding is that they both have very small effects on economic growth. Similar results are obtained using a panel VAR approach. The findings suggest that keeping low and stable levels of inflation is a necessity for economic growth though the benefits may be minimal. The results on the marginal effect of inflation strongly reject the second hypothesis, which says that inflation level in the absence of inflation volatility does not reduce economic growth. This is because, at the minimum level of inflation volatility, the partial derivative of inflation level is still negative and significant. This implies that high inflation level induced by indexation is also detrimental to economic growth. The results are robust as they take into consideration the problems of endogeneity of both inflation level and volatility and collinearity between inflation level and inflation volatility. Further robustness is also found through the use of difference estimators. In addition, the present study uses appropriate measures of inflation volatility and avoids data averaging, which enables us to establish clearly the relationship inflation level, inflation volatility and growth.

**Table 2.1: Full Sample Descriptive Statistics**

| Variables | Mean | $S_O^2$ | $S_B^2$ | $S_W^2$ | Min | Max |
|---|---|---|---|---|---|---|
| Growth | 1.8198 | 5.2094 | 1.8500 | 4.8730 | −46.8925 | 147.5486 |
| Inflation | 56.8012 | 777.1300 | 208.9256 | 748.7839 | 13.0566 | 24411.0300 |
| Variance | 46.7743 | 602.6010 | 218.2754 | 562.0055 | 0.0323 | 15219.9500 |
| Volatility | 24.0357 | 370.3216 | 136.6938 | 344.3780 | 0.0332 | 10281.7600 |
| Investment | 19.9380 | 6.9634 | 5.6002 | 4.1727 | 1.9306 | 83.1590 |
| Gov't Consumption | 17.2851 | 6.9142 | 6.3213 | 3.1962 | 3.2189 | 55.3972 |
| Initial income | 7575.4190 | 7514.7850 | 7514.7850 | 0.0000 | 195.7837 | 27424.9900 |
| Trade openness | 78.7907 | 52.2862 | 49.8283 | 16.3140 | 6.3203 | 438.9016 |
| Life expectancy | 66.2799 | 10.9240 | 10.5490 | 2.7059 | 26.4101 | 82.5071 |
| Schooling | 6.5637 | 2.7425 | 2.6180 | *0.8586* | 0.6150 | 12.9110 |
| Democracy | 16.9232 | 13.3964 | 12.5822 | 4.7539 | 0.0000 | 49.0000 |

All variables are expressed as percentages except Life Expectancy, schooling, initial income and democracy. Government consumption is expressed as a ratio of GDP. $S_O^2$is overall variance,$S_B^2$ is between variance and $S_W^2$ is within variance. They are calculated as: $S_O^2 = \frac{1}{NT-1}\sum_i\sum_t(X_{it} - \bar{X})^2$; $S_B^2 = \frac{1}{NT-1}\sum_i(\bar{X}_i - \bar{X})^2$; $S_W^2 = \frac{1}{NT-1}\sum_i\sum_t(X_{it} - \bar{X}_t)^2$

Countries (N=92); Algeria, Australia, Austria, Barbados, Belgium, Belize, Bolivia, Botswana, Brazil, Burundi, Cameroon, Canada, Central Africa, Chile, China, Colombia, Costa Rica, Cote D'ivoire, Cyprus, Democratic Republic of Congo, Denmark, Dominican Republic, Ecuador ,Egypt, El Salvador, Fiji, Finland, France, Gabon, Gambia, Germany, Ghana, Greece, Guatemala, Honduras, Hungary, Iceland, India, Indonesia , Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea Rep, Luxembourg, Malaysia, Malawi, Mali, Malta, Mauritius, Mexico, Morocco, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Norway, Pakistan, panama, Papua New Guinea, Peru, Philippines, Portugal, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Spain, Sri Lanka, Sudan, Swaziland, Sweden, Switzerland, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Kingdom, United States, Uruguay, Venezuela, Zambia, Zimbabwe.

Table 2.2: Summary Statistics Excluding Hyper Inflation countries

| Variable | Mean | Std.Dev. | Min. | Max. |
|---|---|---|---|---|
| Growth | 1.9821 | 5.2332 | −46.8925 | 147.5486 |
| Inflation | 8.7554 | 14.7121 | −13.0566 | 200.0260 |
| Variance | 6.2648 | 12.8507 | 0.0323 | 198.6239 |
| Volatility | 2.3113 | 4.0223 | 0.0332 | 53.5642 |

Variance is inflation volatility measured as the conditional variance of the inflation level. Volatility is inflation volatility measured as the standard deviation of inflation level.

## Table 2.3 Correlation Matrix

| | Growth | Income | Inflation | Variance | Volatility | Invest | Consump | Openness | Life | Schooling | Demo | Demo 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Growth | 1.000 | | | | | | | | | | | |
| Income | 0.067 | 1.000 | | | | | | | | | | |
| Inflation | -0.087 | -0.049 | 1.000 | | | | | | | | | |
| Variance | -0.068 | -0.067 | 0.203 | 1.000 | | | | | | | | |
| Volatility | 0.080 | -0.009 | 0.551 | 0.406 | 1.000 | | | | | | | |
| Invest | 0.191 | 0.139 | -0.051 | -0.039 | 0.004 | 1.000 | | | | | | |
| Consump | 0.024 | 0.331 | -0.035 | 0.022 | 0.035 | -0.025 | 1.000 | | | | | |
| Openness | 0.145 | 0.225 | -0.030 | -0.008 | -0.017 | 0.044 | 0.342 | 1.000 | | | | |
| Life | 0.176 | 0.824 | -0.068 | -0.077 | -0.032 | 0.294 | 0.326 | 0.305 | 1.000 | | | |
| Schooling | 0.193 | 0.719 | -0.040 | -0.027 | -0.043 | 0.192 | 0.283 | 0.290 | 0.777 | 1.000 | | |
| Demo | 0.115 | 0.717 | -0.035 | -0.026 | -0.017 | 0.138 | 0.244 | 0.124 | 0.702 | 0.673 | 1.000 | |
| Demo 2 | 0.081 | 0.699 | -0.039 | -0.038 | -0.030 | 0.119 | 0.243 | 0.080 | 0.646 | 0.625 | 0.954 | 1.000 |

Life is life expectancy, Demo is democracy, Demo 2 is democracy squared, Income is initial income level, Consump is Government consumption ratio, Invest is investment, Openness is trade openness, Variance is conditional variance of inflation and Volatility is the standard deviation of inflation.

## Table 2.4: Effect of Inflation and Inflation Volatility on Economic Growth using Cross-Sectional Data: Full Sample, 1982 – 2007

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Inflation | -0.0044<br>(0.0042) | -0.0054<br>(0.0059) | -0.0055<br>(0.0046) | -0.0048<br>(0.0073) |
| Variance | -0.0001<br>(0.0037) | 0.0123<br>(0.0254) | | |
| (Inflation * Variance) | | -0.0000<br>(0.0000) | | |
| Volatility | | | 0.0020<br>(0.0062) | 0.0214<br>(0.0782) |
| (Inflation * Volatility) | | | | -0.0000<br>(0.0001) |
| Initial income | -0.7249**<br>(0.3002) | -0.7922**<br>(0.3228) | -0.8114**<br>(0.3687) | -0.7984**<br>(0.04052) |
| Investment | 0.1189***<br>(0.0400) | 0.1245***<br>(0.0451) | 0.1070**<br>(0.0464) | 0.1306<br>(0.1258) |
| Gov't consumption | -0.0022<br>(0.3002) | -0.0009<br>(0.0498) | -0.0094<br>(0.3060) | -0.018<br>(0.1073) |
| Trade openness | 0.0064*<br>(0.0033) | 0.0075**<br>(0.0035) | 0.0063*<br>(0.0036) | 0.0073<br>(0.0059) |
| life expectancy | 0.0947***<br>(0.0298) | 0.0987***<br>(0.0303) | 0.0967***<br>(0.0317) | 0.1012***<br>(0.0311) |
| Schooling | 0.0565<br>(0.0801) | 0.0547<br>(0.0943) | 0.0873<br>(0.1201) | 0.0200<br>(0.3484) |
| Democracy | 0.0212<br>(0.0691) | 0.0096<br>(0.0713) | 0.0085<br>(0.0722) | 0.0105<br>(0.0723) |
| Democracy squared | -0.0006<br>(0.0013) | -0.0002<br>(0.0014) | -0.0002<br>(0.0015) | -0.0002<br>(0.0014) |
| Constant | -1.5250<br>(1.9636) | -1.4584<br>(2.2826) | -0.6701<br>(2.9200) | -1.6656<br>(6.2403) |
| *N* | 92 | 92 | 92 | 92 |
| $R^2$ | 0.5527 | 0.4780 | 0.5222 | 0.4270 |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Variance is the conditional variance of inflation level and volatility is the standard deviation of inflation level. Gov't consumption is government expenditure.

## Table 2.5: Effect of Inflation Level and Volatility on Economic Growth using System GMM Estimator, Full Sample, 1982- 2007

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| L. Growth | 0.1736** | 0.1738** | 0.1758** | 0.1766** |
| | (0.0733) | (0.0733) | (0.0768) | (0.0777) |
| Inflation | -0.0003** | -0.0004* | -0.0002 | -0.0002 |
| | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| Variance | -0.0003*** | -0.0004*** | | |
| | (0.0001) | (0.0001) | | |
| (Inflation * Variance) | | 4.3*e* - 8 | | |
| | | (4.0*e* - 8) | | |
| Volatility | | | -0.0007*** | -0.0007 |
| | | | (0.0002) | (0.0008) |
| (Inflation * Volatility) | | | | 6.0*e* - 9 |
| | | | | (1.1*e* - 7) |
| Initial income | -0.5517*** | -0.5593*** | -0.4829** | -0.4736** |
| | (0.2043) | (0.2079) | (0.2127) | (0.2133) |
| Investment | 0.1017*** | 0.1013*** | 0.1061*** | 0.1053*** |
| | (0.0264) | (0.0266) | (0.0265) | (0.0265) |
| Gov't consumption | -0.0289 | -0.0295 | -0.0276 | -0.0261 |
| | (0.0221) | (0.0223) | (0.0214) | (0.0214) |
| Trade openness | 0.0100*** | 0.0100*** | 0.0098*** | 0.0098*** |
| | (0.0023) | (0.0023) | (0.0022) | (0.0022) |
| life expectancy | 0.0628*** | 0.0629*** | 0.0634*** | 0.0620*** |
| | (0.0189) | (0.0191) | (0.0180) | (0.0179) |
| Schooling | 0.0736 | 0.0753 | 0.0413 | 0.0454 |
| | (0.0619) | (0.0619) | (0.0683) | (0.0681) |
| Democracy | 0.0708** | 0.0700** | 0.0702** | 0.0683** |
| | (0.0319) | (0.0322) | (0.0321) | (0.0321) |
| Democracy squared | -0.0014** | -0.0014** | -0.0014** | -0.0014** |
| | (0.0006) | (0.0007) | (0.0007) | (0.0007) |
| Constant | -1.1763 | -1.1042 | -1.6668 | -1.6665 |
| | (1.1223) | (1.1541) | (1.2582) | (1.2614) |
| *N* | 2279 | 2279 | 2279 | 2279 |
| Hansen test p-value | 0.7050 | 0.7465 | 0.7329 | 0.7484 |
| Resid. AR(1) test p-value | 0.0019 | 0.0019 | 0.0022 | 0.0022 |
| Resid. AR(2) test p-value | 0.3227 | 0.3191 | 0.3467 | 0.3470 |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Variance is the conditional variance of inflation level and volatility is the standard deviation of inflation level. Gov't consumption is government expenditure. Significant time dummies are included in all regressions.

## Table 2.6: Effect of Inflation and Inflation Volatility on Economic Growth using Pooled OLS and Within Groups Estimators

| | Pooled OLS | | | | Within groups | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| L.Growth | 0.2066*** | 0.2064*** | 0.2080*** | 0.2086*** | 0.1270* | 0.1269* | 0.1242* | 0.1244* |
| | (0.0711) | (0.0712) | (0.0707) | (0.0714) | (0.0727 | (0.0727) | (0.0720) | (0.0723) |
| Inflation | -0.0003* | -0.0003* | -0.0002 | -0.0002 | -0.0003 | -0.0003 | -0.0001 | -0.0001 |
| | (0.0002) | (0.0002) | (0.0001) | (0.0001) | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| Variance | -0.0003*** | -0.0003*** | | | -0.0002** | -0.0003*** | | |
| | (0.0001) | (0.0001) | | | (0.0001) | (0.0001) | | |
| Inflation * Variance | | -0.0000 | | | | 0.0000 | | |
| | | (0.0000) | | | | (0.0000) | | |
| Volatility | | | -0.0006** | -0.0006 | | | -0.0006*** | -0.0005 |
| | | | (0.0003) | (0.0005) | | | (0.0002) | (0.0008) |
| Inflation * Volatility | | | | 0.0000 | | | | -0.0000 |
| | | | | (0.0000) | | | | (0.0000) |
| Initial Income | -0.4943*** | -0.4951*** | -0.4655*** | -0.4675*** | | | | |
| | (0.1636) | (0.1639) | (0.1639) | (0.1639) | | | | |
| Investment | 0.1011*** | 0.1012*** | 0.1033*** | 0.1033*** | 0.1038*** | 0.1030*** | 0.1049*** | 0.1049*** |
| | (0.0192) | (0.0192) | (0.0192) | (0.0193) | (0.0382) | (0.0384) | (0.0385) | (0.0385) |
| Gov't consumption | -0.0198 | -0.0198 | -0.0184 | -0.0184 | -0.0592 | -0.0603 | -0.0543 | -0.0543 |
| | (0.0178) | (0.0178) | (0.0176) | (0.0176) | (0.0362) | (0.0367) | (0.0356) | (0.0356) |
| Trade openness | 0.0082*** | 0.0083*** | 0.0082*** | 0.0082*** | 0.0173* | 0.0175* | 0.0158* | 0.0158* |
| | (0.0017) | (0.0017) | (0.0017) | (0.0017) | (0.0089) | (0.0090) | (0.0087) | (0.0087) |
| Life expectancy | 0.0673*** | 0.0673*** | 0.0683*** | 0.0684*** | 0.0514 | 0.0498 | 0.0605 | 0.0605 |
| | (0.0261) | (0.0261) | (0.0260) | (0.0260) | (0.0408) | (0.0410) | (0.0424) | (0.0424) |
| Schooling | 0.0330 | 0.0335 | 0.0203 | 0.0211 | 0.1047 | 0.1080 | 0.1981 | 0.0983 |
| | (0.0489) | (0.0490) | (0.0484) | (0.0484) | (0.1879) | (0.1884) | (0.1921) | (0.1923) |
| Democracy | 0.0498** | 0.0500** | 0.0502** | 0.0502** | 0.1150** | 0.1153** | 0.1165** | 0.1165** |
| | (0.0227) | (0.0227) | (0.0226) | (0.0226) | (0.0451) | (0.0452) | (0.0447) | (0.0448) |
| Democracy squared | -0.0010** | -0.0010** | -0.0010** | -0.0010** | -0.0023** | -0.0023** | -0.0023** | -0.0023** |
| | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0012) | (0.0012) | (0.0011) | (0.0011) |
| Constant | -1.3945 | -1.3958 | -1.6842 | -1.6818 | -5.6894** | -5.5839** | -6.1703** | -6.1736** |
| | (1.1028) | (1.1042) | (1.0900) | (1.0902) | (2.6306) | (2.6557) | (2.6909) | (2.6861) |
| *N* | 2279 | 2279 | 2279 | 2279 | 2279 | 2279 | 2279 | 2279 |
| $R^2$ | 0.1959 | 0.1961 | 0.1966 | 0.1968 | 0.0872 | 0.0874 | 0.0924 | 0.0924 |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Variance is the conditional variance of inflation level and volatility is the standard deviation of inflation level. Gov't consumption is government expenditure. Significant time dummies are included in all regressions.

## Table 2.7: Effect of Inflation and Inflation Volatility on Economic Growth for the Sub-sample Excluding Observations for which Countries were at War

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| L. Growth | 0.2709*** | 0.2703*** | 0.2376*** | 0.2351*** |
| | (0.0552) | (0.0553) | (0.0484) | (0.0484) |
| Inflation | -0.0004** | -0.0004** | -0.0001 | -0.0003*** |
| | (0.0002) | (0.0002) | (0.0001) | (0.0001) |
| Variance | -0.0002*** | -0.0003*** | | |
| | (0.0001) | (0.0001) | | |
| (Inflation * Variance) | | 0.0000 | | |
| | | (0.0000) | | |
| Volatility | | | -0.0005*** | -0.0012** |
| | | | (0.0002) | (0.0005) |
| (Inflation * Volatility) | | | | 0.0000** |
| | | | | (0.0000) |
| Initial income | -0.4754** | -0.4777** | -0.4450* | -0.4823** |
| | (0.2061) | (0.2091) | (0.2460) | (0.2304) |
| Investment | 0.0923*** | 0.0923*** | 0.1079*** | 0.1098*** |
| | (0.0198) | (0.0198) | (0.0253) | (0.0242) |
| Gov't consumption | -0.0383* | -0.0384* | -0.0304 | -0.0299 |
| | (0.0220) | (0.0218) | (0.0337) | (0.0333) |
| Trade openness | 0.0104*** | 0.0104*** | 0.0094*** | 0.0088*** |
| | (0.0022) | (0.0021) | (0.0025) | (0.0026) |
| life expectancy | 0.0485*** | 0.0488*** | 0.0626*** | 0.0646*** |
| | (0.0179) | (0.01801) | (0.0215) | (0.0215) |
| Schooling | 0.0644 | 0.0661 | 0.0389 | 0.0399 |
| | (0.0484) | (0.0492) | (0.0554) | (0.0574) |
| Democracy | 0.0818*** | 0.0812*** | 0.0773* | 0.0780* |
| | (0.0309) | (0.0303) | (0.03971) | (0.0401) |
| Democracy squared | -0.0016** | -0.0016*** | -0.0016** | -0.0017** |
| | (0.0006) | (0.0006) | (0.0008) | (0.0008) |
| Constant | -0.7764 | -0.7791 | -2.0077 | -1.8032 |
| | (1.0365) | (1.0542) | (1.3993) | (1.3238) |
| *N* | 2070 | 2070 | 2070 | 2070 |
| Hansen test p-value | 0.4590 | 0.4300 | 0.8591 | 0.8935 |
| Resid. AR(1) test p-value | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Resid. AR(2) test p-value | 0.1626 | 0.1634 | 0.2157 | 0.2215 |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Variance is the conditional variance of inflation level and volatility is the standard deviation of inflation level. Gov't consumption is government expenditure. Significant time dummies are included in all regressions.

## Table 2.8: Effect of Inflation and Inflation Volatility on Economic Growth using Developing and Developed Sub-samples, 1982- 2007

| | Developing Countries | | | | Developed Countries | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| L. Growth | 0.1530** (0.0647) | 0.1887* (0.0805) | 0.1473** (0.0640) | 0.1472** (0.0648) | 0.3894*** (0.0913) | 0.3894*** (0.0928) | 0.4004*** (0.0662) | 0.479*** (0.0810) |
| Inflation | -0.0003* (0.0002) | -0.0004* (0.0002) | -0.0002 (0.0002) | -0.0002 (0.0002) | -0.0010 (0.0059) | 0.0033 (0.0204) | 0.0037 (0.0330) | -0.0473 (0.0547) |
| Variance | -0.0003*** (0.0001) | -0.0003*** (0.0001) | | | 0.0032 (0.0040) | -0.0004 (0.0119) | | |
| (Inflation * Variance) | | $4.6e-8$ ($3.9e-8$) | | | | 0.0002 (0.0001) | | |
| Volatility | | | -0.0007*** (0.0002) | -0.0006 (0.0008) | | | -0.0140 (0.1156) | 0.1990 (0.2741) |
| (Inflation * Volatility) | | | | 0.0000 (0.0000) | | | | -0.0000 (0.0000) |
| Initial income | -0.8105** (0.3436) | -0.5750* (0.3069) | -0.6816** (0.3060) | -0.8391** (0.3607) | -0.4581*** (0.1641) | -0.4668*** (0.1618) | -0.4772*** (0.1430) | -0.4944** (0.2131) |
| Investment | 0.1227*** (0.0361) | 0.1027*** (0.0333) | 0.1350*** (0.0375) | 0.1348*** (0.0376) | 0.0447 (0.0387) | 0.0468 (0.0405) | 0.0588* (0.0327) | 0.0527 (0.0332) |
| Gov't consumption | -0.0232 (0.0396) | -0.0456* (0.0255) | -0.0222 (0.0388) | -0.0219 (0.0390) | -0.0771** (0.0317) | -0.0729* (0.0378) | -0.0455* (0.0270) | -0.0483* (0.282) |
| Trade Openness | 0.0006 (0.0073) | 0.0071 (0.0056) | -0.0028 (0.0077) | -0.0027 (0.0078) | 0.0084*** (0.0014) | 0.0081*** (0.0013) | 0.0088*** (0.0014) | 0.0092*** (0.0019) |
| Life expectancy | 0.0754*** (0.0265) | 0.0625*** (0.0227) | 0.0701*** (0.0256) | 0.0784*** (0.0250) | -0.0802 (0.0523) | -0.0795 (0..0540) | -0.0540 (0.0430) | -0.0337 (0.0608) |
| Schooling | 0.0911 (0.1149) | 0.1236 (0.0895) | 0.1279 (0.1118) | 0.1455 (0.1183) | -0.0183 (0.0477) | -0.0212 (0.0488) | -0.0195 (0.0429) | -0.0234 (0.0596) |
| Democracy | 0.1137** (0.0523) | 0.0450 (0.0416) | 0.0849 (0.0524) | 0.0869* (0.0514) | -0.0284 (0.0631) | -0.0319 (0.0685) | 0.0173 (0.0646) | 0.0374 (0.0792) |
| Democracy squared | -0.0026* (0.0013) | -0.0009 (0.0012) | -0.0019 (0.0014) | -0.0017 (0.0013) | 0.0002 (0.0011) | 0.0003 (0.0012) | -0.0004 (0.0010) | -0.0006 (0.0012) |
| Constant | -0.1027 (1.8754) | -0.7363 (1.5786) | -0.8898 (1.8262) | -0.2756 (2.0081) | 13.0633*** (4.9309) | 13.0848**** (4.8838) | 9.1028** (3.9218) | 7.6583 (5.3535) |
| *N* | 1576 | 1576 | 1576 | 1576 | 699 | 699 | 699 | 699 |
| Hansen test p-value | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.2769 | 0.2758 | 0.9358 | 0.4339 |
| Resid. AR(1) test p-value | 0.0028 | 0.0033 | 0.0029 | 0.0029 | 0.0018 | 0.0007 | 0.0002 | 0.0003 |
| Resid. AR(2) test p-value | 0.3225 | 0.2541 | 0.3355 | 0.3329 | 0.5120 | 0.5032 | 0.5304 | 0.9533 |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Variance is the conditional variance of inflation level and volatility is the standard deviation of inflation level. Gov't consumption is government expenditure. Significant time dummies are included in all regressions.

Table 2.9: Marginal Effect of Inflation Level on Economic Growth Conditional on Inflation Volatility

| Specification | Evaluated at | | |
|---|---|---|---|
| | Min | Mean | Max |
| Model 2 | -0.0004* | -0.0004* | -0.0004* |
| | (0.0002) | (0.0002) | (0.0002) |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively.

Table 2.10: Long Run Effect of Inflation Level and Volatility on Economic Growth

| Variable | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Inflation | -0.0004** | -0.0005* | -0.0003 | -0.0003 |
| | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| Variance | -0.0004*** | -0.0005*** | | |
| | (0.0001) | (0.0001) | | |
| Volatility | | | -0.0009*** | -0.0009 |
| | | | (0.0002) | (0.0002) |

***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Variance is inflation volatility is measured as the conditional variance of inflation level and Volatility is inflation volatility is measured as the standard deviation of inflation level.

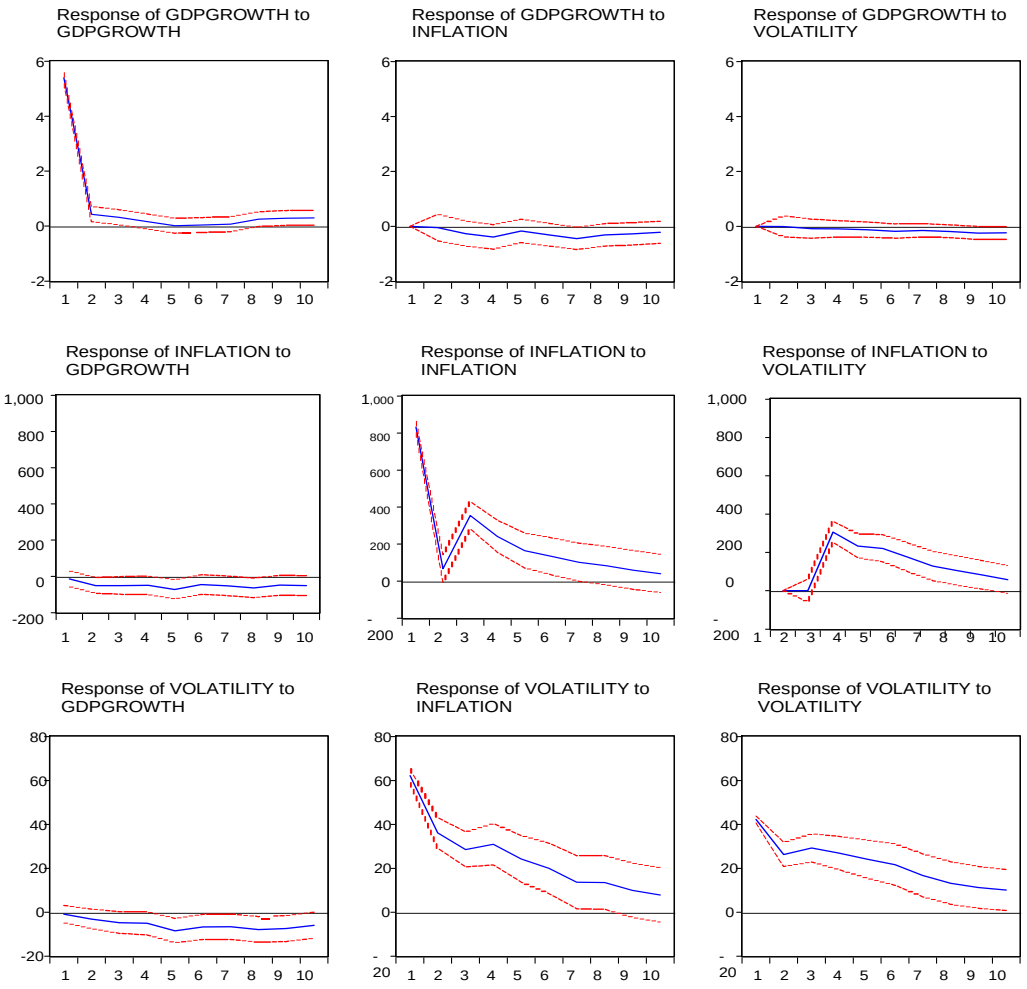
**Table 2.11: Unit Root Test**

| | Breitung | | IPS Test | |
|---|---|---|---|---|
| | (Statistic) | (P-value) | (Statistic) | (P-value) |
| Growth | -12.4863 | 0.0000 | -13.0436 | 0.0000 |
| Inflation level | -6.6617 | 0.0000 | -8.8648 | 0.0000 |
| Inflation volatility | -12.4319 | 0.0000 | -13.2643 | 0.0000 |

Unit root test was carried out on variables in levels. The null is the presence of a unit root.

Table 2.12: Variance Decomposition Analysis

| Variance Decomposition of Growth | | | |
|---|---|---|---|
| Period | *Growth* | *Inflation* | *Volatility* |
| 1 | 100.0000 | 0.0000 | 0.0000 |
| 2 | 99.9648 | 0.0065 | 0.0288 |
| 3 | 99.8690 | 0.0934 | 0.0376 |
| **Variance Decomposition of Inflation** | | | |
| Period | *Growth* | *Inflation* | *Volatility* |
| 1 | 0.0364 | 99.9636 | 0.0000 |
| 2 | 0.7184 | 99.1814 | 0.1004 |
| 3 | 1.3469 | 98.4569 | 0.1963 |
| **Variance Decomposition of Volatility** | | | |
| Period | *Growth* | *Inflation* | *Volatility* |
| 1 | 0.2540 | 20.0528 | 79.9281 |
| 2 | 0.0505 | 22.3018 | 77.6476 |
| 3 | 0.1573 | 18.8020 | 81.0407 |


Response of GDPGROWTH to GDPGROWTH
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Response of GDPGROWTH to VOLATILITY
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# CHAPTER 3

# THE IMPACT OF POLITICAL INSTABILITY ON INFLATION VOLATILITY

## 3.1 Introduction

There is a general consensus among economists that high and volatile inflation adversely affects economic growth and social welfare. Surprisingly, given this general consensus, inflation level has remained stubbornly high and volatile in some Latin American and African countries. Many researchers have tried to understand the determinants of inflation level. However, researchers have not yet extensively investigated the causes of inflation volatility. According to Clemens and Moss (2005), the recent inflation crisis in Zimbabwe can be blamed on political misrule. Furthermore, Fischer (1993) states that inflation rate is viewed by many as an indicator of the overall ability of a government to manage the economy. Thus, a country producing high inflation is one that has lost control of its monetary policy. This calls for understanding the relationship between political instability and inflation volatility.

Rother (2004) finds that the volatility in discretionary inflation policy has contributed to inflation volatility in a panel of 15 OECDs for a period of 35 years. Using a dynamic panel model, Bowdler and Malik (2005) provide evidence for a negative relationship between trade openness and inflation volatility. Cukierman et al. (1992) and Alesina and Summers (1993) argue that central bank independence leads to a low average rate of money

growth and inflation and to greater monetary stability. This is because independence enhances the ability of central banks to commit to price stability and hence low and stable inflation. Although these studies show the relationship between inflation volatility and other variables, they do not shed sufficient light on the root causes of inflation volatility.

Khan and Saqib (2011) argue that political instability does not provide room for implementation of coherent policies, which undermines the competence of government and diminishes its resilience to accommodate shocks that eventually result in macroeconomic disequilibrium characterized by volatile inflation. Additionally, Aisen and Veiga (2006) argue that politically unstable countries are often susceptible to political shocks which lead to discontinuous monetary and fiscal policies and high inflation volatility.

Although there is much research on the impact of political instability on economic growth (Alesina et al., 1996; Gyimah-Brempong & Traynor, 1999; Jong- A-Pin, 2009), little research has been dedicated to understanding the impact of political instability on inflation volatility. Thus, this study aims at providing a link between political instability and inflation volatility in Africa using annual data of 49 African countries covering the period from 1985 to 2009 with the system-GMM estimator. Although emphasis will be put on Africa, a comparison will be made between Africa and 35 countries selected from the rest of the world. These countries are selected according to data availability on political instability proxies while considering a balance between politically unstable and

politically stable countries in order to draw a justified conclusion.

This study contributes to the existing literature as follows: first, to the best of my knowledge the present study is the first study to explore the effect of political instability on inflation volatility in the context of Africa. The study mainly focuses on only African countries because political instability in most African countries has remained stubbornly high even though they have been independent for several decades. In addition, these countries have had relatively more volatile inflation compared to Europe and Asian countries. However, a comparison of Africa with some selected countries from the rest of the world will be made.

Second, this study uses the state failure index, state fragility index and the incidence of coups as measures of political instability. The first two measures are new measures of political instability, and hence, this is the first paper to use these indices as proxies for political instability in studying inflation volatility. The disadvantage of other proxies of political instability that have been used in the literature, such as cabinet changes, is that they are not appropriate for Africa. For example, African countries' cabinets tend to remain unchanged over a long period of time, yet most of these countries have experienced political instabilities. The state failure index and state fragility index are more appropriate measures of political instability for Africa since events considered in compiling these indices (revolutionary wars, ethnic wars, genocides and coups) have been more rampant in Africa. Therefore, these measures of political instability might provide accurate estimations for the relationship between inflation volatility and

political instability in Africa.

Furthermore, the study applies a novel measure of inflation volatility. This is measured as the conditional variance of inflation level constructed from the GARCH (1, 1) model. Conditional variance is the true measure of uncertainty about a variable given a model and information set. The standard deviation of inflation level used in the previous literature as the measure of inflation volatility does not adequately measure the uncertainty of inflation as stated by Barro (1995). With this measure, we can accurately estimate the effect of political instability on inflation volatility.

Additionally, the study uses alternative measures of inflation volatility and political instability for sensitivity analysis. Using many proxies of political instability enables us to see how different channels of political instability affect inflation volatility and which channels have a bigger impact on inflation volatility. Lastly, I demonstrate the robustness of the results to a wide range of controls, namely: per capita income, trade openness, volatility of money supply, agriculture, exchange rate regime, inflation targeting, indebtedness and growth volatility.

The remainder of the paper is outlined as follows: Section 3.2 presents a brief review of the relevant literature; Section 3.3 presents the research methodology; Section 3.4 presents the empirical results and Section 3.5 presents policy implications and conclusion.

## 3.2 Literature Review

### 3.2.1 Channels of Transmission

This section considers some of the channels through which political instability may affect inflation volatility.

First, according to the theory of optimal taxation, governments may have a motive for creating inflation, so as to generate seigniorage. Tax evasion and tax collection costs may make it optimal for the government to rely on the inflation tax as a source of government revenue. Clearly, tax evasion and tax collection costs are likely to be greater in countries that are more politically unstable.

Secondly, political instability may also lead to low output and investment, which shrinks taxable assets and income of those most able to meet government revenue requirements. This may result in increased reliance on the inflation tax.

Additionally, by reducing revenues and increasing public spending, political instability may also contribute to larger fiscal deficits, which may have inflationary consequences for countries with less developed financial markets.

Also, countries with political instability probably tend to have large amounts of underground activities, which raise the optimal inflation tax, implying a high and unstable inflation level.

Finally, political instability does not provide room for implementation of coherent policies, which undermines the competence of government and diminishes its resilience to accommodate shocks that eventually result in macroeconomic disequilibrium characterized by volatile inflation.

### 3.2.2 Review of Empirical Studies on Political Instability and Inflation Volatility

There is very little empirical evidence on the effect of political instability on inflation volatility. Aisen and Veiga (2008) use the system-GMM estimator and a sample of 160 countries covering the period of 1960 to 1999 to analyse the effect of political instability on inflation volatility. The authors find that low economic freedom and a higher degree of political instability, ideological polarization and fragmentation of political system generate more volatile inflation. They further report that increased economic freedom and democracy reduce inflation volatility. This is consistent with the conventional wisdom that, by ensuring economic freedom and good governance, a democratic form of government tends to produce low and stable inflation.

Although the studies below discuss the relationship between inflation level and political instability, they may be of indirect relevance to the relationship between political instability and inflation volatility. This is because inflation level and inflation volatility are highly correlated, as evidenced by Kontonikas (2004).

Khan and Saqib (2011) investigated the effect of political instability on inflation in Pakistan, applying the generalized method of moments using data from 1951 to 2007. They find that effects of monetary factors such as growth rate of broad money supply are rather marginal whereas non-monetary factors such as the political instability strongly and positively affect inflation in Pakistan. Contrary to conventional wisdom, they also report that, as Pakistan moves towards a democratic form of government, inflation rises.

Paldam (1987) used time series data for Latin American countries to study the relationship between political instability and inflation. He argues that the causality from political instability to inflation is due to demand for public expenditure which is then financed by inflation tax. The author finds that inflation tends to fall under military regimes while it tends to grow under civilian government. These results clearly contradict Aisen and Veiga's (2006) result that inflation level tends to decline under democratic governments. Since Paldam (1987) does not carry out any formal econometric analysis, Aisen and Veiga's (2006) results are more credible.

Additionally, Telatar et al. (2010) assume that governments may abuse the monetary policy by forcing monetary authorities to create a monetary surprise in order to increase output in the short run, which results in high inflation without real gain. Hence, monetary policy should be taken out of the hands of politicians in order to eliminate inflationary bias. Accordingly, Hielscher and Markwardt (2011) argue that, in a democratic environment, any political action bears the risk of punishment from voters.

The opportunity for punishment increases the accountability for policy makers. Under such an assumption, it becomes costly for politicians to deviate from the socially preferred central bank independence. The increased creditability of central bank independence results in a low inflation level. However, Barro (1995) find the correlation between central bank independence and inflation to be essentially zero. Similarly, Campillo and Miron (1996) report that central bank independence and exchange rate mechanisms are relatively unimportant determinants of inflation performance, whereas political instability is a relatively important determinant of inflation.

The theoretical model of Cukierman et al. (1992) proves that political instability and polarization determine the equilibrium efficiency of a tax system and the resulting combination of tax revenue and seigniorage the governments use. The authors test the prediction of their model on cross-sectional data for 79 countries. They find that, after controlling for other variables, political instability is positively associated with seigniorage. Additionally, they argue that countries with larger capacity non-export income, more open to trade and with larger mining but smaller agricultural sectors have on average a high taxable capacity or ease of tax collection. Such countries will not rely on seigniorage and therefore will have much capacity to maintain low and stable inflation.

War results in the destruction of goods and tends to raise money supply. This increase in the money supply combined with a decrease in goods leads to inflation. One of the best-known episodes of hyperinflation occurred during the American Civil War, as the South went broke printing Confederate dollars. The British financed their part in World War I by taking out the biggest UK loan in banking history. During World War II, the US National Debt rocketed from 16 billion dollars to 260 billion dollars, resulting in inflation rates in 1946 and 1947 of 18.13 percent and 8.84 percent respectively (source: Inflation data.com).

According to Fischer (2001), the type of inflation that is associated with wars usually arises from an increase in aggregate demand. In the time of war, government spending for military purposes stimulates demand throughout the economy and at the same time a shift of workers from productive labour into war production causes a decline in aggregate supply. In addition, war leads to the type of inflation which is caused by inflationary expectations. This occurs when people begin to raise prices not because of actual changes in supply or demand or cost or the size of money supply but out of fear that such changes might happen. The author also finds that the periods of price stability are always marked by faith in order and harmony.

## 3.3 Research Methodology

### 3.3.1 Econometric Methodology and Model Identification

To be able to empirically test the effect of political instability on inflation volatility, the study uses the dynamic panel data model and system-GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). Panel data is advantageous because it adds more variability to the data, which helps to mitigate collinearity. The study seeks to address the following hypotheses;

1) Does political instability lead to increased inflation volatility?

2) Does the relationship between political instability and inflation volatility hold across alternative measures of political instability and inflation volatility?

The empirical model is therefore written as:

$$infv_{it} = \beta_0 + \beta_1 infv_{it-1} + \beta_2 pol_{it} + \delta_X + \varepsilon_{it} \quad (3.1)$$

Where $infv_{it}$ represents conditional variance of inflation level as a measure of inflation volatility, $pol_{it}$ is political instability, and $\chi$ is a vector of other variables affecting inflation volatility such as inflation level, the share of the agricultural sector in the economy, trade openness, real GDP per capita and volatility of money supply growth. Inflation volatility is persistent so I include lagged dependent variable as a regressor on the right-hand side to get rid of possible autocorrelation.

A country-specific fixed effect is assumed for the error term

$$\varepsilon_{it} = \mu_i + v_{it} \quad (3.2)$$

where $\varepsilon_{it}$ represents the error term. It contains $\mu_i$ which represents country-specific fixed effects that are time invariant, whereas $v_{it}$ is assumed to be independent and identically distributed with mean 0 and variance $\sigma^2_v$ both over time and across countries.

As already mentioned above, this chapter uses the dynamic panel with system GMM approach. Refer to sub-sub-sections 2.3.1.1 and 2.3.1.2 in Chapter 2 for a detailed explanation of this methodology.

### 3.3.2 Data and Sources

The study uses a cross-country panel data of 49 African countries and 35 countries from the rest of the world covering the period from 1985 to 2009. The choice of the sample was due to the availability of political instability data while needing to keep a balance between both politically stable and unstable countries in order to draw a justified conclusion. However, for the case of state fragility, the sample period runs from 1995 to 2009 since the data on state fragility is only available for this period. The economic data is from the IMF International Financial Statistics and World Bank Development Indicators (2011). The data on political instability is from the Polity IV Database, the Integrated Network for Societal Conflict Research (INSCR) data page and the International Conflict Risk Guide (ICRG).

Inflation volatility is measured as the conditional variance of inflation level constructed from quarterly data. To get conditional variance of inflation the study uses the GARCH (1, 1) model. For details on the estimation of this variable, see sub-sections 2.3.2.1 and 2.4.2 in Chapter 2. Following Bowdler and Malik (2005), the logarithm of inflation volatility is used as a dependent variable. In literature, the log transformation of inflation volatility is taken in order to down-weight very large readings that may occur during hyperinflation episodes.

Inflation level is included as a regressor in the estimations. By including inflation level as a regressor, I test the hypothesis that political instability and other control variables have a direct effect on inflation volatility beyond the indirect one that operates through inflation level. A positive coefficient is expected since, according to Kontonikas (2004), high inflation level tends to be volatile. Following the literature, the logarithm of (1+inflation) is used in all the regressions, whereby, inflation is measured as the growth rate of the consumer price index.

For political instability, the study uses three different indicators. First, the study uses an index of state failure as the measure of political instability. This includes three separate kinds of state failure or political crisis namely: revolutionary wars, ethnic wars and genocides. Revolutionary wars are defined as episodes of violent conflict between governments and politically organized groups seeking to overthrow the government. Ethnic wars are episodes of violent conflict between government and national ethnic, religious or other communal minorities seeking major changes in their status. Their

purpose is to change the established political structure. Genocide involves the promotion, execution, and/or implied consent of sustained policies by the governing elite or their agents or, in the case of civil war, either of the contending authorities, which results in the deaths of a substantial portion of a communal group or politicized non-communal group. Revolutionary war and ethnic war are constructed from the average of three components namely: number of rebel combats and activists, annual number of fatalities relating to fighting, and portion of country affected by fighting. These components each range from 0 to 4. A bigger number means more political instability and vice versa. In the case of genocide, this indicator is constructed based on the annual number of deaths. It ranges from 0 to 5. These events, to a greater extent, had big shocks and threats to the central government so that many of them led to the transfer of political leadership to the opposition group whose purpose is to change the established political structure, and also led to the collapse of the established institution (source: Network for Societal Conflict Research (INSCR) data page).

The index of state failure is constructed from the indicators of state failure namely: revolutionary wars, ethnic wars and genocides, using principal component analysis (PCA). From Table 3.1 it can be seen that the first eigenvalue indicates that 60 percent of variation is captured by the first principal component, while the second principal component explains 27 percent of the total variation. The third principal component accounts for 13 percent of the total variation. Table 3.1 also shows that the first two principal components are the best measures of the index since they capture about 87 percent of the information from these indicators. According to the Kaiser criterion, it is

advised to choose principal components with eigenvalues equal to or greater than one. For this reason, I use the first and the second principal components.

The next index that the study uses is the state fragility index. The state Fragility index is a summation of scores for each country on both Effectiveness and Legitimacy in four performance dimensions: Security, Political, Economic, and Social. Each indicator is rated on a four-point fragility scale: 0 “no fragility”, 1 “low fragility”, 2 “medium fragility”, and 3 “high fragility”. The index identifies and quantifies the main social, economic and political factors and qualities that are causally associated with, or can predict, political instability. A country’s fragility is closely associated with its state capacity to manage conflict, make and implement public policy, and deliver essential services; and its systemic resilience in maintaining system coherence, cohesion, and quality of life; responding effectively to challenges and crises; and continuing progressive development.

Most previous studies (Aisen & Veiga, 2006; Khan & Saqib, 2011) have used change in cabinet as a measure of political instability. While this indicator probably captures some aspects of political instability, it is certainly not perfect. For example, Italy is much more politically unstable compared to African countries, using cabinet change as a measure of political instability than using the above-mentioned indices of state failure and state fragility. In addition, most African countries will be shown as politically stable using the change in cabinet measure (since their cabinets tend to cling on to power), yet many of these countries are politically unstable. In this study political instability is defined as

anything that leads to power transfer or any threat to the current government. The study also uses the incidence of coups as measures of political instability. This index is a score of coup events with (4) indicating a success, (3) attempted but failed, (2) plotted coup and (1) alleged coup. A positive coefficient is expected for political instability indices. This is because political instability leads to unstable economic policies and consequently to volatile inflation. In the regressions, political instability is taken to be exogenous since in Africa political instability has hardly taken place as a result of economic bottlenecks such as price hikes.

For sensitivity analysis, the study uses government stability, internal conflict, external conflict and an index constructed from these three political instability indicators using principal component analysis as a measure of political instability. The data on government stability, internal conflict and external conflict is from the International Conflict Risk Guide (ICRG). Government stability is composed of government unity, legislative strength and popular support. This indicator of political instability has been used by Telatar et al. (2010). Internal conflict is composed of civil war/coup threat, terrorism/political violence and civil disorder, whereas, external conflict consists of war, cross-border conflict and foreign pressures. For all these three variables, the maximum rating for each sub-component is four points and the minimum is zero points. A score of 4 equates to very low risk while a score of zero equates to very high risk.

The structure of the economy matters in determining the level of inflation and its volatility. Countries with large informal sectors which are typically untaxed have less ability to collect revenue via non-inflation taxes. Since tax revenue collection costs are high in such countries, this results in relative reliance on inflation tax, hence increased level of inflation, thus its volatility. Like in Cukierman et al. (1992), the informal sector is measured by the size of the agricultural sector. The agricultural sector is measured as value added agriculture relative to GDP. A large agricultural sector captures the informal sector, hence a positive coefficient is expected.

Following Aisen and Veiga (2008), other control variables are included. Income per capita measured as real GDP per capita is controlled for to reflect economic development. Economic development is likely to be accompanied by strong economic institutions such as sophisticated tax systems and more developed financial systems, both of which imply more optimal inflation tax, thus low and stable inflation level. In addition, economic development implies a big tax base, and hence increases non-inflation tax revenue. This in turn indicates less reliance on inflation tax, thus ability to maintain low and stable inflation. Therefore, a negative coefficient is expected. In the regression, the logarithm of real GDP per capita is used in line with previous literature.

Trade openness, measured as a ratio of total foreign trade relative to GDP, is also controlled for. A negative coefficient is expected since in many developing countries exports and imports are a cheap tax base. More open economies can raise revenue from import duties, leading to less reliance on inflation tax, hence ability to achieve low and

stable inflation. However, more open economies are more exposed to external shocks that may result in high and volatile inflation.

The study also controls for volatility of money supply growth. Money supply growth is defined as the growth rate of broad money (M2) and its volatility is measured as standard deviation of money supply growth. A positive coefficient is expected since volatile money supply growth is likely to result in volatile inflation.

## 3.4 Results and Discussions

Tables 3.2 and 3.3 report the summary statistics and the countries included in the sample. Looking at Table 3.2, the average inflation volatility in Africa is 129.3 percent and the average inflation level is 75.2 percent. These figures seem to be too high. Excluding high inflation countries from the sample lowers the mean of inflation volatility and inflation level by a very big percentage to 7.658 percent and 10.333 percent respectively. As defined by Bruno and Easterly (1998), high inflation countries are those with average inflation above 40 percent. In this sample they include: Angola, Democratic Republic of Congo, Sudan, Zambia and Zimbabwe. The average score of coups is 0.252 whereas the average score for the state fragility index is 15.176. This indicates that African states are very fragile both politically and economically. From Table 3.3, average inflation volatility is 71.3 percent whereas the average inflation level is 72.7 percent. These values are lower than those of the African sample. Excluding high inflation countries (Turkey, Nicaragua, Bolivia and Brazil) lowers the mean of inflation volatility dramatically to 5.942 percent and that of inflation level falls to 9.542 percent. These

values are still lower than those of the Africa sample. The average state fragility index is lower (7.200) compared to that of Africa (15.176). This suggests that the rest of the world is less politically and economically fragile compared to Africa.

Table 3.4 reports the correlation matrix between the variables. The correlation coefficients between the various political instability indicators are positive as expected. They range from 0.045 to 0.597. The correlation coefficients between political instability indicators and the inflation volatility are all positive as expected, and they range from 0.075 to 0.500. Inflation level is highly and positively correlated with inflation volatility. This confirms Kontonikas' (2004) results that high inflation tends to be volatile. Volatility in money supply growth and agriculture are positively correlated with inflation volatility, whereas, GDP level and trade openness are negatively correlated with inflation volatility.

### 3.4.1 Econometric Results

This section reports the results of estimating equation (3.2). The estimation results are presented in Table 3.5 to Table 3.14. Table 3.5 reports the results using the African dataset. The estimates in all the Models are run by the system-GMM estimator. The robust Windmeijer (2005) finite-sample corrected standard errors are reported in all the Models. The Models are well specified and the estimator chosen is appropriate since the diagnostics in Table 3.5 are all satisfactory. Particularly, the Hansen test does not reject the over-identification restriction in all the Models. Additionally, the absence of second

order serial correlation is not rejected in all Models.

The coefficient of the first lag of the dependent variable is positive and statistically significant in all the Models with the coefficient ranging from 0.3423 to 0.4834. This shows that, if inflation is volatile today, it will be more volatile tomorrow. The second lag of the dependent variable is negative and statistically significant in all the Models with coefficients ranging from -0.2613 to -0.4203. The explanation for the negative sign of the second lag of the dependent variable is that countries that experienced high and volatile inflation in the past might be more aware of the negative consequences of high and volatile inflation and therefore be more opposed to repeated episodes. The increased inflation aversion causes such countries to maintain lower and stable inflation rates. Hence, high and volatile past inflation implies low and stable current inflation. This explanation is frequently offered to explain Germany's low inflation rate. Since both lags of the dependent variable are significant, it suggests that dynamic GMM is the most appropriate estimator for this regression. Inflation level is positive and significant in all the Models, indicating that high inflation tends to be very volatile.

Starting with the major issue of the effect of political instability on inflation volatility, the study finds that all the indices of political instability positively affect inflation volatility in Africa. The coefficients range from 0.0565 to 0.1839. Separating the state fragility index into its three indicators, the study finds revolutionary war positively and significantly affects inflation volatility. However, ethnic war and genocide are insignificant. This may indicate that the intensity of these wars is low compared to

revolutionary war, hence their impact on the scarcity of resources and policy process may be small, thus their insignificant effect on prices. Alternately, and a more sound reasoning, it may be that political instability is multidimensional, hence individual indicators lack the necessary information for establishing the relationship between these indicators and inflation volatility. Therefore, Model 2 considers the state failure index constructed from the principal component analysis (PCA). The principal components are statistically significant and positively signed. This implies that state failure index is an important determinant of inflation volatility. The next measure of political instability, namely state fragility index, positively and significantly affects inflation volatility as expected. A unit increase in the state fragility index increases inflation volatility by 0.0964%. Lastly, the coups index (another measure of political instability) is positive and significant, as evidenced in Model 4. An increase in this index by one unit increases inflation volatility by 0.0565%.

Considering other variables, agriculture, trade openness and volatility of money supply growth affect inflation volatility positively and significantly, as evidenced in all the Models. The most striking result is that of trade openness. It is positive and significant in all the Models. Bowdler and Malik's (2005) finding that more trade openness leads to less inflation volatility does not hold for Africa. This may be because African countries are weak economies, thus greater openness may lead to greater exposure to external shocks than they can accommodate, thus resulting in increased inflation volatility. The coefficient of real GDP level per capita is negative and significant in Models 1, 2 and 4. This suggest that more developed economies have strong economic institutions such as

sophisticated tax system and financial system, both of which imply low inflation tax, thus low and stable inflation levels. However, real GDP per capita level is insignificant in Model 3 where the state fragility index is used as a measure of political instability. This may be due to the high correlation (-0.728) between real GDP per capita level and state fragility index, which may be causing a multicollinearity problem. This leads to failure of rejecting the null hypothesis, which makes real GDP per capita appear to be insignificant.

Table 3.6 presents the results for the rest of the world sub-sample. All the diagnostics in Table 3.6 are satisfactory. The first lag of the dependent variable is positive and significant in all the Models whereas the second lag is negatively signed and significant in all the Models. Inflation level is positively signed and significant in all the Models. This implies that, even in the rest of the world, high inflation tends to be volatile. Compared to Table 3.5, the results for political instability indices are somewhat weak. Only the first principal component of the state failure index is positive and statistically significant. The individual indicators of the state failure index, the coups index and state fragility index, though positively signed, are insignificant. This indicates that the positive effect of political instability on inflation volatility is weak in this sub-sample compared to the African sample. The reasoning is that the rest of the world is more politically stable and less politically and economically fragile, hence they have more ability to control inflation. As such, political instability in these countries may not have much effect on inflation volatility, unlike in African countries which are both politically and economically fragile. Like in the African sample, agriculture and volatility of money supply growth are positive and significant in all the Models. This implies that, even in the rest of the world, volatile

money supply growth and big agricultural sectors result in volatile inflation. Also, GDP level leads to low and stable inflation, as evidenced in all the Models. However, it enters with a much bigger coefficient compared to that of the African sub-sample. Contrary to the African sample, trade openness is now insignificant. This may be due to the fact that the rest of the world has stronger economies hence trade openness does not transmit into volatile inflation.

### 3.4.2 The Role of the Exchange Rate Regime

The study also considers the consequence of the exchange rate regime on the relationship between political instability and inflation volatility. A fixed exchange rate forces a country to follow the monetary policy of the country against which its currency is pegged. If the discretionary policy is restricted in this way one may observe lower inflation volatility under a fixed exchange rate regime. This could eliminate the relationship between political instability and inflation volatility. Al-faro (2005) argues that adopting a fixed exchange-rate regime creates incentives for policy makers to control monetary supply, thus inflation, and thereby leading to low inflation volatility. Additionally, Campillo and Miron (1996) state that countries that have agreed to peg their currencies, especially when those agreements involve many countries, may face political costs for excessive inflation and therefore find it relatively easy to maintain a consistent policy. However, according to Tornell and Velasco (2000), a fixed exchange rate may encourage fiscal laxity (potentially leading to inflation volatility) because the costs of such polices occur only after reserves have been exhausted, whereas flexible rates imply immediate costs in the form of adverse exchange rate movements. This

indicates that a fixed exchange rate may be less capable of smoothing shocks, thus implying increased inflation volatility. Omitting exchange rate regime in the estimation may lead to omitted variable bias. The exchange rate regime classified by Reinhart and Rogoff (2008), ranging from 1-2 as a peg or a crawling peg and ranging from 3-5 as managed floating or freely floating, is included as a control variable in the regression.

All the diagnostics in Table 3.7 are satisfactory, suggesting that the Model is well specified and the dynamic system-GMM is an appropriate estimator. Exchange rate regime is negatively signed and significant in Models 1 and 3 with the coefficient ranging from -0.1071 to -0.1302. This is contrary to conventional wisdom that a pegged exchange rate enables a country to maintain low and stable inflation. However, these results are in support of Tornell and Velasco (2000), who argue that the fixed exchange rate regime leads to inflation volatility because it encourages fiscal laxity since the costs of the fixed rate polices occur only after reserves have been exhausted, whereas flexible rates imply immediate costs in the form of adverse exchange rate movements. However, this result is not robust as the exchange rate regime is only significant in Models 1 and 3. Considering other variables, the results reported in Table 3.7 are similar to those reported in Table 3.5. The political instability indices are still significant and positively signed, as evidenced in all the Models. Therefore, the political instability effect is robust to the inclusion of the exchange rate regime variable. Agriculture, volatility of money supply growth and trade openness lead to more volatile inflation whereas an increase real GDP per capita reduces inflation volatility. However, agriculture is only significant in Models 3 and 4.

### 3.4.3 The Role of Inflation-Targeting Policy

There is an increasing popularity of inflation targeting as a framework for conducting monetary policy. Theoretical work suggests that the sound implementation of an inflation-targeting policy delivers optimal equilibrium, in the sense of anchoring inflation around a target with relatively low inflation and, if flexible, low output volatility. Empirically, Vega and Winkelried (2005) find out that inflation targeting has helped in reducing the level and volatility of inflation in the countries that adopted it, both industrial and developing countries. Therefore, the study also controls for the inflation-targeting regime to examine its consequence on the political instability-inflation volatility nexus. Inflation-targeting regime is defined as a dummy variable of 1 if the country at that time has an inflation-targeting policy and zero otherwise. (Inflation-targeting dates are taken from Fatas et al. (2007)).

The results are presented in Table 3.8. Contrary to Vega and Winkelried (2005), inflation-targeting policy is insignificant in all the Models. All the political instability variables are positive and significant as expected. This indicates that political instability increases inflation volatility regardless of whether the country has an inflation-targeting policy in place or not. In addition, the results of other variables remain largely unchanged as compared to those in Tables 3.5. In conclusion, the qualitative nature of the results is robust in controlling for inflation-targeting policy.

### 3.4.4 The Role of External Debt Stock

Optimal tax considerations are important determinants of inflation performance, i.e. countries with greater expenditure need to make use of inflation tax and countries that face difficulties in collecting non-inflation taxes make heavier use of inflation tax. Therefore, such countries are more likely to suffer from high and volatile inflation. The study includes external debt stock relative to output as a measure of the need for tax revenue. A positive sign is expected.

Table 3.9 reports these results. The coefficient of debt stock, though positively signed, is insignificant in all the Models. Political instability variables are still positive and significant as expected, hence controlling for debt stock does not affect the political instability-inflation volatility nexus. The rest of the control variables are the same in terms of sign and significance as those reported in Table 3.5. However, agriculture and trade openness are now significant in Model 3 only.

### 3.4.5 The Role of Growth Volatility

Volatility in GDP growth is expected to increase inflation volatility. The study tests the hypothesis that volatile GDP growth can result from greater incidence of shocks to the economy leading to greater volatility of inflation. Hence, the study adds the standard deviation of real GDP per capita growth to the regression. This is also added in order to isolate the influence of political instability on inflation volatility from that of economic uncertainty. Growth volatility is insignificant in all the Models, as evidenced in Table

3.10. The political instability indicators are still positive and significant. The rest of the control variables are much similar to those reported in Table 3.5 both in sign, size and significance.

### 3.4.6 Other Robustness Checks

The first robustness check involves using an alternative measure of inflation volatility. Table 3.11 reports the results from using the standard deviation of inflation level as the measure of inflation volatility. All the diagnostics for other Models in this Table are satisfactory. Inflation level is positive and significant in all the Models as expected. Considering the political instability variables, revolutionary war, state failure index and state fragility index are significant. However, coups index, ethnic war and genocide are insignificant. Volatility of money supply growth and trade openness are positively signed and significant in all the models, whereas agriculture and GDP level are insignificant in all the Models. The weakening of these variables may be due to the fact that the standard deviation is not an appropriate measure of inflation volatility. This gives credit to the conditional variance of inflation constructed from the GARCH(1, 1) model as a better measure of inflation volatility.

The next sensitivity analysis involves using government stability, internal conflict, external conflict and an index constructed from these three political instability indicators using principal component analysis as measures of political instability. The data on government stability, internal conflict and external conflict is from the International

Conflict Risk Guide (ICRG). For all these three variables, the maximum rating for each sub-component is four points and the minimum is zero points. A score of 4 equates to very low risk while a score of zero equates to very high risk. Hence, a negative coefficient for political instability is expected, implying that political instability accelerates inflation volatility. The results are reported in Table 3.12. As evidenced in all the Models, government stability, internal conflict and the index of the three political instability indicators are all significant with the expected signs. This indicates that political instability accelerates inflation volatility and the results are robust to alternative measures of political instability. The rest of the variables are similar to those reported in Table 3.5. The exception is agriculture, which becomes insignificant, and trade openness, which is only significant in Model 1.

In addition, the study runs a static model as opposed to a dynamic model to study the effect of political instability on inflation volatility. The results are estimated using the pooled OLS estimator. The results are reported in Table 3.13. Inflation level is positively signed and significant in all the models. This suggests that high inflation is always volatile. Turning to the variable of interest, all the measures of political instability are positively signed and significant, with exception of the coups index. Therefore, the finding from the dynamic panel that political instability accelerates inflation volatility is further certified by the static model. The control variables are rightly signed and significant. However, less emphasis is put on the static model because the estimation results from the dynamic model showed the presence of significant dynamics, i.e. the lags of inflation volatility were significant. This makes dynamic system-GMM a more appropriate

estimator in the presence of significant dynamics.

Furthermore, the study employs a two-stage regression strategy with the purpose of identifying the variables that truly matter for inflation volatility in Africa. First, the author begins with the estimation of a general Model that contains all variables to determine the variables' significance. However, the political instability indicators enter one at a time. This is to avoid the possibility of collinearity among the political instability variables. Next and lastly, the author re-estimates the Model but now with only significant variables identified in the first stage. This two-stage regression strategy is expected to provide sufficiently robust evidence on the importance of these variables in determining inflation volatility. Table 3.14 reports the results from these estimations.

Based on the general Model and using state failure components as indicators of political instability, the first lag of inflation volatility is positive and significant as expected and also the second lag is negative and significant as expected. Inflation level is positive and significant at 1 percent level, implying that high inflation tends to be volatile. Revolutionary war and ethnic war are positive and significant as expected. Other variables that are robust to general Model estimation are real GDP level per capita and volatility of money supply growth. The rest of the variables are insignificant. In Model 2 the importance of the significant variables in the general Model is further tested. All the variables that were significant in the general Model are still significant, with the exception of ethnic war. Looking at the Models of the state failure index that was constructed from principal component analysis (CPA), only the first principal component

is positive and significant in the general Model. Other variables that are robust to general Model estimation are the lags of inflation volatility, inflation level, real GDP level per capita and volatility of money supply growth. All the variables that were significant in the general Model are still significant in the specific model.

Considering the estimation where state fragility is used as an indicator of political instability, all the lags of inflation volatility, inflation level, state fragility index, volatility of money supply growth and trade openness survive the first stage. In Model 2, the results show that all the variables that were significant in Model 1 still survive the test. Where the coups index is used as an indicator of political instability, the lags of inflation volatility, inflation level, the coups index, volatility of money supply growth and real GDP per capita level are significant in the general Model. In Model 2, the results show that all the variables that were significant in Model 1 still survive the test. On the overall, lagged inflation volatility, inflation level, political instability, volatility of money supply growth, real GDP per capita level and trade openness are the important determinants of inflation volatility in Africa.

## 3.5 Policy Implications and Conclusions

In this paper the effect of political instability on inflation volatility is investigated using the system-GMM estimator for the period of 1985 to 2009. The diagnostic tests confirm the appropriateness of the technique used in the study. The results suggest that political instability significantly accelerates inflation volatility. However, the relationship between these two variables is more pronounced in Africa than in the rest of the world. This may be because Africa is more politically and economically fragile than the rest of the world. The results for the Africa sample are robust to alternative measures of political instability and alternative measures of inflation volatility. It is also worth noting that the results regarding the effect of political instability on inflation volatility are practically the same in all the Tables, regardless of whether exchange rate regime or government debt or inflation targeting policy or growth volatility is controlled for. Also, the static model confirms that political instability leads to more volatile inflation in Africa.

Considering the two-stage regression strategy, all the political instability indicators robustly affect inflation volatility. Nevertheless, considering the individual components of the state failure index, only revolutionary war is robust. This may be due to the fact that individual components are not informative enough but the index of state failure constructed from principle component analysis from these indicators is more informative. Its first principle component that captures more information from all these political instability indicators is positively signed, significant and robust. Among other variables, the first and second lags of inflation volatility, inflation level, volatility in

money supply growth, real GDP per capita level and trade openness are the only robust and important determinants of inflation volatility.

All in all, to attain price stability emphasis should be placed on ensuring political stability, keeping low levels of inflation, maintaining stability in money supply growth and attaining high levels of economic development. This is because these variables robustly and significantly affect inflation volatility as they pass the two-stage regression test.

## Table 3.1: Principal Component Analysis for State Failure Index

| | PC1 | PC2 | PC3 |
|---|---|---|---|
| Eigen value | 1.78 | 1.00 | 0.39 |
| Proportion | 0.60 | 0.27 | 0.13 |
| Cumulative | 0.60 | 0.87 | 1.00 |
| Variable | Vector 1 | Vector 2 | Vector 3 |
| Revolutionary | 0.44 | 0.88 | 0.16 |
| Ethnic | 0.65 | -0.19 | -0.73 |
| Genocide | 0.62 | -0.43 | 0.66 |

## Table 3.2: Descriptive Statistics for Africa Sample

| | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|
| Inflation volatility | 1.293 | 14.457 | 0.000 | 312.200 |
| Inflation | 0.752 | 10.087 | -0.176 | 244.110 |
| Revolutionary war | 0.227 | 0.776 | 0.000 | 4.000 |
| Ethnic war | 0.340 | 0.893 | 0.000 | 4.000 |
| Genocide | 0.129 | 0.672 | 0.000 | 5.000 |
| State fragility | 15.176 | 5.017 | 1.000 | 24.000 |
| Coups | 0.252 | 0.837 | 0.000 | 4.000 |
| Agriculture | 0.275 | 0.170 | 0.018 | 0.940 |
| M2 growth volatility | 3.626 | 19.748 | 0.026 | 138.79 |
| GDP level | 6.272 | 1.087 | 4.057 | 9.084 |
| Trade openness | 0.729 | 0.386 | 0.108 | 2.752 |

Countries (N=49); Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central Republic of Africa, Chad, Comoros, Democratic Republic of Congo, Congo Republic, Cote D'Ivoire, Djibouti, Egypt, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

## Table 3.3: Descriptive Statistics for Rest of the World Sub-sample

| | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|
| Inflation volatility | 0.713 | 7.461 | 0.000 | 142.135 |
| Inflation | 0.727 | 6.990 | -0.284 | 136.116 |
| Revolutionary war | 0.203 | 0.718 | 0.000 | 4.000 |
| Ethnic war | 0.455 | 0.918 | 0.000 | 4.000 |
| Genocide | 0.017 | 0.167 | 0.000 | 3.500 |
| State fragility | 7.200 | 0.316 | 0.000 | 22.000 |
| Coups | 0.070 | 0.433 | 0.000 | 4.000 |
| Agriculture | 0.112 | 0.099 | 0.003 | 0.517 |
| M2 growth volatility | 1.632 | 5.431 | 0.018 | 29.335 |
| GDP level | 8.394 | 1.575 | 5.072 | 10.940 |
| Trade openness | 0.646 | 0.462 | 0.124 | 3.230 |

Countries (N=35); Australia, Bangladesh, Belgium, Bolivia, Brazil, Canada, China, Colombia, Fiji, Finland, France, Germany, India, Indonesia, Iran, Iraq, Israel, Italy, Japan, Korea, Lebanon, Luxembourg, Malaysia, Mexico, Nepal, Nicaragua, Norway, Pakistan, Philippines, Sri Lanka, Turkey, United Kingdom, United States of America, Uruguay, Venezuela.

## Table 3.4: Correlation Matrix

| | Volatility | Inflation | Revolt | Ethnic | Genocide | State | Coups | Agric | SDM2 | GDP | Open |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Volatility | 1.000 | | | | | | | | | | |
| Inflation | 0.602 | 1.000 | | | | | | | | | |
| Revolt | 0.253 | 0.261 | 1.000 | | | | | | | | |
| Ethnic | 0.280 | 0.259 | 0.330 | 1.000 | | | | | | | |
| Genocide | 0.199 | 0.211 | 0.214 | 0.597 | 1.000 | | | | | | |
| State | 0.500 | 0.201 | 0.294 | 0.430 | 0.257 | 1.000 | | | | | |
| Coups | 0.075 | -0.018 | 0.045 | 0.085 | 0.092 | 0.167 | 1.000 | | | | |
| Agric | 0.382 | 0.111 | 0.061 | 0.206 | 0.052 | 0.644 | 0.131 | 1.000 | | | |
| SDM2 | 0.376 | 0.280 | 0.063 | 0.034 | -0.001 | 0.072 | -0.049 | -0.071 | 1.000 | | |
| GDP | -0.420 | -0.155 | -0.074 | -0.224 | -0.056 | -0.738 | -0.150 | -0.830 | -0.043 | 1.000 | |
| Open | -0.129 | -0.033 | -0.066 | -0.274 | -0.113 | -0.432 | -0.043 | -0.522 | -0.032 | 0.496 | 1.000 |

Volatility is inflation volatility, Inflation is inflation level, Ethnic is ethnic war, Revolt is the revolutionary war, State is the state fragility index, Agric is agriculture, SDM2 is volatility of money supply growth, GDP is GDP level and Open is trade openness.

**Table 3.5: The Effect of Political Instability on Inflation Volatility; Africa Sample**

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| L.Inflation volatility | 0.4684*** | 0.4834*** | 0.3423*** | 0.4144*** |
| | (0.0785) | (0.0686) | (0.0869) | (0.1078) |
| L2.Inflation volatility | -0.3656*** | -0.3785*** | -0.2613*** | -0.4203*** |
| | (0.0569) | (0.0511) | (0.0774) | (0.1056) |
| Inflation level | 1.4941*** | 1.5474*** | 1.8174*** | 1.7819*** |
| | (0.2720) | (0.3174) | (0.36.3) | (0.3071) |
| Revolutionary | 0.1839*** | | | |
| | (0.0584) | | | |
| Ethnic | 0.0710 | | | |
| | (0.0633) | | | |
| Genocide | 0.0967 | | | |
| | (0.0977) | | | |
| Pc1 | | 0.1361** | | |
| | | (0.0553) | | |
| Pc2 | | 0.0878* | | |
| | | (0.0475) | | |
| State fragility | | | 0.0964*** | |
| | | | (0.0274) | |
| Coups | | | | 0.0565* |
| | | | | (0.0310) |
| Agriculture | 1.8008* | 1.9275* | 2.2766** | 1.8812* |
| | (0.9839) | (0.9896) | (0.9883) | (1.0446) |
| M2 growth volatility | 0.0153*** | 0.0153*** | 0.0200*** | 0.0168*** |
| | (0.0024) | (0.0024) | (0.0024) | (0.0027) |
| GDP level | -0.3319** | -0.2894* | -0.0083 | -0.3889** |
| | (0.1605) | (0.1692) | (0.1614) | (0.1891) |
| Trade openness | 0.4701** | 0.4628** | 0.7487*** | 0.4396* |
| | (0.2098) | (0.1994) | (0.2484) | (0.2650) |
| Constant | -1.9255 | -2.1514 | -6.0137*** | -1.8860 |
| | (1.2475) | (1.3200) | (1.4874) | (1.3978) |
| *N* | 914 | 914 | 627 | 914 |
| Hansen test p-value | 0.9933 | 0.9942 | 0.3160 | 0.5648 |
| Resid. AR(1) test p-value | 0.0008 | 0.0004 | 0.0073 | 0.0053 |
| Resid. AR(2) test p-value | 0.9017 | 0.9589 | 0.2847 | .06590 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. PC1 and PC2 represent the state failure index constructed from principle component analysis.

Table 3.6: The Effects of Political Instability on Volatility; Rest of the World Sub-sample

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| L.Inflation volatility | 0.1463** | 0.1515** | 0.4927*** | 0.7402*** |
| | (0.0697) | (0.0636 | (0.1153) | (0.0632) |
| L2.Inflation volatility | -0.2645*** | -0.2638*** | -0.1231** | -0.1175** |
| | (0.0844) | (0.0830) | (0.0506) | (0.0479) |
| Inflation level | 3.2381*** | 3.6690*** | 5.8089*** | 1.6482*** |
| | (0.9146) | (0.9854) | (1.5108) | (0.59.2) |
| Revolutionary | -0.1793 | | | |
| | (0.1232) | | | |
| Ethnic | 0.3858 | | | |
| | (0.2954) | | | |
| Genocide | 0.4596 | | | |
| | (0.3923) | | | |
| Pc1 | | 0.4245* | | |
| | | (0.2320) | | |
| Pc2 | | -0.1315 | | |
| | | (0.1037) | | |
| State fragility | | | 0.0540 | |
| | | | (0.0388) | |
| Coups | | | | 0.0073 |
| | | | | (0.0206) |
| Agriculture | 4.7423** | 4.2998** | 0.5140 | 1.9736** |
| | (1.8739) | (1.8709) | (1.8256) | (0.9218) |
| M2 growth volatility | 0.0512** | 0.0524** | 0.0195* | 0.0108* |
| | (0.0252) | (0.0226) | (0.0110) | (0.0057) |
| GDP level | -3.5597* | -2.6010** | -2.0815** | -2.8119** |
| | (2.0089) | (1.1375) | (0.9146) | (1.2762) |
| Trade openness | -0.2898 | -0.3256 | 0.0270 | -0.0308 |
| | (0.3375) | (0.3383) | (0.1286) | (0.1028) |
| Constant | -6.3308*** | -6.0872*** | -4.1559*** | -2.3097*** |
| | (0.8071) | (0.7573) | (0.8978) | (0.4490) |
| *N* | 711 | 711 | 482 | 711 |
| Hansen test p-value | 0.4078 | 0.3432 | 0.4890 | 0.9993 |
| Resid. AR(1) test p-value | 0.0244 | 0.0219 | 0.0033 | 0.0010 |
| Resid. AR(2) test p-value | 0.9800 | 0.9266 | 0.2474 | 0.6991 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. PC1 and PC2 represent the state failure index constructed from principle component analysis.

Table 3.7: The Effect of Political Instability on Inflation Volatility Controlling for Exchange Rate Regime; Africa Sample

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| L.Inflation volatility | 0.5127*** | 0.4547*** | 0.3242*** | 0.5563*** |
| | (0.0713) | (0.1167) | (0.0871) | (0.0662) |
| L2.Inflation volatility | -0.3597*** | -0.5088*** | -0.2502*** | -0.2813*** |
| | (0.0627) | (0.1006) | (0.0688) | (0.0417) |
| Inflation level | 1.5287*** | 1.7940*** | 2.4187*** | 1.4526*** |
| | (0.3640) | (0.3966) | (0.3035) | (0.3129) |
| Revolutionary | 0.2086** | | | |
| | (0.0993) | | | |
| Ethnic | 0.0954 | | | |
| | (0.0712) | | | |
| Genocide | 0.0705 | | | |
| | (0.1498) | | | |
| Pc1 | | 0.2078** | | |
| | | (0.0969) | | |
| Pc2 | | 0.1167* | | |
| | | (0.0690) | | |
| State fragility | | | 0.0993*** | |
| | | | (0.0284) | |
| Coups | | | | 0.0452* |
| | | | | (0.0264) |
| Agriculture | 1.6816 | 1.8449 | 2.1928* | 1.5558* |
| | (1.0555) | (1.2271) | (1.1616) | (0.9393) |
| M2 growth volatility | 0.0142*** | 0.0173*** | 0.0172*** | 0.0126*** |
| | (0.0027) | (0.0038) | (0.0028) | (0.0022) |
| GDP level | -0.3136* | -0.4375** | -0.0312 | -0.2634* |
| | (0.1649) | (0.1927) | (0.1774) | (0.1433) |
| Trade openness | 0.4902** | 0.5966** | 0.6698*** | 0.3247* |
| | (0.2049) | (0.2393) | (0.2315) | (0.1903) |
| Exchange rate regime | -0.1071* | -0.1108 | -0.1302* | -0.0762 |
| | (0.0641) | (0.0801) | (0.0742) | (0.0546) |
| Constant | -1.6560 | -1.6076 | -5.6220*** | -1.4503 |
| | (1.3121) | (1.4884) | (1.5077) | (1.1845) |
| *N* | 842 | 842 | 596 | 842 |
| Hansen test p-value | 0.9927 | 0.5553 | 0.4212 | 1.0000 |
| Resid. AR(1) test p-value | 0.0010 | 0.0057 | 0.0070 | 0.0007 |
| Resid. AR(2) test p-value | 0.6070 | 0.5678 | 0.4431 | 0.1282 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. PC1 and PC2 represent the state failure index constructed from principle component analysis.

Table 3.8: The Effect of Political Instability on Inflation Volatility Controlling for Inflation Targeting; Africa Sample

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| L.Inflation volatility | 0.4627*** | 0.4287*** | 0.3335*** | 0.4043*** |
| | (0.0794) | (0.1126) | (0.0889) | (0.1108) |
| L2.Inflation volatility | -0.3713*** | -0.4918*** | -0.2626*** | -0.4244*** |
| | (0.0592) | (0.1296) | (0.0793) | (0.1149) |
| Inflation level | 1.5125*** | 1.0841*** | 1.8294*** | 1.8101*** |
| | (0.2859) | (0.3983) | (0.3591) | (0.3086) |
| Revolutionary | 0.1862*** | | | |
| | (0.0605) | | | |
| Ethnic | 0.0712 | | | |
| | (0.0648) | | | |
| Genocide | 0.0979 | | | |
| | (0.0983) | | | |
| Pc1 | | 0.1866** | | |
| | | (0.0807) | | |
| Pc2 | | 0.1272** | | |
| | | (0.0528) | | |
| State fragility | | | 0.0958*** | |
| | | | (0.0285) | |
| Coups | | | | 0.0532* |
| | | | | (0.0295) |
| Agriculture | 1.7849* | 2.1030 | 2.2175** | 1.9739* |
| | (1.0104) | (1.2807) | (0.9537) | (1.1055) |
| M2 growth volatility | 0.0154*** | 0.0173*** | 0.0202*** | 0.0171*** |
| | (0.0025) | (0.0034) | (0.0025) | (0.0028) |
| GDP level | -0.3256** | -0.4252* | -0.0085 | -0.3684* |
| | (0.1607) | (0.2202) | (0.1600) | (0.1937) |
| Trade openness | 0.4447* | 0.5434** | 0.7096*** | 0.4158* |
| | (0.2073) | (0.2365) | (0.2500) | (0.2523) |
| Inflation targeting | -0.5684 | -0.0882 | -0.3366 | -0.8016 |
| | (0.9929) | (1.1883) | (0.6743) | (0.9744) |
| Constant | -1.9741 | -2.0963 | -5.9857*** | -2.0782 |
| | (1.2540) | (1.6617) | (1.4830) | (1.4499) |
| *N* | 914 | 914 | 627 | 914 |
| Hansen test p-value | 0.9933 | 0.5528 | 0.3493 | 0.5645 |
| Resid. AR(1) test p-value | 0.0008 | 0.0082 | 0.0082 | 0.0072 |
| Resid. AR(2) test p-value | 0.9574 | 0.5525 | 0.2729 | 0.6600 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. PC1 and PC2 represent the state failure index constructed from principle component analysis.

Table 3.9: The Effect of Political Instability on Inflation Volatility Controlling for Government Debt; Africa Sample

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| L.Inflation volatility | 0.4217*** | 0.5056*** | 0.3648*** | 0.5454*** |
| | (0.0908) | (0.1043) | (0.0888) | (0.0765) |
| L2.Inflation volatility | -0.3727*** | -.5768*** | -0.2853*** | -0.2856*** |
| | (0.0677) | (0.1006) | (0.0776) | (0.0496) |
| Inflation level | 1.4801*** | 1.7829*** | 1.8002*** | 1.4193*** |
| | (0.2647) | (0.3927) | (0.3712) | (0.2280) |
| Revolutionary | 0.2031*** | | | |
| | (0.0571) | | | |
| Ethnic | 0.1238*** | | | |
| | (0.0416) | | | |
| Genocide | 0.0619 | | | |
| | (0.0833) | | | |
| Pc1 | | 0.1855*** | | |
| | | (0.0674) | | |
| Pc2 | | 0.1183** | | |
| | | (0.0539) | | |
| State fragility | | | 0.0900*** | |
| | | | (0.0299) | |
| Coups | | | | 0.05669** |
| | | | | (0.0259) |
| Agriculture | 1.4197 | 1.1681 | 1.9059* | 0.8903 |
| | (0.9584) | (1.2393) | (1.0671) | (0.9592) |
| M2 growth volatility | 0.0168*** | 0.0171*** | 0.0198*** | 0.126*** |
| | (0.0023) | (0.0032) | (0.0025) | (0.0020) |
| GDP level | -0.3228** | -0.4094* | -0.0583 | -0.2820* |
| | (0.1497) | (0.2161) | (0.1834) | (0.1624) |
| Trade openness | 0.2995 | 0.2629 | 0.6694** | 0.0617 |
| | (0.2249) | (0.2841) | (0.2846) | (0.2394) |
| Government debt | 0.1502 | 0.1672 | 0.1022 | 0.1039 |
| | (0.1224) | (0.1834) | ()0.1152 | (0.1225) |
| Constant | -2.1333* | -1.8076 | -5.5332*** | -1.2618 |
| | (1.1764) | (1.6437) | (1.7363) | (1.2982) |
| *N* | 874 | 874 | 604 | 876 |
| Hansen test p-value | 0.9996 | 0.7111 | 0.4709 | 1.000 |
| Resid. AR(1) test p-value | 0.0036 | 0.0013 | 0.0062 | 0.0005 |
| Resid. AR(2) test p-value | 0.9983 | 0.2567 | 0.2556 | 0.4495 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. PC1 and PC2 represent the state failure index constructed from principle component analysis.

Table 3.10: The Effect of Political Instability on Inflation Volatility Controlling for GDP Growth Volatility; Africa Sample

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| L.Inflation volatility | 0.4685*** | 0.4436*** | 0.3436*** | 0.4059*** |
| | (0.0805) | (0.1074) | (0.0869) | (0.1177) |
| L2.Inflation volatility | -0.3711*** | -0.4982*** | -0.2577*** | -0.4048*** |
| | (0.0587) | (0.1216) | (0.0782) | (0.1206) |
| Inflation level | 1.5264*** | 1.8333*** | 1.8368*** | 1.8106*** |
| | (0.2972) | (0.4346) | (0.3770) | (0.3193) |
| Revolutionary | 0.1746*** | | | |
| | (0.0551) | | | |
| Ethnic | 0.0534 | | | |
| | (0.0601) | | | |
| Genocide | 0.1152 | | | |
| | (0.1058) | | | |
| Pc1 | | 0.1749** | | |
| | | (0.0819) | | |
| Pc2 | | 0.1099* | | |
| | | (0.0575) | | |
| State fragility | | | 0.0946*** | |
| | | | (0.0287) | |
| Coups | | | | 0.0520* |
| | | | | (0.0276) |
| Agriculture | 1.6165* | 1.6371 | 2.2895** | 1.5405 |
| | (0.9683) | (1.1257) | (1.0271) | (1.0599) |
| M2 growth volatility | 0.0151*** | 0.0166*** | 0.0200*** | 0.0162*** |
| | (0.0025) | (0.0034) | (0.0025) | (0.0025) |
| GDP level | -0.3293** | -0.4271** | -0.0049 | -0.3848** |
| | (0.1463) | (0.1903) | (0.1799) | (0.1786) |
| Trade openness | 0.3883* | 0.4734* | 0.7603*** | 0.3096 |
| | (0.2251) | (0.2682) | (0.2774) | (0.972) |
| GDP growth volatility | 2.0086 | 2.9004 | -0.3811 | 3.0539 |
| | (2.2784) | (3.0697) | (2.8246) | (3.1213) |
| Constant | -1.9931* | -1.9023 | -6.0011*** | -1.8840 |
| | (1.1789) | (1.4173) | (1.6274) | (1.3418) |
| *N* | 914 | 914 | 627 | 916 |
| Hansen test p-value | 0.9927 | 0.5345 | 0.3588 | 0.5725 |
| Resid. AR(1) test p-value | 0.0009 | 0.0052 | 0.0072 | 0.0103 |
| Resid. AR(2) test p-value | 0.9341 | 0.5138 | 0.3032 | 0.7503 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. PC1 and PC2 represent the state failure index constructed from principle component analysis.

Table 3.11: The Effect of Political Instability on Inflation Volatility Using Standard Deviation of Inflation Level as a Measure of Inflation Volatility; Africa Sample

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| L.Inflation volatility | 0.4474*** | 0.4812*** | 0.5338*** | 0.4669*** |
| | (0.1171) | (0.0767) | (0.1144) | (0.0721) |
| L2.Inflation volatility | -0.1393* | -0.1768** | -0.1780** | -0.1148** |
| | (0.0843) | (0.0855) | (0.0724) | (0.0520) |
| Inflation level | 1.0555*** | 1.2361** | 1.4575*** | 1.1801*** |
| | (0.3320) | (0.5637) | (0.2376) | (0.3127) |
| Revolutionary | 0.0890** | | | |
| | (0.0409) | | | |
| Ethnic | 0.0544 | | | |
| | (0.0638) | | | |
| Genocide | 0.0131 | | | |
| | (0.0421) | | | |
| Pc1 | | 0.0585* | | |
| | | (0.0323) | | |
| Pc2 | | 0.0514* | | |
| | | (0.0304) | | |
| State fragility | | | 0.0407** | |
| | | | (0.0201) | |
| Coups | | | | 0.0318 |
| | | | | (0.0515) |
| Agriculture | 0.6778 | 1.8267 | 1.2047 | 2.2638 |
| | (1.1319) | (1.2217) | (0.8042) | (2.0839) |
| M2 growth volatility | 0.0031* | 0.0035** | 0.0038*** | 0.0045* |
| | (0.0016) | (0.0016) | (0.0010) | (0.0025) |
| GDP level | -0.2409 | -0.0874 | 0.0519 | 0.1072 |
| | (0.2204) | (0.4451) | (0.1569) | (0.3419) |
| Trade openness | 0.3207** | 0.3541* | 0.3523*** | 0.2769** |
| | (0.1360) | (0.2035) | (0.1269) | (0.1097) |
| Constant | -1.5179 | -2.8349 | -4.0880*** | -3.9752 |
| | (1.5200) | (3.1304) | (1.5336) | (2.8451) |
| *N* | 913 | 913 | 626 | 915 |
| Hansen test p-value | 0.9997 | 1.0000 | 0.8937 | 1.0000 |
| Resid. AR(1) test p-value | 0.0003 | 0.0000 | 0.0001 | 0.0000 |
| Resid. AR(2) test p-value | 0.5672 | 0.3228 | 0.1299 | 0.4421 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. PC1 and PC2 represent the state failure index constructed from principle component analysis.

Table 3.12: The Effect of Political Instability on Inflation Volatility Using Other Measures of Political Instability; Africa Sample

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| L.Inflation volatility | 0.4987*** | 0.4556*** | 0.5193*** | 0.3584** |
| | (0.1376) | (0.1038) | (0.1284) | (0.1428) |
| L2.Inflation volatility | -0.4151*** | -0.2752*** | -0.4077*** | -0.3530** |
| | (0.1270) | (0.0629) | (0.1185) | (0.1406) |
| Inflation level | 1.5432*** | 1.3557*** | 1.7115*** | 1.6917*** |
| | (0.3031) | (0.2345) | (0.3637) | (0.3492) |
| Internal conflicts | -0.1136** | | | |
| | (0.0451) | | | |
| Government stability | | -0.1137*** | | |
| | | (0.0386) | | |
| External conflicts | | | -0.0553 | |
| | | | (0.0401) | |
| gpc1 | | | | -0.2374*** |
| | | | | (0.0826) |
| Agriculture | 0.7000 | -0.6974 | 0.7194 | 0.2176 |
| | (1.5282) | (2.4192) | (1.2618) | (2.3493) |
| M2 growth volatility | 0.0145*** | 0.0124*** | 0.0135*** | 0.0145*** |
| | (0.0026) | (0.0028) | (0.0025) | (0.0036) |
| GDP level | -0.4720* | -0.6343* | -0.5451** | -0.6390* |
| | (0.2576) | (0.3444) | (0.2274) | (0.3738) |
| Trade openness | 0.7503* | 0.1760 | 0.3793 | 0.5767 |
| | (0.3866) | (0.4065) | (0.3606) | (0.4081) |
| Constant | -0.0656 | 2.0135 | 0.2472 | 0.0756 |
| | (2.0011) | (2.9743) | (1.7004) | (3.0203) |
| *N* | 662 | 662 | 662 | 662 |
| Hansen test p-value | 0.8909 | 1.0000 | 0.9724 | 0.9743 |
| Resid. AR(1) test p-value | 0.0121 | 0.0058 | 0.0090 | 0.0377 |
| Resid. AR(2) test p-value | 0.6704 | 0.7592 | 0.6499 | 0.9231 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Gpc1 is an index constructed from principle component analysis for these three political instability indices.

Table 3.13: The Effect of Political Instability on Inflation Volatility Using a Static Model

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Inflation level | 1.8690*** | 1.8668** | 2.3557*** | 2.0968*** |
| | (0.2723) | (0.2779) | (0.3205) | (0.2676) |
| Revolutionary | 0.1977*** | | | |
| | (0.0475) | | | |
| Ethnic | 0.0282 | | | |
| | (0.0381) | | | |
| Genocide | 0.1871*** | | | |
| | (0.0507) | | | |
| Pc1 | | 0.1604*** | | |
| | | (0.0336) | | |
| Pc2 | | 0.0692** | | |
| | | (0.0312) | | |
| State fragility | | | 0.1083*** | |
| | | | (0.0113) | |
| Coups | | | | 0.0624 |
| | | | | (0.0480) |
| Agriculture | 2.1960*** | 2.1743*** | 2.7647*** | 2.1315*** |
| | (0.3887) | (0.3893) | (0.4848) | (0.4034) |
| M2 growth volatility | 0.0172*** | 0.0171*** | 0.0206*** | 0.0167*** |
| | (0.0021) | (0.0021) | (0.0031) | (0.0021) |
| GDP level | -0.3207*** | -0.3152*** | 0.0537 | -0.3195*** |
| | (0.0704) | (0.0700) | (0.0873) | (0.0719) |
| Trade openness | 0.5531*** | 0.5726*** | 0.8279*** | 0.4883*** |
| | (0.1132) | (0.1129) | (0.1252) | (0.1113) |
| Constant | -2.5343*** | -2.5020*** | -7.1308*** | -2.4477*** |
| | (0.5277) | (0.05249) | (0.7414) | (0.5415) |
| *N* | 1008 | 1008 | 638 | 1010 |
| $R^2$ | 0.5201 | 0.5188 | 0.6053 | 0.5138 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. PC1 and PC2 represent the state failure index constructed from principle component analysis.

Table 3.14: The Effect of Political Instability on Inflation Volatility from a General Model to a Specific Model; Africa Sample

| | State failure | | PCA | | State fragility | | Coups | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| L.Inflation volatility | 0.5225*** (0.0749) | 0.4987*** (0.0704) | 0.5331** (0.0711) | 0.5083*** (0.0734) | 0.3205*** (0.0913) | 0.3636*** (0.0820) | 0.3782*** (0.1304) | 0.4391*** (0.0883) |
| L2.Inflation volatility | -0.3970*** (0.0597) | -0.4033*** (0.0543) | -0.4022*** (0.0595) | -0.3910*** (0.0534) | -0.2470*** (0.0683) | -0.2837*** (0.0766) | -0.1817* (0.1025) | -0.1884** (0.0783) |
| Inflation level | 1.5792*** (0.3675) | 1.3863*** (0.1361) | 1.5403*** (0.3304) | 1.4003*** (0.1706) | 2.3505*** (0.3216) | 1.7730*** (0.3751) | 2.3286*** (0.3250) | 1.3953*** (0.2659) |
| Revolutionary | 0.2143*** (0.0823) | 0.1568** (0.0698) | | | | | | |
| Ethnic | 0.1249*** (0.0482) | 0.1204 (0.0774) | | | | | | |
| Genocide | 0.1229 (0.0921) | | | | | | | |
| Pc1 | | | 0.1927*** (0.0532) | 0.1318*** (0.0456) | | | | |
| Pc2 | | | 0.0863 (0.0601) | | | | | |
| State fragility | | | | | 0.0971*** (0.0309) | 0.1352*** (0.0272) | | |
| Coups | | | | | | | 0.6122* (0.3606) | 0.6214** (0.3155) |
| Agriculture | 0.9814 (1.3320) | | 0.6495 (1.2322) | | 1.8216 (1.1733) | | 0.3819 (1.1509) | |
| M2 growth volatility | 0.0139*** (0.0029) | 0.0141*** (0.0017) | 0.0133*** (0.0028 | 0.0140*** (0.0020) | 0.0176*** (0.0029) | 0.0182*** (0.0022) | 0.0151*** (0.0037) | 0.0168*** (0.0019) |
| GDP level | -0.3450* (0.1794) | -0.4587*** (0.1155) | -0.3651** (0.1852) | -0.4666*** (0.1061) | -0.0601 (0.1859) | | -0.3292* (0.1906) | -0.3194*** (0.1094) |
| Trade openness | 0.1996 (0.3495) | | 0.1525 (0.3548) | | 0.6239** (0.3071) | 0.4163* (0.2343) | 0.0642 (0.3332) | |
| Exchange rate regime | -0.1116 (0.0754) | | -0.0995 (0.0735) | | -0.1301 (0.0865) | | -0.0701 (0.0727) | |
| Inflation targeting | -0.6804 (1.1225) | | -0.9507 (1.1230) | | -0.0751 (0.7459) | | -0.3042 (0.3572) | |
| Government debt | 0.0793 (0.1822) | | 0.0587 (0.1809) | | 0.0962 (0.0868) | | -0.0343 (0.1036) | |
| GDP growth volatility | 1.2680 (11.4117) | | 3.7103 (10.4013) | | -1.9940 (4.9153) | | 5.2642 (4.3977) | |
| Constant | -1.2958 (1.4857) | -0.2922 (0.6666) | -1.0195 (1.5197) | -0.1385 (0.6018) | -5.257*** (1.6195) | -5.7683*** (0.6557) | -1.3609 (1.4560) | -0.9099* (0.5301) |
| *N* | 802 | 981 | 802 | 978 | 573 | 648 | 573 | 682 |
| Hansen test p-value | 0.9992 | 0.9608 | 0.9988 | 0.9716 | 0.6384 | 0.2541 | 0.6272 | 0.3115 |
| Resid. AR(1) test p-value | 0.0012 | 0.0002 | 0.0011 | 0.0003 | 0.0089 | 0.0050 | 0.0097 | 0.0019 |
| Resid. AR(2) test p-value | 0.8017 | 0.3366 | 0.8466 | 0.5473 | 0.4648 | 0.2195 | 0.5997 | 0.2494 |

Figures in parentheses stand for Robust Windmeijer (2005) finite-sample corrected standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. State failure refers to the three components of the state failure index. PCA is the state failure index constructed by principle component analysis. PC1 and PC2 represent the state failure index constructed from principle component analysis. All cases, Model 1 the general Model that includes all variables whereas Model 2 the specific Model that includes variables that were significant in Model 1.

# CHAPTER 4

# Financial Development and Income Inequality: Does Inflation Matter?

## 4.1 Introduction

Among the research areas in economics that have attracted a substantial amount of research attention, is the effect of financial development on income inequality. Generally, the findings indicate that financial development helps to reduce income inequality (Liang, 2006; Beck et al., 2007; Kappel, 2010; Shahbaz & Islam, 2011). Another area of research investigates the connection between inflation and financial development. Economists Haslag and Koo (1999), Boyd et al. (2001) and Bittencourt (2011), among others, generally find that inflation is detrimental for the entire financial development. Both the banking sector and the stock market sector performance are negatively affected by inflation. Their results are robust to different estimators and different measures of financial development. However, these two areas of research (inflation-finance and finance-income inequality) have lived apart and there has not been any effort to bring these two strands together. This is worth investigating as these variables interact with each other.

Beck et al. (2007) find that financial development disproportionately increases the income of the poorest quintile and reduces income inequality. About 40 percent of the long-run impact of financial development on income growth of the poorest quintile is the result of reductions in income inequality, while 60 percent is due to the impact of financial

development on aggregate economic growth. On the other hand, Boyd et al.'s (2001) findings show that inflation adversely affects financial development. They find that, at low-to-moderate rates of inflation, there is a strong negative association between inflation and lending by the financial sector to the private sector, the quantity of bank assets, and the volume of liabilities issued by banks. Additionally, their results show that, at low-to-moderate rates of inflation, there is a pronounced inverse relationship between inflation and measures of stock market liquidity and trading volume.

Though many economists have shown that financial development is associated with a reduction in income inequality, the research so far has not yet considered whether there are economic conditions associated with the finance-inequality nexus. Inflation reduces the ability of financial intermediaries to improve resource allocation. If changes in inflation rate affect financial development, then such changes will also have implications on income inequality. Therefore, the main contribution of this study is to examine how inflation level affects the financial development-income inequality nexus, i.e., to provide empirical evidence about the moderating effect of inflation on the financial development-income inequality relationship. To my best knowledge, this is the first paper to examine how inflation and financial development jointly affect income inequality.

In view of the above, this study seeks to address three main hypotheses using a non-overlapping five-year average panel data of 60 countries from all over the world, covering a period from 1980 to 2009 employing a two-step GMM fixed effect estimator. The hypotheses are as follows:

1) Does inflation level negatively affect financial development?

2) Does financial development reduce income inequality?

3) Does inflation significantly reduce the benefits from financial development on income inequality?

In addition, this study makes a comparison between the effect of financial development on income inequality in developing and developed countries. Given that financial development encompasses quality and quantity of investment, saving, mobilization and management of risk, these functions may not be captured by a single proxy. As an additional contribution, this paper uses a variety of financial development proxies for robustness check compared to the previous researchers in this field. The present study uses both bank-based and market-based financial development indicators in addition to a financial development index constructed from principal component analysis from all the financial development indicators. The countries in the sample were selected according to data availability.

This study finds that financial development reduces income inequality. This is in consonance with the findings of Liang (2006) and Beck et al. (2007). However, the interaction term between inflation and financial development is positive. This indicates that the gain from financial development on income inequality diminishes as inflation level rises.

The remainder of the paper is outlined as follows: Section 4.2 presents a brief review of the relevant literature; Section 4.3 presents the research methodology; Section 4.4 presents the empirical results and Section 4.5 presents policy implications and conclusion.

## 4.2 Literature Review

### 4.2.1 Theoretical Link between Inflation-Finance and Finance-Income Inequality

Khan et al. (2006) emphasise the importance of informational asymmetries in credit markets. According to the authors, financial markets arise to address endogenous frictions that are present in the process of allocating credit and investment capital. Indeed, such frictions are essential for understanding the role of financial institutions in development. In the absence of such friction the Modigliani-Miller theorem would be binding, and finance would be irrelevant for capital allocation.

On similar grounds, Choi et al. (1996) demonstrate the theoretical link between finance and inflation. The authors show how increases in the rate of inflation adversely affect credit market frictions with negative repercussions for financial sector performance and therefore long-run real activity. According to this theory, there is an information friction whose severity is endogenous.

An increase in the rate of inflation drives down the real rate of return on money and on other assets as well. [1] When returns on savings and real interest rate paid by borrowers fall, the incentive to borrow rises whereas the incentive to lend reduces. High inflation also leads to greater inflation variability and greater variability in the returns on all assets. The implied reduction and greater variability in real returns reduces the availability of credit and draws additional lower quality borrowers into the pool of credit seekers. The diminishing availability of funds and the erosion in the quality of the borrower pool increases the severity of credit market frictions. Increased market frictions lead to credit rationing since investors are not willing to make loans to low quality borrowers at lower real interest rates. Credit rationing becomes more severe as inflation rises.

As a result, the financial sector makes fewer loans, resource allocation is less efficient, and intermediary activity diminishes with adverse implications for financial sector performance. The authors further emphasise that only when inflation exceeds a certain threshold level do informational frictions necessarily play a substantial role. They argue that, when inflation is very low, credit market frictions may be non-binding, so that inflation does not distort the flow of information or interfere with resource allocation and growth. However, once the rate of inflation exceeds a certain threshold level, credit market frictions become binding, and there is a discrete drop in financial sector performance as credit rationing intensifies.

[1] See Khan et al. (2006) for the explanation for why returns on assets fall as inflation rises.

There are two main theories on the finance-inequality nexus. The theory of Galor and Zeira (1993) predicts a negative and linear relationship between financial development and income inequality. The authors consider a model with indivisibility in human capital investment where agents live for two periods and generations are linked through bequests. Agents can either be unskilled in both periods or invest in human capital in period one and be skilled in the second period. The wage of the skilled worker is greater than that of the unskilled worker. Due to financial market imperfections, opportunity for investment in human capital may be restricted to agents with sufficiently large inheritance or those who can obtain external credit to fund investment in human capital.

In this case, the initial distribution of wealth affects aggregate output and investment both in the short and in the long run. In the long run there will be a polarization of wealth between the high-income skilled workers and the low-income unskilled workers. The rich and the better educated will converge to high-income steady states whereas the poor and less educated will converge to low-income steady state. However, financial development will provide broader and easier access to credit for the low-income agents through alleviating constraints that they face. This will provide more opportunities for the poor to borrow and invest in human capital or high return projects, hence reducing income inequality. Therefore, this theory predicts a negative linear relationship between finance and inequality.

By contrast, in the second theory of Greenwood and Jovanovic (1990), an inverted U-shaped relationship exists between financial development and income inequality. The authors assume that the economy has two production technologies, one which is safe with constant but low return and another which is more risky but with high expected return. To enter the financial market a fixed entry cost is charged. Due to this, access to the financial sector may be restricted to agents with a high level of wealth superior to a certain threshold level. The authors also show that financial intermediaries help to overcome financial friction on risky investments through collecting and analysing information on investment projects.

Financial intermediaries also smooth away the idiosyncratic shock through risk diversification, trading and pooling. At any given period there are participants in the financial market and non-participants. The wealth of non-participants is greatly influenced by idiosyncratic shock. However, participants in the financial market receive a promised return by investing their capital in the financial system because the idiosyncratic risk is smoothed out. The return of participants is worth more than that of non-participants, hence participants will never exit the financial market. The authors conclude that, along financial intermediary development, the evolution of income inequality follows an inverted U-shaped path. That is, financial development could widen income inequality during the early stage of development, then tend to lessen it as average income rises and more households gain access to financial intermediaries and services.

### 4.2.2 Empirical Evidence

Using stock market data for the United States over the period 1958-1993, Choi et al. (1996) find that high rates of inflation significantly reduced the growth rate of stock market transactions. Additionally, they report that as inflation rises the real returns received by investors fall significantly. Indeed, over such periods even nominal returns to investors appear to be negatively associated with inflation. They also find that high inflation increases the variability of stock returns and reduces the level of financial market activity. Finally, they also observed that over the low inflation period (1982-1987) using Korea data, inflation had no significant effect on the returns on equity, its volatility or the growth rate of stock market transactions. All these results are consistent with the inflation-finance theory by Choi et al. (1996) and robust to different data from different countries.

Based on cross-sectional and dynamic panel (GMM) regressions, and using different measures of financial development, Boyd et al. (2001) find that, at low-to-moderate rates of inflation, there is a strong negative association between inflation and lending by the financial sector to the private sector, the quantity of bank assets, and the volume of liabilities issued by banks. Additionally, they report that, at low-to-moderate rates of inflation, there is a pronounced inverse relationship between inflation and measures of stock market liquidity and trading volume. Their findings lend support to the presence of a non-linear relationship between inflation and financial sector performance. As inflation rises, financial sector performance falls, but the marginal impact of additional inflation on the financial sector also diminishes rapidly.

Accordingly, Khan et al. (2006) use cross-country data of 168 countries for a period of 1960-1999 and employ an econometric method of threshold estimation to test the non-linearity between inflation and financial development. They find that low inflation rates have no significant effect on financial market conditions. However, for inflation rates above the threshold, further increase in inflation strongly and negatively affects financial development. The threshold ranges from 3-6 percent. Their results are robust to different measures of financial development.

Furthermore, Boyd and Champ (2003) find that high inflation negatively affects equity markets and banks. Stock market capitalization and trading have been found to be smaller relative to the size of the overall economy in high inflation countries. Similarly, they observe that the size of the banking industry relative to the size of the overall economy is lower in high inflation environments. In addition, they also discover a positive relationship between asset return volatility and inflation. Likewise, Bittencourt (2011), using time series and panel data on different data sets for Brazil from 1985 to 2004 and different estimators, evidenced adverse effects of inflation for financial development. Thus, the author concludes that low and stable inflation rates should be consistently pursued in order to have a more sophisticated financial structure with all its attached benefits.

Considering the finance-income inequality nexus, Clarke et al. (2006) tested the hypothesis of whether there exists an inverted U-shaped or linear relationship between financial development and income inequality. They provide weak evidence for the

inverted U-shaped relationship but find strong evidence for a negative linear relationship between financial development and income inequality. Similarly, Liang (2006) used Chinese provincial data over the period 1991-2000 and applied the generalized method of moments (GMM) technique to study the relationship between finance and income inequality. The author found a negative and linear relationship between finance and income inequality, hence support for Galor and Zeira's (1993) theory. This implies that financial development reduces income inequality. His results are robust to different measures of financial development.

Bittencourt (2006) investigated the link between financial development and inequality in the case of Brazil in the 1980s and 1990s using the pooled ordinary least square estimator and first difference instrumental variable estimator. The empirical results show that more broad access to financial and credit markets had a significant and robust effect in reducing income inequality in Brazil. Additionally, using cross-sectional and panel data regression, Kappel (2010) found that inequality and poverty are reduced not only through enhancement of loan markets but also through more developed stock markets. His finds clear support for a negative linear relationship between financial development and income inequality.

Similarly, Beck et al. (2007) find that in countries with better-developed financial intermediaries the income of the lowest quintile grows faster than average GDP per capita and income inequality falls more rapidly. They use credit by financial intermediaries to the private sector divided by GDP as the measure of financial

intermediary development. They also take the linear relationship between financial development and income inequality as given. Their results indicate that financial development disproportionately increases the income of the poorest quintile and reduces income inequality. About 40 percent of the long-run impact of financial development on income growth of the poorest quintile is the result of reductions in income inequality, while 60 percent is due to the impact of financial development on aggregate economic growth.

Consonantly, Shahbaz and Islam (2011), using data from 1971 to 2005, implemented the Auto Regressive Distributed Lag (ARDL) bounds testing approach to examine the existence of long-run and short-run relationships between financial development and income inequality. Their findings indicate that financial development reduces income inequality in Pakistan, hence providing support for Galor and Zeira's (1993) theory. However, they also find that financial instability aggravates income inequality. Also, Mookerjee and Kalipioni (2010) found that availability of financial services measured by the number of bank branches per 100,000 population robustly reduces income inequality across countries, whereas barriers to bank access significantly increase income inequality.

Contrary to the above, Law and Tan (2009), using the ARDL bonds test for time series data from 1980 to 2000 and a variety of financial development indicators find that financial development is very weak and statistically insignificant in reducing income inequality in Malaysia. However, their results could be weakened due to the use of time

series data only. This is because a single country time series study simply lacks the variety of financial development experiences necessary for establishing the relationship between finance and income inequality. Though most empirical studies find a negative relationship between financial development and income inequality, Jahan and McDonald (2011) state that not all financial development leads to a reduction in income inequality, at least in the short run. For example, stock market liberalization in emerging markets shows that the benefits accrue to the rich. Similarly, financial globalization, especially foreign direct investment, has been associated with widening income disparities.

In conclusion, there is substantial theoretical and empirical literature suggesting that financial development plays an important role in making incomes more equal. However, there is also substantial theoretical and empirical literature suggesting that inflation reduces the ability of financial intermediaries to improve resource allocation. Despite the interaction between these two areas of economics, there has not yet been any effort to bring these two strands together. Therefore, the aim of this study is to examine the effect of inflation on the financial development-income inequality nexus.

## 4.3 Research Methodology

### 4.3.1 Econometric Methodology and Model Identification

The study assesses the effect of inflation on the finance-inequality nexus through answering the following questions:

1) Does inflation level negatively affect financial development?

2) Does financial development reduce income inequality?

3) Does inflation significantly reduce the benefits from financial development on income inequality?

To be able to empirically test the effect of financial development on income inequality conditional on inflation, the study uses the two-step GMM fixed effect estimation. For a detailed explanation of this methodology refer to sub-sub-sections 2.3.1.1 and 2.3.1.2 in Chapter 2. The empirical models are formulated as:

$$fin_{it} = \beta_0 + \beta_1 inf_{it} + \beta_2 gdp_{it} + \eta_{it} \quad (4.1)$$

$$gini_{it} = \beta_0 + \beta_1 fin_{it} + \beta_2 (fin_{it} \times inf_{it}) + \delta_X + \varepsilon_{it} \quad (4.2)$$

Where $gini_{it}$ represents the logarithm of the Gini coefficient a measure of income inequality. $f\ in_{it}$ is financial development whereas $inf_{it}$ is inflation level. $gdp_{it}$ is the logarithm of GDP level. *X* is a vector of all other variables affecting income inequality. These include: stage of economic development, education, government expenditure, trade openness and unemployment.

Equations 4.1 and 4.2 are estimated separately. A country-specific fixed effect is assumed for the error terms in equations 4.1 and 4.2 above:

$$\varepsilon_{it} = v_i + \eta_{it} \quad (4.3)$$

$$\mu_{it} = \mu_i + v_{it} \quad (4.4)$$

Where $\varepsilon_{it}$ and $\mu_{it}$ represents the error terms in equations 4.1 and 4.2 respectively. Equations 4.3 and 4.4 contain $v_i$ and $\mu_i$ respectively, which represents country-specific fixed effects that are time invariant, whereas $\eta_{it}$ and $v_{it}$ in equations 4.3 and 4.4 respectively are assumed to be independent and identically distributed with mean 0 and variance $\sigma^2$ both over time and across countries.

In order to capture the extent to which inflation level affects the finance- inequality nexus, an interaction term between financial development and inflation is included in equation (4.2).[2] Hence, the focus of this study is to examine how inflation affects the marginal effect of financial development on income inequality. Most studies that use interactions consider $\beta_1$ and $\beta_2$ in equation (4.2), focusing on their sign and significance. This approach fails to account for the covariance between $\beta_1$ and $\beta_2$. This may lead to misleading results in terms of significance. However, following Jaccard and Turrisi (2003), this study takes into account the covariance between $\beta_1$ and $\beta_2$.

[2] It is important to note that since the objective of this study is to compute the total effect of financial development on income inequality conditioned on inflation rather than the direct effect of inflation on income inequality, inflation is not added in the regression but is only interacted with financial development. Thus, inflation affects income inequality via its effect on financial development.

This allows for correct calculation of standard errors surrounding the overall marginal effect of financial development on income inequality conditional on the level of inflation. It is expected that although financial development reduces income inequality, its effect diminishes as inflation rises.

Differentiating equation (4.2) with respect to financial development we get:

$$\frac{\partial gini_{it}}{\partial fin_{it}} = \beta_1 + \beta_2 inf_{it} \quad (4.5)$$

with standard error band driven from,

$$\hat{\sigma}\left(\frac{\partial gini_{it}}{\partial fin_{it}}\right) = \sqrt[2]{\left(var(\hat{\beta}_1) + (inf_{it})^2 var(\hat{\beta}_2) + 2(inf_{it})cov(\hat{\beta}_1\hat{\beta}_2)\right)} \quad (4.6)$$

### 4.3.2 Data

The study uses a cross-country panel data of 60 countries from all over the world covering a period from 1980 to 2009. The data was mostly sourced from World Bank development indicators. Choice of the sample was due to data availability. Only countries that had more than 4 consecutive observations on the Gini coefficient in the non-overlapping five-year average data were retained. The study uses non-overlapping five-year average data because income inequality data (measured by the Gini coefficient) is not available annually.

The data on the Gini coefficient is more limited compared to other variables. Many countries have less than 15 observations with only a few countries having more than 20 observations on an annual basis. Using five-year non-overlapping data, I obtain a more balanced data set. Since income inequality is more stable over time, five-year average data will not lead to much information loss. Moreover, this removes short-term fluctuations, helping the study to focus on the long-run relationship which is of interest. However, five-year data averaging results in few observations, which makes it impossible to check for cointegration. The Gini coefficient measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. A higher value indicates higher income inequality. In the regression the logarithm of the Gini coefficient is used in line with previous literature.

Given that financial development encompasses quality and quantity of investment, saving mobilization and management of risk, these functions may not be captured by a single proxy. Therefore, the study uses 4 measures of financial development, 2 are bank-based while 2 are market-based. Firstly, the study uses private credit as a measure of financial development. This is measured as credit provided by deposit money bank and other financial institutions to the private sector as a ratio of GDP. It excludes credit issued to government and public enterprises. Furthermore, it excludes credit issued by the central banks and development banks. According to Beck et al. (2007), this proxy is superior to other measures of financial development as it better reflects the extent of efficient resources allocation. It is based on the assumption that the private sector is

more productive than the public sector when it comes to the utilization of funds.

The study also uses ratio of broad money (M2) to GDP as a measure of financial development. However, this proxy has been criticized by Demetriades and Hussein (1996) and Beck et al. (2007). They argue that the ratio of broad money to GDP simply measures the extent to which financial transactions are monetized rather than the function of the financial system such as saving, mobilization and efficient resource allocation as presented in the theoretical model. However, they observe that the ratio (M2/Y) might be relevant in developing countries where a substantial component of broad money is held outside the banking sector.

The market-based financial development indicators include: stock market capitalization as a ratio of GDP and stock market total value traded as a ratio of GDP. Using these 2 proxies reduces the sample size to 50 countries. It excludes mostly developing countries due to the rudimentary stage of capital markets in those countries. These two indicators of equity market finance have been used by Khan et al. (2006). It is expected that financial development reduces income inequality by alleviating credit constraints faced by the poor; hence, a negative coefficient is expected.

For robustness check, a financial development index was constructed from all these financial development indicators (both bank-based and market-based) from principal component analysis. Principal component analysis pulls together the uniqueness of each indicator into one index, and hence, this financial development index may be more informative and may thus give more reliable results compared to the individual financial development indicators.

During inflation periods, there is reduction and volatility in real returns on assets which results in increased credit market friction. This in turn leads to increased credit rationing thereby hindering the proper functioning of financial intermediaries with adverse implications for income inequality. Therefore, inflation negatively affects income inequality via its adverse effect on financial development. Hence, the regression includes an interaction term between inflation and financial development to capture this effect. Inflation is measured as the growth rate of the consumer price index.

It is obvious that income inequality is not determined by financial development and inflation only. Therefore, following Liang (2006) and Li and Zou (2002), other variables are added as control variables to the equation (4.2) above. These are:

- Unemployment measured as a ratio of unemployed labour force to total labour force. A positive coefficient is expected since unemployment levels and unemployment risk are likely to be highest among people with low earning capacity. Hence, an increase in unemployment worsens the relative position of the low-income groups.

- Trade openness measured as a ratio of total foreign trade to GDP. This is used to capture the degree of international openness. Interplays between international openness and technology adoption may constitute an important mechanism, leading to a possible decrease of income differentials in the liberalizing countries, through skill enhancing trade. Hence, a negative coefficient is expected.

- Primary school enrolment rate as a measure of education. A negative coefficient is expected. As more people get educated they become more skilled. This enables them to earn higher wages which leads to more equal incomes. Also, there is a decrease in the premium on education as the relative supply of educated workers increases, thereby lowering income inequality. In the regression, the lag of education is used to control for possible simultaneity.

- Government consumption measured as a ratio of general government consumption expenditure to GDP. It is not clear whether government consumption increases or decreases income inequality. For example, if most redistribution through the tax and transfer system is towards the low-income groups, government consumption may result in low-income inequality levels. However, government consumption may result in increased income inequality if the rich households use their political power to exploit the poor. Therefore, the coefficient on government consumption can either be positive or negative.

- The natural logarithm of real GDP per capita, used as a proxy for the stage development of a given economic system,

- The natural logarithm of real GDP level per capita squared. This is included since Simon Kuznets' hypothesis predicts an inverted U-shaped relationship between economic development and income inequality. Hence, the real GDP per capita is expected to be positively signed whereas the squared term should be negatively signed. That is to say, at early stages of economic development, an increase in economic development leads to increased income inequality, but at advanced stages of economic development, an increase in economic development results in lower levels of income inequity.

### 4.3.3 Endogeneity of GDP Level

The presence of endogeneity in the regression above could lead to biased results. The relationship between income inequality and GDP level is bi-directional. For example, inequality might be destructive to growth because it may bring about political instability which discourages investment and growth (Berg & Ostry, 2011). In addition, more unequal distribution of income leads to low human capital accumulation, political instability and social unrest, characterized by rioting leading to destruction of property and hence hindering growth (Weil, 2005). However, according to Kuznets' hypothesis economic development affects inequality by first increasing it at a low stage of development and reducing it later when the economy has advanced in development.

It can be clearly seen that there is the possibility of simultaneity between income inequality and economic development. If any one of the regressors is endogenous, the OLS estimates of all the regressors are biased. Therefore, the study uses a two-step GMM fixed effect estimator to address the possibility of reverse causality. The estimator is advantageous as it deals with heteroskedasticity of unknown form (Baum et al., 2003). The study uses the lagged values for GDP level as instruments. For robustness check the study also uses a 2SLS estimator with standard errors corrected for heteroskedasticity. This estimator is less efficient compared to the two-step GMM as its weighting matrix is suboptimal.

## 4.4 Results and Discussions

Table 4.1 reports the summary statistics and the countries included in the sample. It can be seen that all variables display considerable variation between and within countries, justifying the use of panel estimation technique. Table 4.2 reports the correlation matrix between the variables. The correlation coefficients between the various financial development indicators are high and positive as expected. They range from 0.552 to 0.869. The correlation coefficients between financial development indicators and the Gini coefficient are all negative as expected, and they range from -0.175 to -0.323. Interestingly, the study finds a negative correlation between inflation and the various financial development indicators ranging from -0.108 to -0.183. This suggests that inflation hinders the proper functioning of the financial system, and this will in turn affect the financial development-income inequality nexus.

Unemployment is positively correlated with income inequality, whereas, education, trade openness, government expenditure, GDP level and its squared term are negatively correlated with the Gini coefficient.

The econometric results are presented in Tables 4.3 to 4.13. The regressions are first estimated by the two-step GMM fixed effect estimator and later estimated by the two-stage least square (2SLS) for robustness check. However the two-stage least square estimator is less efficient compared to the two-step GMM as its weighting matrix is suboptimal. The two important diagnostic tests are satisfactory in all the estimations. Specifically, the Hansen J-statistics does not reject the over-identification restrictions in all cases. The weak identification test is also presented. The null hypothesis is that instruments are weakly correlated with the endogenous regressor. The rule of thumb is that a Kleibergen-Paap Wald F statistic greater than 10 satisfies the rejection of the null (Baum et al., 2003). As shown in all the Tables, the Kleibergen-Paap Wald F statistic is greater than 10. Hence, the study rejects the null hypothesis, thereby concluding that the instruments are not weakly correlated with the endogenous regressors.

### 4.4.1 Effect of Inflation on Financial Development

The study begins by running a simple regression between financial development indicators and inflation level, controlling for stage of economic development. The study controls for economic development to prevent omitted variable bias. The results of the effect of inflation on financial development are presented in Tables 4.3 and 4.4.

As evidenced in Table 4.3, inflation negatively affects banking sector financial development. The coefficient of inflation is negative and significant irrespective of the banking sector financial development indicator used. The coefficients range from -0.7863 to - 1.1183. These results are in support of Bittencourt's (2011) findings that inflation negatively affects these measures of financial development. GDP level, a measure of economic development, is positive and significant at 1 percent level in all the models. This implies that economic development is associated with higher levels of financial development. Considering Table 4.4, irrespective of the market-based financial development indicators used, inflation level is negative and significant as expected. Also, GDP level is positive and significant as expected. In conclusion, inflation is detrimental for the entire financial sector performance.

### 4.4.2 Private Credit

Focusing on Table 4.5, private credit is negative and statistically significant at 1 percent level, as evidenced in all the Models. Private credit has coefficients that range from -0.1205 to -0.1245, implying that a unit increase in private credit reduces income inequality by 0.121 to 0.125 percent. This confirms the importance of financial development in driving-out income inequality. As the financial sector develops, credit constraints on the poor are lessened, thus improving capital allocation. Ease of and more access to credit helps the poor to invest in high-return projects thereby reducing income inequality. These results are in consonance with findings of Liang (2006), Beck et al. (2007), Kappel (2010) and Shahbaz and Islam (2011).

To show how inflation affects the finance-inequality nexus, an interaction term between financial development and inflation is included in the regression. The interaction term is positive and significant, with coefficients ranging from 0.0832 to 0.0896. This implies that, although financial development reduces income inequality, this effect is severely depressed by inflation. Hence, inflation plays an important role of determining the overall effect of financial development on income inequality.

Considering the control variables, unemployment aggravates income inequality, as evidenced by a positive and significant coefficient in all the Models. This lends support to Liang's (2006) results. He found that, although financial development has reduced income inequality in urban China, this positive contribution has been offset by increased urban unemployment and massive lay-offs. Contrary to Liang (2006), the study finds that education tends to reduce income inequality. My findings are similar to De Gregorio and Lee (2002) in terms of sign and significance. A unit increase in education reduces income inequality by 0.2766 to 0.2938 percent. The possible explanation for a negative coefficient is that as more people get educated they become more skilled. This enables them to earn higher wages thereby reducing the income gap between the rich and the poor. Also, there is a decrease in the premium on education as the relative supply of educated workers increases, thereby lowering income inequality between the educated and uneducated.

GDP level is positive and significant in all the models. The coefficient of the squared term of GDP level is significant and negatively signed in all the models. Therefore, the study finds evidence for the Kuznets' hypothesis that predicts an inverted U-shaped relationship between economic development and income inequality. That is to say, income inequality increases over time while a country is developing, and then, after a certain average income is attained, inequality begins to decrease. The results show that trade openness has an insignificant effect on income inequality. Hence, the study does not find evidence for Dollar and Kraay's (2002) finding that trade openness improves income of the poor. In addition, this contradicts Shahbaz and Islam (2011), who find that trade openness aggravates income inequality. Government consumption is insignificant in all the Models.

### 4.4.3 Broad Money

The results of broad money as a measure of financial development are presented in Table 4.5. Broad money is significant and negative in all the Models with coefficient ranging from -0.2824 to -0.2836. The interaction term is significant and positive in all the Models. This indicates that, although financial development reduces income inequality, this effect is offset by inflation. Considering the control variables, the results for broad money are similar to those of private credit in terms of sign, magnitude and significance. All diagnostic tests are satisfactory in all the Models. This indicates that the Models are well specified.

### 4.4.4 Market Capitalization

The results when market capitalization is used as a financial development indicator are reported in Table 4.6. Stock market capitalization is insignificant in all the Models. This implies that stock market development has no effect on income inequality, unlike the banking sector development. The interaction term between inflation and market capitalization is positive but insignificant. This suggests that effects of inflation on stock market capitalization do not result in increased income inequality. Unemployment leads to increased income inequality but it is only significant when two-step GMM is used as an estimator. Education leads to more equal incomes. There is evidence of the Kuznets' hypothesis since GDP level is positively signed and significant and its square term is negatively signed and significant. The rest of the variables are insignificant.

### 4.4.5 Stock Market Total Value Traded

The results when Stock Market total Value Traded is used as a measure of financial development are reported in Table 4.6. Stock Market total Value Traded is insignificant in all the models. This implies also that stock market development has no effect on income inequality. This may be due to the fact that the stock market financial sector is a formal sector, yet the poor rely heavily on the informal sector. Therefore, financial development in stock markets may favour the rich and the educated against the poor. The interaction term between Stock Market total Value Traded and inflation is insignificant. This indicates that the effects of inflation on Stock Market total Value Traded may not transmit into increased income inequality.

The results of the control variables are similar to the results in Table 4.5 (where private credit is used as a proxy for financial development) in terms of sign and significance.

### 4.4.6 Total Effect of Financial Development on Income Inequality

It is important to note that once an interaction term is included in the regression what really matters is the significance of the total effect of financial development (coefficient of financial development plus coefficient of interaction term) and not simply the significance of each separate coefficient. Therefore, to analyse the effect of inflation rate on the financial development-income inequality nexus, the study calculates total effects of financial development on income inequality at various levels of inflation, i.e. at one standard deviation below the mean of inflation, at the mean of inflation and at one standard deviation above the mean of inflation. The results of the total effect of financial development on income inequality are presented in Table 4.7.

Focusing on Table 4.7, it is clear that at one standard deviation below the mean of inflation all the measures of bank-based financial development are negatively signed and significant at the 1 percent level with coefficients ranging from -0.302 to -0.471. This implies that when inflation is very low financial development reduces income inequality since inflation does not distort the normal operation of the financial system. This is in line with the prediction of Choi et al. (1996), who show that when inflation is very low market frictions may be non-binding therefore inflation does not interfere with resource allocation by financial intermediaries.

Similarly, at the mean of inflation, all the bank-based indicators of financial development are negative and significant. However, the magnitude of the total effect is small compared to when it is evaluated at one standard deviation below the mean of inflation. The total effect become smaller as inflation rises. This infers that, as inflation rises, the positive gain from financial development on income inequality diminishes. At one standard deviation above the mean of inflation, private credit is positive and significant at 10 percent significance level. This indicates that, at high inflation levels, financial systems perform poorly and this may in turn transmit into increased income inequality. This is because, in high inflationary environments and thus poor financial sector performance, the rich may find it easier than the poor to access financial services to hedge against inflation. Also, increased credit rationing as a result of high inflation imposes credit constraints on the poor who may have high return projects, thereby intensifying inequality. At one standard deviation above the mean, broad money becomes positively signed, however it is insignificant.

The total effects of market capitalization and Stock Market Total Value Traded financial development indicator are insignificant at all levels of inflation. This is not surprising since in the regression both Stock Market Total Value Traded, market capitalization and their interaction terms are insignificant. This suggests that the stock market channel of financial development may not help to reduce income inequality irrespective of the level of inflation. This may be due to the fact that this channel is in the formal sector yet the poor are in the informal sector.

### 4.4.7 Sensitivity Analysis

As already mentioned above, different measures of financial development are used as robustness check. The study finds that bank-based financial development reduces income inequality. However, its positive contribution is offset as inflation increases. Market-based financial development has an insignificant effect on income inequality. The results are also robust to different estimators used (two-stage least square (2SLS) and two-step GMM fixed effect estimators).

The next robustness check was to split the sample into the developing countries sub-sample and the developed countries sub-sample in order to make a comparison of how financial development affects income inequality in these sub-samples. Private credit is used as a measure of financial development in both sub-samples. Broad money is only used for the developing countries since Beck et al. (2007) observe that the ratio (M2/Y) might be relevant in developing countries where a substantial portion of broad money is held outside the banking sector. Similarly, Stock Market total Value Traded is used for only developed counties since these countries have well-developed capital markets compared to the rudimentary stage of capital markets in most developing countries. The results are presented in Table 4.8.

In the developing countries sub-sample, the results are similar to those reported in Table 4.5 in terms of size and significance. Private credit and broad money reduce income inequality. The interaction terms are positive and significant. This implies that inflation offsets the gains from financial development on income inequality.

The results are similar to those reported in Table 4.5, with the exception that GDP level and its squared term become insignificant. The weakening of the results may be that splitting the sample into two leads to information loss necessary for establishing the relationship between economic development and the Gini coefficient. Additionally, government consumption is now significant and positively signed. This implies that in most developing countries government expenditure is driven by political consideration at the expense of productive projects, which results in increased income inequality. Caution has to be taken while interpreting the results relating to broad money measure of financial development in the developing countries sub-sample in Table 4.8. This is because the weak identification test is failed and this can lead to biased results.

In the developed countries sub-sample, private credit has a slightly higher impact on income inequality than in the developing countries sub-sample. Possibly this is because financial services can easily reach the poor in developed economies due to the advanced stage of development compared to developing countries. The interaction terms are insignificant in all the models. This is not surprising since developed countries keep very low levels of inflation. Accordingly, inflation does not interfere with the efficiency of resource allocation or financial intermediation. This is in line with Choi et al. (1996), who observed that over the low inflation period (1982-1987) using Korean data, inflation had no significant effect on the returns on equity, its volatility or the growth rate of stock market transactions.

To my surprise, although advanced economies have well-developed capital markets, Stock Market Total Value Traded is also insignificant in the developed countries sub-sample. In the developed countries sub-sample, government consumption and trade openness help to make incomes more equal. Government expenditure is sensitive to the sub-sample used. It is now negative and significant. This implies that developed countries have appropriate redistribution programmes, for example unemployment benefits among others, which help in reducing inequality unlike developing countries. Additionally, in advanced economies government expenditure is driven by necessity consideration such as capital accumulation and health. In contrast, in most developing countries, government expenditure is driven by political consideration at the expense of productive projects. The rest of the variables are insignificant. The insignificance of these variables may be due to information loss resulting from dividing the full sample into sub-samples.

The study also calculates total effects of financial development on income inequality in developing and developed countries at various levels of inflation, i.e. at one standard deviation below the mean of inflation, at the mean of inflation and at one standard deviation above the mean of inflation. The results of the marginal effect of financial development on income inequality are presented in Tables 4.9 and 4.10 for the developing countries sub-sample and developed countries sub-sample respectively. Considering the developing countries sub-sample, financial development only reduces income inequality at the minimum of inflation.

As inflation rises financial development ceases to reduce income inequality. For private credit, when inflation is very high, financial development results in increased income inequality. This may be because high inflation intensifies credit rationing, hence only the rich with collateral security can afford to borrow to invest, thereby increasing income inequality. In the developed countries sub-sample private credit reduces income inequality both at the minimum and mean of inflation. This may be because of the low inflation levels that developed countries keep compared to higher inflation levels in developing countries. However, private credit, although negatively signed at the maximum of inflation, is insignificant. This indicates that even in developed countries a high inflation level will negatively affect financial intermediation, which may have an adverse effect on income inequality. Although developed countries have developed stock markets, Stock Market total Value Traded has an insignificant effect on income inequality, irrespective of the level of inflation.

Lastly, the study used a financial development index constructed from principal component analysis to measure financial development. This is because the individual indicators of financial development may not be as informative as the index constructed from the collection of these individual indicators from principal component analysis. Principal component analysis pulls together the uniqueness of each indicator into one index, hence it may be more informative and thus may give more reliable results compared to the individual financial development indicators.

The financial development index is constructed from the financial development indicator namely; private credit, broad money, stock market capitalization and stock market total value traded. From Table 4.11 it can be seen that the first eigenvalue indicates that 75.3 percent of the variation is captured by the first principal component while the second principal component explains 16.8 percent of the total variation. The third component accounts for 5.6 percent of the total variation whereas the fourth principal component captures only 3.3 percent of the total variation. From Table 4.11 it can also be seen that the first principal component is the best measure of the financial development index since it captures 75.34 percent of the information from these indicators. According to the Kaiser criterion, only principal components with eigenvalues equal to or greater than 1 should be chosen. For this reason the study uses the first principal component as the measure for financial development.

The results from using the financial development index as a measure of financial development are reported in Table 4.12. The financial development index is negatively signed and significant, which is an indication that financial development reduces income inequality. However, the interaction between the financial development index and inflation is positive and significant. This suggests that, even though financial development reduces income inequality, its benefits are offset by inflation. These findings are in line with the results obtained when we use the banking sector indicators of financial development. They however differ from the results obtained from the capital market measures of financial development.

Since the financial development index is more informative than individual financial development indicators, as it includes information from all these indicators, more emphasis should be put on these results than on those from individual indicators. Therefore, overall, financial development reduces income inequality but its benefits are offset by inflation.

Regarding other controls, unemployment intensifies income inequality. On the other hand, education makes incomes equal. GDP level and GDP level squared are sensitive to the financial development measure modification, becoming insignificant. The rest of the control variables are insignificant.

To further evaluate the effect of inflation on the finance-income inequality nexus, the marginal effect of the financial development index on income inequality is calculated at various levels of inflation, i.e. at one standard deviation below the mean, at the mean and at one standard deviation above the mean. As it is clearly seen in Table 4.13, the financial development index is negative and significant at both the minimum level and at the mean of inflation. This suggests that financial development reduces income inequality. However, the magnitude of the coefficient of the financial development index reduces as inflation increases and becomes insignificant at the maximum level of inflation. This indicates that the benefits of financial development are offset by the increases in inflation.

## 4.5 Policy Implications and Conclusion

This paper examines the effect of inflation on the financial development-income inequality nexus using two-step GMM fixed effect estimators for 60 countries selected according to data availability. The present study utilizes a broader number of financial development indicators than previous studies on financial development effects on income inequality. The study follows Jaccard and Turrisi (2003), to interpret the interaction terms. What the study finds is strong evidence that bank-based financial development is associated with more equal incomes. Nevertheless, the gains from financial development on income inequality are diminished as inflation rises. In addition, the private credit channel of financial development may lead to increased income inequality in high inflation environments. This is because its marginal effect is positive and significant at high levels of inflation. The results are robust to different measures of bank-based financial development indicators, different estimators and different samples.

On the other hand, the market-based financial development indicators do not reduce income inequality since they are insignificant in all the models estimated and at different levels of inflation. Nevertheless, this may not be robust as individual indicators of financial development may lack all the necessary information necessary for establishing the finance-inequality relationship. The empirical evidence from above shows that different types of financial development react differently in the way they affect income inequality.

More emphasis should be placed on bank-based financial development compared to market-based financial development. This is because the former helps to make incomes equal whereas the latter has insignificant effects on income inequality. However, the financial development index from principal component analysis suggests that, overall, financial development reduces income inequality but the benefits are offset by high inflation. More emphasis should be put on this result as this index is more informative than individual indicators. Additionally, it is very vital to maintain low levels of inflation in order to reap the benefits of financial development. This is because inflation leads to poor financial system performance characterized by inefficient resource allocation which transmits into increased income inequality. To the best of my knowledge, this is the first study to examine the effect of inflation on the finance-inequality nexus.

Table 4.1: Sample Descriptive Statistics

| Variables | Mean | $S_O^2$ | $S_B^2$ | $S_W^2$ | Min | Max |
|---|---|---|---|---|---|---|
| Gini coefficient | 38.160 | 10.228 | 9.746 | 3.198 | 19.490 | 60.420 |
| Private credit | 0.703 | 0.511 | 0.469 | 0.218 | 0.063 | 3.105 |
| Broad money | 0.511 | 0.337 | 0.305 | 0.130 | 0.057 | 2.205 |
| Capitalization | 0.441 | 0.495 | 0.410 | 0.271 | 0.000 | 2.982 |
| Stock traded | 0.330 | 0.605 | 0.443 | 0.424 | 0.000 | 4.444 |
| Inflation | 0.585 | 2.724 | 1.457 | 2.363 | -0.017 | 28.131 |
| Trade openness | 0.731 | 0.516 | 0.488 | 0.152 | 0.138 | 4.194 |
| Unemployment | 0.079 | 0.044 | 0.043 | 0.023 | 0.010 | 0.268 |
| Education | 0.766 | 0.300 | 0.289 | 0.100 | 0.062 | 1.552 |
| Government | 0.153 | 0.053 | 0.048 | 0.022 | 0.041 | 0.360 |
| GDP level | 8841.866 | 10418.048 | 10109.600 | 2509.643 | 173.767 | 41066.664 |

$S_O^2$ is overall variance, $S_B^2$ is between variance and $S_W^2$ is within variance. They are calculated as: $S_O^2 = \frac{1}{NT-1}\sum_i \sum_t (X_{it} - \bar{X})^2$; $S_B^2 = \frac{1}{NT-1}\sum_i (\bar{X}_i - \bar{X})^2$; $S_W^2 = \frac{1}{NT-1}\sum_i \sum_t (X_{it} - \bar{X}_t)^2$

Capitalization is Stock market capitalization and Stock traded is Stock market total value traded. Countries (N=60); Argentina, Australia, Austria, Bangladesh, Bolivia , Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica , Cote D'Ivoire, Denmark, Dominican Republic, Ecuador, Finland, France, Germany, Honduras, Hungary, Indonesia , Ireland, Italy, Japan, Kazakhstan, Korea Rep, Latvia, Lithuania, Madagascar, Malaysia, Mauritania, Mexico, Moldova Rep, Morocco, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Panama, Peru, Philippines, Poland, Russian Federation, Romania, Singapore, Slovak Rep, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United States, Uruguay, Venezuela.

Table 4.2: Correlation Matrix

| | Gini | Private | Broad | Capital | Stock | Inflat | Unemp | Educ | Trade | Govern | GDP | GDP2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gini | 1.000 | | | | | | | | | | | |
| Private | -0.323 | 1.000 | | | | | | | | | | |
| Broad | -0.292 | 0.869 | 1.000 | | | | | | | | | |
| Capital | -0.175 | 0.604 | 0.623 | 1.000 | | | | | | | | |
| Stock | -0.320 | 0.579 | 0.552 | 0.797 | 1.000 | | | | | | | |
| Inflat | 0.034 | -0.108 | -0.183 | -0.160 | -0.109 | 1.000 | | | | | | |
| Unemp | 0.101 | -0.299 | -0.284 | -0.303 | -0.286 | 0.075 | 1.000 | | | | | |
| Educ | -0.483 | 0.452 | 0.413 | 0.428 | 0.346 | 0.007 | 0.013 | 1.000 | | | | |
| Trade | -0.108 | 0.028 | 0.229 | 0.380 | 0.153 | -0.097 | -0.015 | 0.159 | 1.000 | | | |
| Govern | -0.475 | 0.321 | 0.249 | 0.164 | 0.198 | -0.083 | 0.176 | 0.524 | 0.068 | 1.000 | | |
| GDP | -0.348 | 0.631 | 0.573 | 0.550 | 0.497 | -0.106 | -0.092 | 0.786 | 0.136 | 0.489 | 1.000 | |
| GDP2 | -0.377 | 0.653 | 0.594 | 0.566 | 0.520 | -0.115 | -0.123 | 0.775 | 0.128 | 0.495 | 0.996 | 1.000 |

Gini is Gini coefficient, Private is Private credit, Broad is Broad money, Capital is stock market capitalization, Stock is Stock Market Total Value Traded, Inflat is inflation level, Unemp is Unemployment, Trade is Trade openness, Educ is education, Govern is Government expenditure, GDP is GDP level and GDP2 is GDP level squared.

Table 4.3: Effect of Inflation Level on Financial Development (Banking Sector)

| | Private credit | | Broad money | |
|---|---|---|---|---|
| | (GMM) | (2SLS) | (GMM) | (2SLS) |
| Inflation | -1.1183*** | -0.9503*** | -0.8047*** | -0.7863*** |
| | (0.3064) | (0.3238) | (0.2194) | (0.2314) |
| GDP level | 0.2985*** | 0.3195*** | 0.1321*** | 0.1655*** |
| | (0.0664) | (0.0724) | (0.0508) | (0.0548) |
| Constant | -1.6290*** | -1.8215*** | -0.4978 | -0.7524* |
| | (0.5463) | (0.5941) | (0.4185) | (0.4511) |
| *N* | 147 | 147 | 152 | 152 |
| K-Paap F stat | 30.5707 | 30.5707 | 28.7971 | 28.7971 |
| Hansen test P- Value | 0.4364 | 0.4364 | 0.1556 | 0.1556 |

Figures in parentheses stand for Robust standard errors, ***, **,* stand for statistical significance at1 percent, 5 percent and 10 percent levels respectively.

Table 4.4: Effect of Inflation Level on Financial Development (Market Sector)

| | Market capitalization | | Share traded | |
|---|---|---|---|---|
| | (GMM) | (2SLS) | (GMM) | (2SLS) |
| Inflation | -07670*** | -0.7994*** | -0.5656** | -0.6431* |
| | (0.2495) | (0.3015) | (0.2553) | (0.3409) |
| GDP level | 0.2347*** | 0.2504*** | 0.2651*** | 0.3116*** |
| | (0.0495) | (0.0656) | (0.0424) | (0.0575) |
| Constant | -1.4291*** | -1.5260*** | -1.8165*** | -2.1303*** |
| | (0.4015) | (0.5534) | (0.3392) | (0.4645) |
| *N* | 131 | 131 | 131 | 131 |
| K-Paap F stat | 31.4016 | 31.4016 | 31.4016 | 31.4016 |
| Hansen test P- Value | 0.2162 | 0.2162 | 0.3801 | 0.3801 |

Figures in parentheses stand for Robust standard errors, ***, **,* stand for statistical significance at1 percent, 5 percent and 10 percent levels respectively.

Table 4.5: Effect of Financial Development on Income Inequality Conditional on Inflation Level

| | Private | | Broad Money | |
|---|---|---|---|---|
| | (GMM) | (2SLS) | (GMM) | (2SLS) |
| Private | -0.1245*** | -0.1205*** | | |
| | (0.0339) | (0.0348) | | |
| (Private * Inflation) | 0.0832*** | 0.0896*** | | |
| | (0.0247) | (0.0264) | | |
| Broad money | | | -0.2824*** | -0.2836*** |
| | | | (0.0978) | (0.1014) |
| Broad money * Inflation | | | 0.0884** | 0.0930*** |
| | | | (0.0376) | (0.0379) |
| GDP level | 0.8472*** | 0.8809*** | 1.5557*** | 1.4873*** |
| | (0.2865) | (0.3189) | (0.5435) | (0.5764) |
| GDP level squared | -0.0350* | -0.0368* | -0.0713** | -0.0679* |
| | (0.0191) | (0.0220) | (0.0335) | (0.0363) |
| Unemployment | 0.7666** | 0.7424* | 1.0404*** | 0.9926** |
| | (0.2983) | (0.3965) | (0.3010) | (0.4189) |
| Education | -0.2766*** | -0.2938*** | -0.3334*** | -0.3367*** |
| | (0.0787) | (0.0813) | (0.1154) | (0.1156) |
| Trade openness | -0.0651 | -0.0832 | 0.0134 | -0.0231 |
| | (0.0635) | (0.0688) | (0.0740) | (0.0782) |
| Government | 0.0449 | 0.0792 | 0.0377 | -0.0152 |
| | (0.4916) | (0.4938) | (0.5341) | (0.5484) |
| *N* | 140 | 140 | 134 | 134 |
| K-Paap F stat | 31.9251 | 22.8805 | 13.3735 | 13.3735 |
| Hansen Test P- value | 0.6973 | 0.5643 | 0.2280 | 0.2280 |

Figures in parentheses stand for Robust standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Government is general government consumption as a share of GDP. Significant time dummies are included in the regression.

Table 4.6: Effect of Financial Development on Income Inequality Conditional on Inflation Level

| | Capitalization | | Stock traded | |
|---|---|---|---|---|
| | (GMM) | (2SLS) | (GMM) | (2SLS) |
| Capitalization | -0.0584 | -0.0286 | | |
| | (0.0561) | (0.0573) | | |
| (Capitalization * Inflation) | 0.5718 | 0.1261 | | |
| | (0.5042) | (0.5795) | | |
| Stock Traded | | | -0.0181 | -0.0256 |
| | | | (0.0346) | (0.0358) |
| Stock Traded * Inflation | | | 0.1941 | 0.1070 |
| | | | (5802) | (0.5859) |
| GDP level | 0.8080*** | 1.0616*** | 0.9938*** | 1.0052*** |
| | (0.2675) | (0.3320) | (0.3696) | (3879) |
| GDP level squared | -0.0395** | -0.0572** | -0.0523** | -0.0539** |
| | (0.0188) | (0.0227) | (0.0254) | (0.0271) |
| Unemployment | 0.9267** | 0.5404 | 0.7802* | 0.6696 |
| | (0.3845) | (0.4166) | (0.4598) | (0.5458) |
| Education | -0.1966** | -0.1903* | -0.1910* | 0.1893* |
| | (0.0990) | (0.1020) | (0.1081) | (0.1143) |
| Trade openness | -0.0284 | -0.0773 | -0.0788 | -0.0931 |
| | (0.0745) | (0.0774) | (0.0795) | (0.0843) |
| Government | 0.3640 | -0.4751 | -0.4058 | -0.4889 |
| | (0.4718) | (0.6072) | (0.4923) | (0.5307) |
| *N* | 128 | 128 | 128 | 128 |
| K-Paap F stat | 41.6067 | 41.6067 | 25.5834 | 25.5834 |
| Hansen Test P- value | 0.2020 | 0.2020 | 0.3400 | 0.3400 |

Figures in parentheses stand for Robust standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Capitalization is stock market capitalization and stock traded is stock market total value traded. Government is general government consumption as a share of GDP. Significant time dummies are included in the regression.

Table 4.7: Total Effect of Financial Development on Income Inequality at Various Levels of Inflation

| Financial development | Evaluated at | | |
|---|---|---|---|
| | SDVB | Mean | SDVA |
| Private Credit | -0.302*** | -0.076** | 0.151* |
| | (0.070) | (0.033) | (0.080) |
| Broad Money | -0.471*** | -0.231** | 0.010 |
| | (0.140) | (0.095) | (0.141) |
| Capitalization | -1.281 | 0.276 | 1.834 |
| | (1.104) | (0.275) | (1.645) |
| Stock Traded | -0.433 | 0.096 | 0.624 |
| | (1.252) | (0.330) | (1.909) |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Capitalization is equal to stock market capitalization, stock traded is stock market total value traded, SDVB is one standard deviation below the mean and SDVA is one standard deviation above the mean.

Table 4.8: Effect of Financial Development on Income Inequality Conditional on Inflation Level

| | Developing | | Developed | |
|---|---|---|---|---|
| | (Private Credit) | (Broad money) | (Private Credit) | (Capitalization) |
| Private credit | -0.0214 | | -0.0871** | |
| | (0.0365) | | (0.0393) | |
| (Private credit * Inflation) | 0.0904*** | | 0.2793 | |
| | (0.0214) | | (0.6555) | |
| Broad money | | -0.2972* | | |
| | | (0.1582) | | |
| Broad money * Inflation | | 0.1080*** | | |
| | | (0.0298) | | |
| Stock Traded | | | | 0.0208 |
| | | | | (0.0461) |
| Stock Traded * Inflation | | | | 0.4711 |
| | | | | (2.3407) |
| GDP level | -0.2532 | 0.9853 | -0.0627 | 1.6527 |
| | (0.4369) | (0.8982) | (1.6723) | (1.6018) |
| GDP level squared | 0.0359 | -0.0408 | 0.0241 | -0.0715 |
| | (0.0297) | (0.0570) | (0.0870) | (0.0804) |
| Unemployment | 1.0667*** | 0.8755*** | 0.7655 | 0.8981 |
| | (0.2008) | (0.3238) | (0.7452) | (0.5750) |
| Education | -0.2827*** | -0.2842*** | 0.3396 | 0.2835 |
| | (0.0643) | (0.0954) | (0.3273) | (0.3187) |
| Trade openness | 0.0059 | 0.0340 | -0.5673*** | -0.6048*** |
| | (0.0575) | (0.0539) | (0.1160) | (0.1530) |
| Government | 1.0796** | 0.9280* | -2.6137*** | -3.8633*** |
| | (0.4713) | (0.4794) | (0.8847) | (0.8025) |
| *N* | 84 | 89 | 62 | 62 |
| K-Paap F stat | 12.5236 | 4.1078 | 15.5790 | 22.5420 |
| Hansen Test P- value | 0.2195 | 0.4289 | 0.7634 | 0.4461 |

Figures in parentheses stand for Robust standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Capitalization is stock market capitalization and stock traded is stock market total value traded. Government is general government consumption as a share of GDP. Significant time dummies are included in the regression.

Table 4.9: Total Effect of Financial Development on Income Inequality at Various Levels of Inflation in Developing Countries

| | Evaluated at | | |
|---|---|---|---|
| Financial development | SDVB | Mean | SDVA |
| Private credit | -0.242*** | 0.050 | 0.355*** |
| | (0.072) | (0.035) | (0.084) |
| Broad money | -0.561*** | -0.204 | 0.153 |
| | (0.186) | (0.156) | (0.182) |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Capitalization is equal to stock market capitalization, stock traded is stock market total value traded, SDVB is one standard deviation below the mean and SDVA is one standard deviation above the mean.

Table 4.10: Total Effect of Financial Development on Income Inequality at Various Levels of Inflation in Developed Countries

| | Evaluated at | | |
|---|---|---|---|
| Financial development | SDVB | Mean | SDVA |
| Private credit | -0.086** | -0.077** | -0.068 |
| | (0.038) | (0.035) | (0.435) |
| Stock traded | 0.023 | 0.038 | 0.054 |
| | (0.037) | (0.052) | (0.124) |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Capitalization is equal to stock market capitalization, stock traded is stock market total value traded, SDVB is one standard deviation below the mean and SDVA is one standard deviation above the mean.

Table 4.11: Principal Component Analysis for Financial Development Index

| | PC 1 | PC 2 | PC 3 | PC 4 |
|---|---|---|---|---|
| Eigenvalue | 3.0134 | 0.6710 | 0.2221 | 0.0934 |
| Proportion | 0.7534 | 0.1678 | 0.0555 | 0.0334 |
| Cumulative | 0.7534 | 0.9211 | 0.9766 | 1.000 |
| Variable | *Vector 1* | *Vector 2* | *Vector 3* | *Vector 4* |
| Private credit | 0.5112 | -0.4646 | 0.3820 | -0.6139 |
| Broad money | 0.5069 | -0.5069 | -0.2475 | 0.6518 |
| Capitalization | 0.5048 | 0.4222 | -0.6804 | -0.3226 |
| Stock traded | 0.4764 | 0.5907 | 0.5744 | 0.3071 |

Table 4.12: Effect of Financial Development on Income Inequality Conditional on Inflation Level using the Financial Development Index from Principal Component Analysis

| | (GMM) | (2SLS) |
|---|---|---|
| Financial development index | -0.0480*** | -0.0443*** |
| | (0.0181) | (0.0189) |
| Financial development index * Inflation | 0.0047*** | 0.0048*** |
| | (0.0013) | (0.0012 |
| GDP level squared | 0.1398 | 0.0248 |
| | (0.4808) | (0.4884) |
| GDP level | 0.0072 | 0.0142 |
| | (0.0311) | (0.0319) |
| Unemployment | 0.7361* | 0.7050* |
| | (0.3976) | (0.3972) |
| Education | -0.1020* | -0.1020* |
| | (0.0577) | (0.0572) |
| Trade openness | -0.0865 | -0.0927 |
| | (0.0689) | (0.0700) |
| Government | 0.0126 | -0.0061 |
| | (0.4800) | (0.4797) |
| *N* | 160 | 160 |
| K-PaapF stat | 28.2293 | 19.8398 |
| Hansen test P-Value | 0.3391 | 0.5067 |

Figures in parentheses stand for Robust standard errors,***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. Government is general government consumption as a share of GDP. Significant time dummies are included in the regression.

Table 4.13: Total Effect of Financial Development on Income Inequality at Various Levels of Inflation using the Financial Development Index from Principal Component Analysis

| Financial development | Evaluated at | | |
|---|---|---|---|
| | SDVB | Mean | SDVA |
| Financial development index | -0.0582*** | -0.0453** | -0.0324 |
| | (0.0174) | (0.0184) | (0.0200) |

Figures in parentheses stand for standard errors, ***, **,* stand for statistical significance at 1 percent, 5 percent and 10 percent levels respectively. SDVB is one standard deviation below the mean and SDVA is one standard deviation above the mean.

# CHAPTER 5

# Conclusions

This thesis presents a study on three topics in economics namely: inflation-growth nexus, political instability-inflation volatility relationship and income inequality-financial development nexus conditioned on inflation. The main conclusions for the three different empirical chapters are summarized below.

In Chapter 2, I examine the effect of inflation level and inflation volatility on economic growth for 92 countries from 1982 to 2007 using the dynamic panel with system GMM estimator. I find detrimental effects of inflation level and inflation volatility on economic growth. Surprisingly, both inflation level and inflation volatility have a very small effect on economic growth. The results are further certified by the use of Panel VAR and other estimators like pooled OLS and Within Groups estimators. The results are robust as the study takes into consideration the collinearity problem that exists between inflation level and inflation volatility, and it also addresses the endogeneity problem of both inflation level and inflation volatility in the growth regression.

The study also finds that inflation level in the absence on inflation volatility still has an adverse effect on economic growth. This is because the marginal effect of inflation on economic growth is still negative and significant at the minimum of inflation volatility. This leads to the conclusion that even high inflation achieved through indexation is still harmful

to economic growth. All in all, keeping low and stable inflation levels are necessary but not sufficient conditions for economic growth. This is because inflation level and inflation volatility have very small effects on economic growth.

In Chapter 3, I investigate the effect of political instability on inflation volatility with an emphasis on Africa. This is the first study on the effect of political instability on inflation volatility in the African context. Employing the dynamic panel technique with system GMM estimator, I find that political instability increases inflation volatility. However, the relationship between these two variables is more pronounced in Africa than in the rest of the world sub-sample. This may be because Africa is more politically and economically fragile than the rest of the world. The results are robust to different measures of inflation volatility and political instability and to the inclusion of a set of control variables. Using the two-stage regression strategy, other variables that robustly determine inflation volatility are: inflation level, volatility of money supply growth and the level of GDP per capita. Hence, in order to maintain stable inflation, emphasis should be placed on keeping low levels of inflation, ensuring political stability, maintaining stable money supply growth and attaining high levels of economic development.

In Chapter 4, I provide empirical evidence about the effect of inflation on the financial development-income inequality relationship using two-step optimal GMM and two-stage Least Square with fixed effect estimator. The study utilizes a broader number of financial development indicators than previous studies investigating the financial development effect

on income inequality have done. Additionally, the study also uses a financial development index constructed from principal component analysis from all these indicators. All these proxies for financial development enable us to examine how the different dimensions of financial development affect income inequality conditioned on inflation. The study shows that the effect of financial development on income inequality differs according to the level of inflation. The study finds that financial development reduces income inequity. Nevertheless, the gains from financial development diminish as inflation rises. However, only bank-based financial development indicators are significant. The market-based financial development indicators are insignificant, which may suggest that this channel of financial development does not help to reduce income inequality. Nevertheless, the results from the financial development index constructed from principal component analysis from all the financial development indicators suggest that financial development reduces income inequality but its benefits are offset by inflation. More emphasis should be put on this result as this index is more informative than individual indicators. As a policy implication, it is very vital to maintain low levels of inflation in order to reap the benefits that financial development has on income inequality. This is because inflation leads to poor financial system performance characterized by inefficient resource allocation which transmits into increased income inequality.

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