A Dynamic Enquiry into the Causes of Hyperinflation in Zimbabwe

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Abstract

The purpose of this study is to determine the causes of hyperinflation in Zimbabwe for the period February 1999 to December 2006 using appropriate econometric techniques. Results from long run and shot run econometric models shows money supply, black market for foreign exchange (US$) and lagged values of hyperinflation to be positively correlated with the country's hyperinflation trend. This result accords well with the various theories of hyperinflation. Surprisingly, political rights index as a determinant is negatively associated with hyperinflation, suggesting that an increase in this variable reduces hyperinflation. This is against economic theory, which expects a positive sign for this, variable. Granger causality test is also conducted between money supply and hyperinflation to empirically test the direction of causality, while sensitivity tests are done to infer the effect of money supply shock on hyperinflation trend.

1.1   INTRODUCTION

"Inflation is like sin; every government denounces it and every government practices it"
Sir Frederick Keith-Ross

Zimbabweans are getting stronger. Thirty years ago it took five people to carry fifty Zimbabwean dollars (Z\$50)'s worth of groceries. Today a child can even carry five hundred thousand dollars (Z\$50 x 10⁴)'s worth of groceries.

The study of hyperinflation has fascinated economists for many years, in part because they continue to be concerned about policies required to attain price stability (Siklos, 1995). This renewed interest can be attributed to Cagan's (1956) seminal paper on the demand for money under hyperinflation. Although Zimbabwe's hyperinflation in terms of monthly averages and maximums rates to date (as of April 2007) is by far below the most renowned-recorded hyperinflation episodes, it still remains a fact that its severity has reduced the majority of Zimbabweans into destitutes. Comparing to other countries, Makinen (1986) notes that hyperinflation records show that when initial stabilization occurred in Greek, the country's government converted its unit of account, the old drachma, for the new drachma at a rate of 50 billion to one, with conversions of one trillion to one for Germany and 400 octillion to one for Hungary II^2. Although Zimbabwe's inflation turned into hyperinflation in February 1999, its March 2007 rate of 2200.2 per cent is still by far the above country's peak rates.

While a number of hyperinflation definitions exist, the widely used and most adopted definition is that of Cagan (1956). Cagan defined

> *"hyperinflation as beginning in the month the rise in price exceeds 50 percent and as ending in the month before the monthly rise in prices drops below that amount and stays below for at least a year"(p.25).*

Nevertheless, this definition does not rule out a rise in price at a rate below 50 percent per month for the intervening months. On the other hand, Alesina and Drazen (1989) argues that hyperinflation may be viewed as a means of creating conditions in which a group reluctantly accepts shouldering the economic burdens attendant on a stabilization. Another alternative definition considers hyperinflation as "an inflationary cycle without any tendency towards equilibrium" (Wikipedia). Generally, one can therefore simply consider hyperinflation as inflation out of control, a condition in which prices increase rapidly as a currency losses its value. Thus, following Cagan (1956)'s definition (the one employed in this study), inflation figures shows that Zimbabwe entered the hyperinflationary trend in February 1999 when the rate was just at the threshold figure of 50 per cent, and ever since, the monthly rate has been on a rising trend until today.

Although there is a great deal of debate about the root causes of hyperinflation, it becomes visible when there is an unchecked increase in the money supply or drastic debasement of coinage, and is often associated with wars (or their aftermath), economic depressions, and political or social upheavals. Bomberger and Makinen (1983) pointed out that, it is frequently asserted that the cause of hyperinflation rests in a government

whose political survival is so precarious that it cannot levy sufficient explicit taxes. As such, the government will be forced to rely on the issue of new money as the principal source of tax revenue. This is an apt characterization of the situation in Germany, Austria, Hungary, Poland, and Russia following World War I (WWI).

Capie (1986) on the other hand argues that the combination of weak governments, civil disorder and unrest, leads to conditions which facilitates the loss of fiscal discipline and to the use of inflation tax as the overwhelming source of government revenue. In short, literature reveal that important issues revolve around civil disorder and weak governments, wage-push pressure, the significance of reparations payments, and the role of central bank independence, in persuading policymakers to select a path destined to produce hyperinflation (Siklos, 1995). Nevertheless, for isolated incidences, Webb (1986) and Siklos (1991) have argued (for Germany and post-World War II Hungarian hyperinflations) that fiscal news, instead of the acceleration of money growth may be an equally good, if perhaps better, candidate to explain the pattern of inflation expectations.

In the Zimbabwean hyperinflationary case, money printing has assumed an important role as far as financing government's expenditure activities in recent years. Given the absence of central bank independence (in practice), growth of money has therefore played a significant role in the upward inflationary trend. Another important contributory factor is foreign currency black market exchange rate (mainly US dollars) and its resultant black market premium. Although nominal interest rates, imported inflation and external debt have also propagated hyperinflation, their influence is however minimal.

1.2   Objectives

Whilst the inflation figures for Zimbabwe are currently the highest in the world and the only country with rates currently above 1000 per cent, there is generally no scholarly literature on this subject matter on the country. Whilst the Chhibber et al (1989)'s study on Zimbabwe included inflation, a number of changes have took place with the passage of time. For instance, 'Chhibber et al (1989, p 7-8)'s study reveal that Zimbabwe is traditionally a relatively moderate inflation that has experienced one significant surge in prices since independence in the 1981-82 period'. For the first decade after independence (the period covered by Chhibber et al 1989) until 1990, average annual inflation rates were hovering below 15 per cent. To this end, this paper aim to close this gap in literature about the country's inflation trend.

Thus restricting the study to the period covering February1999 through to March 2007, the specific objectives of this paper include the following:

   i.   To identify the relevant variables influencing hyperinflation in Zimbabwe, using both theoretical and empirical approaches;
   ii. To ascertain which explanatory variables are significant determinants of Zimbabwe's hyperinflation;

iii.   Establish whether money supply (growth) propel hyperinflation; hyperinflation causes money supply (growth) or whether the two do not have any relationship, using time-series data.

iv.   To investigate the dynamic response characteristics of monetary supply growth on hyperinflation and provide relevant policy recommendations thereof.

1.3   Methodology

The period covered by the study is 1999(2) – 2006(12) and monthly data will be used. Explanatory variables include nominal money supply, nominal interest rate, foreign currency black market premium (a hybrid of official and black/parallel nominal United States of America dollar (USD or US$) exchange rates), nominal wages, political rights and United States of America's consumer prices. Most of these variables are typical of those applied in other empirical analysis of inflation in the Sub-Saharan African (SSA) countries (see Dlamini et al, (2001), Chhibber et al (1989), Chhibber and Shafik, (1990)). Zimbabwe prices are represented by inflation rate**,** which is used as the dependent variable in the estimation.

The study employs the econometric technique of cointegration and error correction modeling (ECM) in order to estimate a more specific relationship between hyperinflation and its determinants. Cointegration analysis provides the potential information about long-term equilibrium relationship of model, that is, between the dependent variable and independent variables. The ECM on the other hand, as a tool of analysis, overcomes the problems of spurious regression through the use of appropriate differenced stationary variables in order to determine the short-term adjustments in the model. Given the fact that most time series generally exhibit a non-stationary pattern in their levels, unit root testing as a pre-testing device for cointegration will be carried out in order to determine the degree of stationarity.

The study proceeds as follows. Section 2 will present literature review, while section 3 will deal with historical overview of hyperinflation starting with a brief world overview before dwelling on Zimbabwe. Section 4 will be concerned with modeling hyperinflation and interpretation of the results, with section 5 providing dynamic response characteristics and policy implications. Section 6 concludes the study.

2   LITERATURE REVIEW

2.1   Introduction

It is important to note that while literature exists on the causes of hyperinflation, no theoretical perspective have been developed solemnly to explain this phenomenon per se. Rather, the causes of hyperinflation has been explained along the same determinants as those of inflation, and this sound appealing given that hyperinflation is nothing else than inflation at very high levels. Thus although causes of hyperinflation are theoretically the

same as those of inflation, the magnitudes of some of the variable causes are very severe than in the case of normal inflation. To this end, theoretical review will be mainly aligned to the causes of inflation, though the abnormality of some of the variables will be highlighted to suitably explain hyperinflation in Zimbabwe.

2.2.1 The Quantity Theory of Money

Currently, the various hypothesis of hyperinflation have one thing in common, namely assigning their proximate cause to movements in the money supply (Friedman 1992). The debate about the role of money supply changes in explaining price level movements is more than a century old. The important of money growth as a determinant factor in explaining price movements were first uttered by Jophin (1826) when he said, 'There is no opinion better established, though it is seldom consistently maintained, than that the general scale of prices existing in every country, is determined by the amount of money which circulates in it' (p.3). More than a century latter, Milton Friedman (1992), 'baptized' the triumph of the quantity theory relationship between the money supply and the price level, when he said that '… inflation is always and everywhere a monetary phenomenon' (p. xi).

Thus, the main cause of hyperinflation is a massive imbalance between the supply and demand of a certain currency or type of money, usually due to a complete loss of confidence in the currency similar to a bank-run. This has most often occurred because of excessive money printing, although other factors may have a reinforcing effect. Often the body responsible for printing the currency cannot physically print paper currency faster than the rate at which it is devaluing, thus neutralizing their attempts to stimulate the economy. Hyperinflation is generally associated with paper money because the means to increasing the money supply with paper money is the simplest: add more zeroes to the plates and print, or even stamp old notes with new numbers. It is also the most dramatic so far with electronic money now posing the possibility of even faster 'printing' and de-regulated capital markets allowing currency to 'go global' (Wikipedia).

Borrowing from Keynes (1920) suggestions, namely that 'even the weakest government can enforce inflation when it can enforce nothing else'; evidence indicates that Zimbabwean government has been good at using the money machine print. For instance, the unbudgeted government expenditure of 1997 (to pay the war veterans gratuities); the publicly condemned and unjustifiable Zimbabwe's intervention in the Democratic Republic of Congo (DRC)'s war in 1998; the expenses of the controversial land reform (begging 2000), the parliamentary (2000/2005) and presidential (2002) elections, introduction of senators in 2005 (at least 66 posts) as part of 'widening the think tank base' and the international payments obligations, especially since 2004, all resulted in massive money printing by the government. Above these highlighted and topical expenditure issues, the printing machines has also been the government's 'Messiah' for such expenses as civil servants' salaries[3].

2.2.2 Cost-Push Theory of Inflation

The cost-push theory underscores the fact that prices rise due to increasing cost of the factors of production. This theory maintains that prices of goods and services rise because wages are pushed up by trade unions' bargaining power, or by the pricing policies of oligopolistic and monopolistic firms with market power. Thus labour market rigidities and changes in the cost of labour are considered a major cause of inflation in developed countries, albeit not generally considered a major cause of inflation in most developing countries.

Although Chhibber and Shafik (1990) argued that 'wage push inflation is rare in Africa', largely because wages constitute only a small part of national income, Zimbabwe's situation since the new millennium have proved that wage are a force to recon with when analyzing hyperinflationary trends. Whilst before hyperinflationary started, wages were generally reviewed twice a year (in January and July) both in the government (public) and private sectors, the situation has since changed. Even though up to now the public sector unshakably continued to review its salaries as before (i.e., in January and July) as if nothing happened (of course at the expense of high labour turnover and loss of skilled personnel), the private sector has since changed the review process. In most private companies since 2000, salaries have been reviewed quarterly and upwardly 'in line with inflation trends', with some other private companies reviewing them on monthly bases. These labour costs have contributed to the higher market prices as companies have been putting higher mark ups to recover their costs.

Another important factor of production costs for the country has been imported raw materials. Given the acute shortage of foreign currency in the country since 2000 (due to, and not limited to, exports decline, closed donor community, dried foreign currency reserves and reduced financial aid from IMF and World Bank), most imports have been financed by expensive foreign currency from the black market, thus resulting in higher output costs surfacing in higher market/consumer prices.

2.2.3. Demand-Pull Theory

This school of thought postulates that inflationary pressures arise because of excess demand for goods and services resulting from expansionary monetary and fiscal policies. Over and above these suggested monetary expansion and fiscal policies, the Zimbabwean situation has been compounded by shortages of basic commodities (i.e., mealie-meal (staple diet), cooking oil, flour, fuel, sugar, to mention a few), thus result in pent-up upward pressure in the overall prices.

2.2.4 Inflation and Expectations

Expectations of future inflation are another important determinant of hyperinflation. Expectations can be dichotomized into adaptive and rational expectations. According to

rational expectations, both households and firms form their expectations of inflation based on recently observed inflation and this may affect the general price level. Proponents of the theory maintain that prices are rising because people expect them to rise and they expect them to rise because they have seen them rising. Rational expectations, on the other hand, assume that people use all the available information including that about current policies to forecast the future. Thus according to this theory economic agents are forward looking rather than backward looking. The basic notion of the advocates of this theory is that if policymakers are credibly committed to reducing inflation, rational people will understand the commitment and quickly lower their expectation of inflation.

Both adaptive (mostly used by the majority) and rational (mostly employed by the enlightened, i.e., businessmen, learned etc) expectations have contributed to the hyperinflation in Zimbabwe. The fact that the public view the government as having no credibility at all with regards to fighting inflation, as evidenced by its action of money printing, unjustified expenditure increases, among other things, is viewed by the public to mean that the real 'war' against hyperinflation is yet to start (at least from the policy marker's side).

2.2.5   Recent Theories of Inflation

Literature on recent theories of inflation that have emerged in the past few years emphasized the role played by political stability, policy credibility and the reputation of the government and the political cycles in determining or explaining inflation. According to Selialia (1995), this emerging literature on inflation has come to be known as the political economy approach to macroeconomic policy. These recent theories have shifted attention away from traditional direct economic causes of inflation, such as money creation, towards political and institutional determinants of inflationary pressures.

Like most of African countries, Zimbabwe's political environment has been typified by severe restrictions on political and civil liberties. A glimpse at the political rights and civil liberties indexes from the Freedom House shows that the country's ratings since independence have been above four (4), indicating repressive environment[4]. Thus the intensification of political instability and macroeconomic instability following the coming into fore of resilience opposition political party in 1999, the controversial land reform since 1999 and most importantly the fact that the country been increasingly isolated from the international community, have resulted in political factors being some of the major determinants of hyperinflation in the country.

2.2.6   Structural Factors

Structural factors are also believed to influence the rate of hyperinflation in Zimbabwe. Examples include weather conditions and pricing policies of the government. It can be argued that government's intention of protecting the general consumers through

controlled market/consumer prices have wreck havoc in most production industries, especially the food sector as the decreed prices have been far below production costs, resulting in some companies reducing production, reducing quality or diverting production to other related goods (for instance, instead of producing normal flour whose price is controlled, one can start producing cake flour whose price is not regulated). These production problems have resulted in shortages of some basic commodities, leading to demand pull hyperinflation.

The effects of droughts since 2000 coupled with under utilization of most commercial farms (after the land reform) have also resulted in production decline and shortages of most locally produced consumption products.

2.2.7   Other factors

Foreign currency shortages as well as exchange rate misalignment have also resulted in general increase in prices. Although foreign currency shortages have been a perennial economic problem for Zimbabwe since independence, the severity of the problem first came to light in 1987, before subsiding and reappearing again at a severe scale since 2000.   Added to the shortage is the exchange rate misalignment where by the official exchange has been far below the market-determined rates, resulting in a growing black/parallel market for foreign currency. Due to this shortage, imports of raw materials have been acquired using expensive foreign currency from the black market. The ultimate effect of this has been cost-push inflation.

2.3   Empirical Evidence

Unlike inflation, which tends to have wider occurrences, hyperinflation is a relatively rare phenomenon since time immemorial such that a few scattered incidences and experiences tend to happen across the world after a period of time. Nevertheless, a couple of studies have been recorded in the 20th century.

A study by Wang (1999) provides an analytical account of the Georgian hyperinflation and stabilization. The research found that hyperinflation in Georgia was mainly a result of a mixture of a host of factors including a combination of accommodating financial policies and government's attempt to maintain stable prices for key commodities (bread and energy). Given the multiple shocks that the government was facing in its budget, reliance on monetary financing of the fiscal deficit accelerated depreciation of the currency and domestic inflation was propelled to higher levels. On the other hand, fixing of prices of bread and energy in the local currency (the coupon) was tantamount to indexing the implicit budgetary subsidies to the exchange rate. The end result was a vicious circle of fiscal deficit; central bank credit emissions, currency devaluation and substitution, and larger fiscal deficit thus reinforced the usual inflation-expectation dynamics and the tax revenue erosion effect, quickly pushing prices to higher levels.

The devastation and economic effects of the war of Hungary, which resulted in excessive economic losses, are attributed to reparations, among other factors. Siklos (1995) point out that demands for reparation payments, coupled with difficulties in collecting taxes throughout the period of hyperinflation (1945 – 1946) meant that the Hungarian government had to quickly resort to seigniorage to finance its expenditures. It is noted that from July to December 1945, tax revenues represented, on average, 6.5 percent of government expenditure, thus necessitating money printing to cover the remainder 93.5 percent of government expenditure.

Bernholz (1995) argue that the Bolivian hyperinflation was caused by public budget deficit financed by an inflationary increase of the monetary based. The study noted that from 1975 onwards, the public budget (including losses of government-owned firms) began to show increasing deficits of around 10 percent to the country's gross domestic product (GDP). Further, the rising foreign debt at the backdrop of depleting foreign reserves to service the foreign debt made it even difficult for the country to obtain new foreign credits. The foreign exchange market crisis, which developed in March 1982, resulted in a large devaluation of the local currency Peso and this reinforced inflation due to imported inflation. The budget rose and had to be financed by issuing of money since foreign credit was a closed option

Research by Michael et al (1994) on Germany's hyperinflation suggests that reparations were a major cause of the country's rampant hyperinflation. The study pointed that an essential backdrop to the German hyperinflation episode was the pervasive issue of reparations to the Allies. Supported by Kindelberger (1984), the study proposed that the German experience reflected the incapacity of organized and powerful groups to agree on how to share the burden of reconstruction and reparations amongst themselves. Evidence indicated that deliveries (of reparations) in kind began in August 1919 and did not formally end until November 1923, whilst monetary payments continued until the Dawes Plan in August 1924. During this period there were four revisions to the Versailles Treaty, which set out the reparations obligations. To pay for the reparations obligations, the country had to resort to the printing machine, thus initiating inflation and propagating hyperinflation

According to Makinen (1986), the Greek hyperinflation was set in motion by World War II. The study noted that at the outbreak of WWII, Greece was neutral, but not immune to war. And as a result its foreign trade and tariff receipts, a major revenue source, declined. Thus a combination of scarcity of imported raw materials that led to a further decline in industrial production (averaging 30 percent lower in 1940 than in 1939) and war, especially the Italian conquest of Albania, which necessitated unplanned military expenditures, are among the chief hyperinflation factors. While the budget showed a surplus in the 1939 (September 1, 1938-August 31, 1939) fiscal year of 271 million drachma, the decline in revenues and the extraordinary expenditures produced a deficit of 790 million drachma for the following 1940 fiscal year. Notes advanced by the Bank of Greece covered the deficit. The study further noted that during the period of resistance, the Greek budget deteriorated further while tax revenue simultaneously declined and at

the same time expenditures for military purposes rose 10-fold. Advances from the Bank of Greece continued to fund the deficit.

Bomberger and Makinen (1983) pointed out that the second hyperinflation in Hungary (Hungary II), besides emanating from money printing, it was also propagated by the fact that much of the country's capital was vandalized and removed, thus rendering the country unable to produce the little that it could. The fact that the country was a battleground, the study further assets that as the Germany army retreated, it pursued a policy of removing much of the portable capital stock to Germany and destroying much that remained (e.g., the railroad system). On the other hand, the Soviet army systematically removed a great deal of the remaining physical capital. To this effect, it was estimated that WWI destroyed some 40 percent of the non-human wealth of Hungary (Commercial Bank of Pest 1947). This vandalism drastically affected the supply side of the economy, resulting in upward pressure on prices due to excess demand.

3   HISTORICAL OVERVIEW OF HYPERINFLATION IN ZIMBABWE

3.1   World Overview

Although Zimbabwe's hyperinflation in terms of monthly averages and maximums to date (as of April 2007) is by far below the most renowned-recorded hyperinflation episodes, it still remains a fact that its severity has reduced the majority of Zimbabweans into destitutes. Comparing to other countries, hyperinflation records show that when initial stabilization occurred in Greek, the country's government converted its unit of account, the old drachma, for the new drachma at a rate of 50 billion to one, with conversions of one trillion to one for Germany and 400 octillion to one for Hungary II (Makinen, 1986).

The following table provides a glimpse into the main episodes of hyperinflation of the 20th century according to Cagan (1956) definition, with other hyperinflations recorded in Table A1 of the Appendix.

Table 1: Main Episodes of Hyperinflation

Country	Year Ended	Duration (Non of Months)	Average Monthly Inflation Rate (percentage)
Pre-World War II			
Austria	1922	11	47.1
Germany	1923	15	37.2
Poland	1924	13	81.1
Russia	1924	37	57.0
Hungary I	1924	28	46
Greece	1924	13	36.5
Hungary II	1924	12	2345×10^3
Post-World War II			
Taiwan	1949	17	30.7

China	1949	44	78
Bolivia	1985	18	48.1
Peru	1989	8	48.4
Yugoslavia	1989	4	50.9
Poland	1990	4	41.2
Brazil	1990	4	68.6
Argentina	1990	11	66.0
Ukraine	1993	14	1024
Georgia	1994	13	44.1
Zaire (DRC)	1994	36	66.5

Sources: Siklos (2000, p. 15)

3.2   Zimbabwe's Historical Overview

3.2.1   CPI Index Components

Before detailing the country's historical development of hyperinflation, it is also important to briefly look into the main components (and their respective weights), which constitute (make up) the consumer price index from which inflation rates are derived. Table 2 shows the various components of Zimbabwe's CPI as categorized by Central Statistical Office (CSO), the country's main primary data collector. The weights use 2001 as the base year. The country compile two types of CPI: i) Monetary expenditures only and ii) Monetary and Non monetary expenditures. Table 2 is for the latter type given that in a hyperinflationary environment, there will be a high possibility of co-existence of monetary transactions and barter trade.

Table 2: Composition of Zimbabwe's CPI: Weights in 2001

|	**Category**	**Weight (2001=100)**
1	Food and Non-Alcoholic	31.9335
2	Alcoholic beverages and Tobacco	4.9068
3	Clothing and Footwear	5.7061
4	Rent, Rates, Fuel and Power	16.2291
5	Furniture, Household Equipment and Maintenance	15.1069
6	Health	1.3055
7	Transport	9.7671
8	Communication	0.9875
9	Recreation and culture	5.7452
10	Education	2.8521
11	Restaurants and Hotels	1.5177
12	Miscellaneous goods and Services	3.9425
	TOTAL	**100**
	Food and Non Alcoholic Beverages	31.9335
	Non Food	68.0665
	Total	**100**

Source: Central Statistical Office (CSO)

Table 2 clearly shows that Food and Non-Alcoholic is the single component, which command a very high weight in the country's CPI. Thus any larger proportionate increase (decrease) in this category will surely have a bigger positive (negative) effect on the inflation rate.

3.2.2. Hyperinflation Development History

The history of hyperinflation in Zimbabwe can be said to date back to early 1999. Although data shows that the country's monthly inflation rate reached the 50 per cent mark in February 1999, this monthly rate was above 100 per cent by November 2001 before jumping to rates higher than 200 per cent by January 2003. By the December 2003, the rate was squarely at 600 per cent, though it temporarily declined through 2004 and 2005, reaching the trough of 124 per cent in March 2005. Since April 2006, the monthly rate has been above 1000 percent, with the upward trend reaching the highest ever (as of April 2007) of 2200.2 per cent in March 2007, as shown in Figure 1 and Table A2 in the Appendix. Since the country is still in this hyperinflationary trend (at the time of writing), evidence on the ground shows that no serious policy is yet to be instituted to curb this 'evil' phenomenon which has haunted the majority of the citizen.

Figure 1: Zimbabwe's monthly inflation trend: 1999(2) – 2007(03)
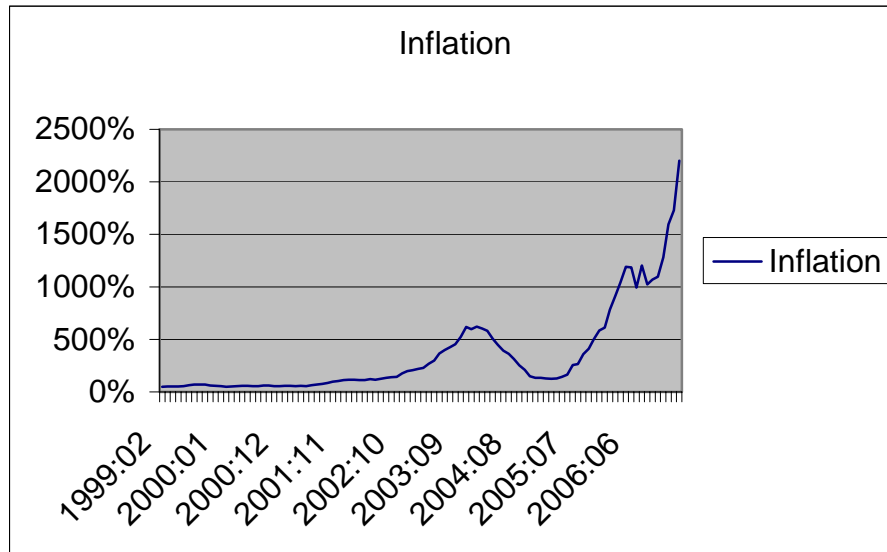
Among the factors which have been presented under literature review to be the major causes of this hyperinflation in Zimbabwe, the study can rank them as follows (in descending order of severity): money printing (seigniorage), foreign currency shortages (with its resultant black market premium), demand pull-inflation (due to disrupted production activities, especially in the agricultural sector), and imported/cost-push inflation. Although Reserve Bank of Zimbabwe (RBZ)'s monetary policy statements in recent years have suggested policy measures to deal with hyperinflation, incredible actions by the same institution have discouraged the majority in the 'war' against

hyperinflation. That is, actions such as money printing (which have been referred to earlier) to finance government expenditures have meant that the public views any hyperinflation stabilization policy from RBZ as more of jokes. Thus to this day, hyperinflation still persists.

3.2.3 Zimbabwe and Stylized Facts about Hyperinflation

It is important to point out that Zimbabwean hyperinflationary environment is also evidenced by fulfillment of some, if not all, of the stylized facts or general characteristics of hyperinflation that have been enumerated in literature. These facts/characteristics are as follows:

1. The general population prefers to keep its wealth in non-monetary assets or in a relatively stable foreign currency. Amounts of local currency held are immediately invested to maintain purchasing power.
2. The general population regards monetary amounts not in terms of the local currency but in terms of a relatively stable foreign currency. Prices may be quoted in foreign currency.
3. Sales and purchases on credit take place at prices that compensate for the expected loss of purchasing power during the credit period, even if the period is short.
4. Interest rates, wages and prices are linked to a price index and the cumulative inflation rate over three years approaches, or exceeds, 100%.
5. At the beginning of inflation, the real stock of money, i.e., the nominal stock of money divided by the price level, decreases.
6. If a country embarks of a more expansionary monetary policy than its main trading partners, the corresponding (flexible) exchange rates rise more strongly and quickly than the relative price level. An undervaluation of its currency results and purchasing power parity does not hold. With fixed exchange rates an overvaluation will develop.
7. When inflation has lasted for some time and accelerates more and more, the real stock of domestic money begins to fall to such an extent that in the last phase of hyperinflation it reaches a level, which is far below the normal stock of the time before inflation.
8. When a country enters into advanced or hyperinflation, the real budget deficit increases.
9. The consolidated budget deficit of all government agencies including state-owned firms, amounts to a high fraction of total government expenditures and is mainly financed by money creation.
10. A substantial part of the deficit is caused by the inflation itself, since tax receipts out of ordinary taxes devalue before the government has expended them.
11. The population has lost all belief in government and central bank. Or as a Brazilian expressed it in 1984: 'If our ministers express some opinion we just

believe the contrary' (Sources: Bernholz (1995) and International Accounting Standard 29).

4   MODELING HYPERINFLATION IN ZIMBABWE

4.1   Methodology

The econometric analysis in this study is four-fold: test for stationarity of the series used in the econometric model; testing causality between hyperinflation and money supply; test of the existence of static long-run equilibrium relationship between inflation and its determinants; and development of a parsimonious dynamic model of the short-run relationship between inflation and its determinants, which could used as the basis for design and assessment of hyperinflation stabilization policy.

4.2   Model Specification

From the above theoretical and empirical exposition, the hyperinflation function for Zimbabwe for the period February 1999 to December 2006 can be specified as follows:

$$\text{Log INFL} = \beta_0 + \beta_1 \text{LogM2} + \beta_2 \text{LogY} + \beta_3 \text{LogPREM} + \beta_4 \text{LogINFL (-1)} + \beta_5 \text{PR} + \beta_6 \text{LogUS\_CPI} + \beta_7 \text{LogNW} + e_t \qquad (1)$$

$B_1, \beta_3, \beta_4\ \beta_5, \beta_6, \beta_7 > 0; \beta_2 ?$

where		
	INLF	= Zimbabwe's inflation rate
	M2	= money supply
	Y	= real income (GDP)
	PREM	= foreign currency (US$) black market premium[5]
	INFL (-1)	= lag inflation
	PR	= Freedom House's political rights index
	US_CPI	= United States of America' consumer price index
	NW	= Nominal wage

Hyperinflation models predict that money supply (M2) should be positively correlated with hyperinflation. Due to government finance conditions, the domestic money stock is endogenized since it plays an important role of financing the fiscal deficit. The strong link between fiscal deficit and money growth in Zimbabwe, especially since 1997 suggests that over-expansionary fiscal policy is often at the heart of hyperinflationary trend in the country. Thus high fiscal deficits produce rapid money growth, which results in high rates of hyperinflation.

The relationship between hyperinflation and economic activity or GDP(Y) is indeterminate. Whilst one branch of theory suggest a negative correlation that is the

higher the Y, the lower the inflation; on the other hand, the other branch of theory predicts a positive relationship.

Given the severe shortages of foreign currency to import necessary raw materials and inputs, most companies have resorted to sourcing the foreign currency at the black market at relatively punitive rates. As such, these costs have to be recovered by passing on the burden to consumers in the form of higher prices. Thus, a positive relationship between black market premium and hyperinflation is expected.

In the case of Zimbabwe, the study expect the short-term determinant to be the expected rate of inflation, in view of the discussions of the country's monetary history, especially the frequency of money printing. Repressive political rights (according to the Freedom House index), nominal wages and imported inflation captured by the United States of America (USA)'s CPI are all expected to augment hyperinflationary tendencies, thus positive correlation between each of these three variables and hyperinflation is expected.

4.3. Inflation and Money growth

There is general consensus about the excessive money supply (or growth of money) as one of the major determinant of hyperinflation in any country. For it is widely believed that deficits are normally inflationary if and on if they are financed by money printing. Whilst the relationship between money supply and hyperinflation has been greatly explored in one direction, that is, from money to inflation, evidence from the post-World War I (WWI) experiences have also shown that, though in the first instance money growth causes hyperinflation, hyperinflation in turn necessitates printing of more money.

Therefore, the question of whether money supply M) causes hyperinflation rates (Π) or vice versa in Zimbabwe is investigated empirically using pairwise Granger causality test. Through Granger causality tests[6], one can proceed to test for the direction of causality between the two series. Standard Granger (1986) causality test examines the role of past changes in money growth (M), in explaining the current variations in hyperinflation (Π). On the other hand, a reversed causality direction is determined by experimenting with variables M and Π interchanged, using the following equations:

$$M_t = \sum_{i=1} \beta_i M_{t-1} + \sum_{i=1} \alpha_i \Pi_{t-1} + U_t \dots\dots\dots\dots\dots\dots\dots \text{ (2a)}$$

$$\Pi i = \sum_{i=1i} \alpha_i \Pi_{t-1} + \sum_{i=1} \beta_i M_{t-1} + V_t \dots\dots\dots\dots\dots\dots\dots \text{ (2b)}$$

to determine whether or not M_t do Granger cause Πi and vice versa, respectively. In terms of interpretation, Πi are said to be Granger-caused by M if money syupply help in the prediction of Πi, or equivalently if the coefficient on the lagged money supply values

are statistically significant. In our case, there are four possible causal relationships between hyperinflation (Π) and money supply (M):

i. Unidirectional causality from M to Π;
ii. Unidirectional causality from Π to M;
iii. Bidirectional causality when M causes Π and vice versa;
iv. Independence when there is no causal relationship between Π and M.

The null hypothesis postulated for this test is that, money supply growth causes hyperinflation. The results of the Granger causality test are presented in Section 4.6.3.

4.4.1 Data Analysis

The study employed monthly time series data covering the period February 1999 to December 2006 to investigate the statistical significance of the variables that relate to the hyperinflation. Data on inflation rates, GDP, nominal wages, the black market and official exchange rates (for the US\$) are collected from Reserve Bank of Zimbabwe (RBZ). Data for the USA consumer price index are from World Bank's World Development Indicators (WDI), while political rights (PR) series is from the Freedom House Index.

4.5 Stationarity and Non-Stationarity

The importance of the stationarity phenomenon arises from the fact that almost all the entire body of statistical estimation theory is based on asymptotic convergence theorems i.e., the weak law of large numbers, which assume that all data series are stationary. Nevertheless, in reality, non-stationarity is extremely common in macroeconomic time-series data such as money, inflation, consumption and exchange rates. Thus treating nonstationary series as if they were stationary will bias the Ordinary Least Squares (OLS) and thus result in misleading economic analysis. That is the model will systematically fail to predict outcomes and can also lead to the problem of spurious (nonsensical/misleading) regressions where R-squared is approximating unity, *t* and *F*-statistics look significant and valid. In essence, the problem lies with the presence of nonsensical regression that arises where the regression of non-stationary series, which are known to be unrelated, indicates that the series are correlated. Hence, there is often a problem of incorrectly concluding that a relationship exists between two unrelated non-stationary series. This problem generally increases with the sample size, and is not normally solved by including a deterministic time trend as one of the explanatory variables in order to induce stationarity.

Thus to avoid inappropriate model specification and to increase the confidence of the results, time series properties of the data are investigated. Although there are a number of methods used to test for stationarity and the presence of unit roots, the methods used here are the Augmented Dickey-Fuller (ADF) and the Philips Peron (PP) tests. By definition a

series is stationary if it has a constant mean and a constant finite variance. On the contrary, a non-stationary series contains a clear time trend and has a variance that is not constant overtime. If a series is non-stationary, it will display a high degree of persistence i.e. shocks do not die out. A series X_t is said to be integrated of order d, denoted as I(d), if it must be differenced d times for it to become stationary[7]. For example, a variable is said to be integrated of order one, or I(1), if it is stationary after differencing once, or of order two, I(2) if differenced twice. If the variable is stationary without differencing, then it is integrated of order zero, I(0). The ADF regression test can be written as:

$$\Delta\chi_t = \beta_0 + \lambda\chi_{t-1} + \beta_1 t + \sum_{t=2}^{p} \gamma_i \Delta\chi_{t-1} + \varepsilon_t \ \ldots\ldots\ldots\ldots\ldots \text{(3)}$$

Where t is the time trend, p is the number of lags; ε_t is a stationary disturbance error term. The null hypothesis that x_t is non-stationary is rejected if λ_1 is significantly negative. The number of lags (n) of Δx_t is normally chosen to ensure that regression residual is approximately white noise. To this end, Table A3 of the Appendix provides unit root test results (ADF and PP tests) and the tests indicate that all the variables are stationary at first difference, that is, they are I(1) variables.

4.6   Estimated Results

4.6.1   Long-run (Cointegration) Relationship

This analysis tests whether if variables are integrated of the same order, a linear combination of the variables will also be integrated of the same order or lower order. The belief underpinning cointegration analysis is that although macroeconomic variables may tend to trend up and down over time, groups of variables may move together. In the case where a tendency for some linear relationships to hold among a set of variables over long periods of time, then cointegration analysis helps to discover relationship. To this end, Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary, I(0) and in that situation, the non-stationary (with a unit root), time series will be said to be cointegrated. That is, they are individually non-stationary, integrated of the same order but their linear combination is integrated of a lower order. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship between the variables.

This cointegration provides a platform of dichotomizing the evolution of time series data into the following components:

   i.   Long run equilibrium characteristics (the cointegrating vector);
   ii. Short run disequlibrium dynamics

In this case there will be a direct link between cointegration and the so-called error (or equilibrium) correction model. Therefore, cointegration allows the inclusion of a combination of long and short run information in the same model. This scenario has the

advantage of minimizing the drawbacks associated with the loss of information from simple attempts to achieve a stationary series, for example, by differencing.

There are basically two approaches used in literature to analyze cointegration: the Engle-Granger (E-G) approach and the Johansen Maximum Likelihood procedure. The limitation of the E-G approach is applicable when more than two variables are involved in the model. Nevertheless, in spite of its limitations, it is a widely used method for its simplicity and straightforward application. The Johansen Maximum Likelihood procedure is an ideal approach to estimate when there are more than one cointegrating vectors or variables in the case of Equation 1. Since the latter approach is relatively complex, the study will employ the E-G approach.

The estimated results of the parsimonious long-run static equation presented in Table 3 (only for variables which were significant) reveal that money supply, black market premium, lagged values of inflation and political rights are all significant at least at one percent level of significant. Whilst all the other variables carry expected positive signs according to theory, political rights carry a wrong sign. According to theory, political instability (a combination of civil disorder, repressive laws, etc) is expected to be positively related to hyperinflation. For Zimbabwe, the otherwise negative sign maybe explained in light of the price repressive laws/regulations, which the government has been heavily enforcing since the beginning of hyperinflation, with heavy finds and threats of imprisonment being administered especially to retailer food shops and transport operators. The effect of this enforcement can be the cause of the negative relationship between hyperinflation and political rights. Given that food and transport have a combined weight of nearly 42 percent (31.9% and 9.77%, respectively) in the CPI means that any successful price control enforcements on these products will negatively affect inflation trend. The importance of price control's effects on inflation were also echoed by the International Monetary Fund (IMF) (2007) when it said for Zimbabwe 'half the products in the basket used to measure the Consumer Price Index (CPI) are controlled by government'.

The elasticity of hyperinflation with respect to money supply, black market premium, lagged values of inflation and political rights are 0.51, 0.11, 0.002 and -1.12, respectively. The long-run estimation indicates that the model fits the data well as evidenced by values of both R^2 (adjusted R^2) and F-statistic tests, which are above 86 percent. The R-squared, which measures the "goodness of fit" of the equation is satisfactory at 87 per cent, indicating that 87 per cent of the variations in Zimbabwe's hyperinflation rate is explained by variations in the changes in money supply, black market premium, the lagged inflation rate, political rights, and the residual error term. The F-test statistic of 151.74, with a p-value of 0.00, indicates that all four variables jointly determine hyperinflation in Zimbabwe.

Table 3: OLS Long-run Cointegrated Equilibrium Model of Hyperinflation

Dependent Variable: LN_INFL [Sample 1999(02) – 2000(12)]

Variable	Coefficient	Standard Error	t-statistic	Probability
C	4.47	0.56	7.97	0.0000
LN_M2	0.51	0.028	18.19	0.0000
LN_PREM	0.11	0.019	5.67	0.0000
MINFL_1	0.002	0.0007	2.87	0.0051
PR	-1.12	0.143	-7.79	0.0000
R^2	0.872	F-statistic	151.74	
Adjusted R^2	0.866	Prob(F-statistic)	0.0000	

4.6.2 Short Run Error Correction Modeling (ECM)

The existence of at least one cointegrating vector among the variables implies that an ECM can be estimated. The ECM approach used here is useful for the formulation of a short term price adjustment model, which models changes in Zimbabwe prices in terms of changes in the other variables in the model, and the adjustment towards the long run equilibrium in each time period. This draws upon the error correction formulation, which is the counterpart of every long run cointegrating relationship.

To avoid any estimations bias from the results, the ECM model was tested for such econometric assumptions as normality, heteroskedasticity, serial correction and mis-specification and these tests are presented in the appendix Table A4. Generally, the tests confirm that the shot-run model is statistically good, with Cusum test showing absence of any structural break in the period under study.

The results from the parsimonious error correction model (ECM) are presented in Table 4. All variables in the ECM are entered in first difference form. In this equation, (ECM_{t-1}) is the lagged error correction factor, given by the residuals from the static cointegration Equation 1. In other words, (ECM_{t-1}) is the long run information set, represented by what economic theory posits as the equilibrium hyperinflation behaviour. It is a stationary linear combination of the variables postulated in theory. It is a cointegrating vector. The coefficient of (ECM_{t-1}) shows the speed of adjustment to long run solution that enters to influence short run movements in hyperinflation. The results show that the coefficient of the error term (ECM_{t-1}) has a negative sign, which is significant at ten percent level of significance. This is in line with theory, which expects it to be negative and less than unity in absolute terms, since we do not expect a 100 per cent or instantaneous adjustment. Thus this significant negative sign on the ECM ensures that the all the explanatory variables in ECM work together for hyperinflation to get to equilibrium in the short run.

The statistical fit for the short run dynamic reduced form equation for Zimbabwe's hyperinflation appears to be relatively acceptable as indicated by adjusted R^2, which is slightly above 50 per cent and the relatively high F-statistic value of 11.49. Otherwise, all

the other variables in the model carry expected signs and are significant at one per cent level. Thus the ECM results confirm the appropriateness of the error correction approach framework and that it should be used in conjunction with the long run equilibrium relationship for better policy recommendations.

Table 4: Parsimonious single equation ECM of hyperinflation in Zimbabwe

Modelling ΔLN_INFLby OLS [Sample 1999(2) – 2006(12)]

Variable	Coefficient	Standard Error	t-statistic	Probability
C	-0.02	0.02	-1.17	0.24
ECM_{t-1}	-0.05	0.03	-1.86	0.07
DLN_INFL(-1)	0.24	0.10	2.50	0.01
DLN_INFL(-2)	0.39	0.10	3.78	0.0003
DLN_PAR(-2)	0.10	0.06	1.72	0.09
DLN_M2(-2)	0.26	0.12	2.17	0.012
R^2	0.54	F-statistic	11.49	
Adjusted – R^2	0.51	Prob(F-statistic)	0.0000	

Note: DLN_INFL means differenced inflation series

4.6.3   Results of Pairwise Granger Causality test

The Granger causality test is used to determine the nature of causality between changes in hyperinflation rate and money supply rate in Zimbabwe. The test is based on monthly stationary data series for the period 1999(2) to 2006(12). The Granger causality test presented in Table 5 discloses that the direction of causality is generally bi-directional, from money growth to hyperinflation and vice versa. Thus for Zimbabwe, these two series feed each other, and any meaningful hyperinflation stabilization policy has to be modeled in such a way that these two problems can be simultaneously dealt with.

Table 5: Pairwise Granger Causality Test [Monthly Data: 1975(2) – 2006(12)]

Null Hypothesis	Obs	F-Statistic	Prob
DLN_M2 does not Granger Cause DLN_INFL	93	2.84787	0.06332
DLDN_INFL does not Granger Cause DLN_M2		3.68053	0.02917

5   DYNAMIC   RESPONSE   CHARACTERISTICS   AND   POLICY   IMPLICATIONS

The hyperinflation model is subjected to sensitivity testing in the form of dynamic simulations to determine whether the resulting multiplier effects are consistent and therefore whether the model is stable and robust. Specifically given the fact that money

growth is one of the major causes of hyperinflation in Zimbabwe, this section will present sensitivity tests for shocked money supply only. Other variables could however be done in the same manner. The dynamic response properties reveal some of the policy implications of the model. The response characteristics and some policy implications are therefore discussed below.

5.1   Sensitivity tests

The permanent shock was applied to money supply by allowing it to fall by 25 per cent above its baseline level from January 2001 onwards. Given that hyperinflation should be reduced rather than increased, a negative shock is the most appropriate action. The result of the sensitivity test is shown in Figure 2.

Figure 2: Effects of a 25 percent decrease in money supply on hyperinflation
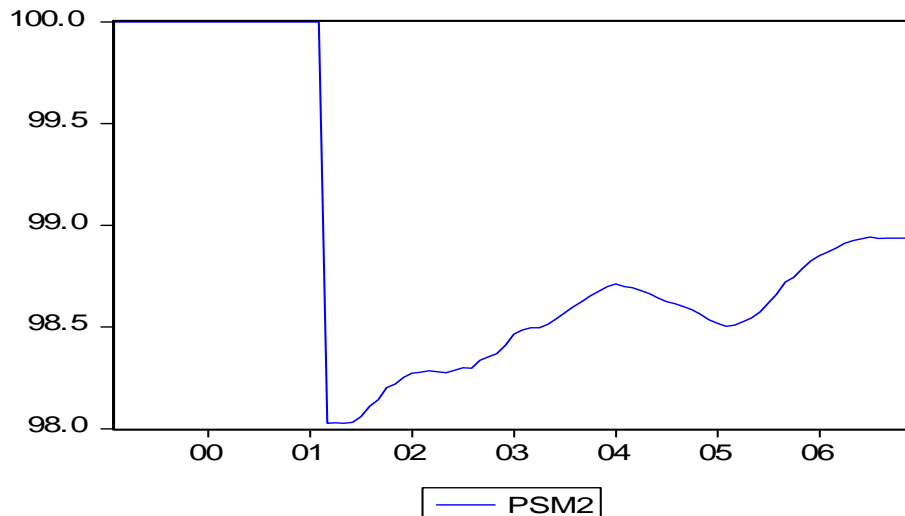
Figure 2 show that a 25 per cent reduction in money supply in Zimbabwe has a relatively pronounced effect (on monthly basis) on the decline of inflation in the country. After applying the reduction shock on money supply in January 2001, inflation falls by 2 percent (soon after the shock) on a total scale of 100 percent to a turning point of just above 98 percent. For instance, a 2 percent decline on a monthly inflation rate of 57 percent will be 1.14 percent, causing the rate to fall to 55.85 percent. Thus the portrayed figure above is consistent with economic theory, which assumes a positive correlation between money supply and hyperinflation, that is the lower the former, the less the latter.

5.2   Policy implications

The simple policy recommendations constructed from the sensitivity test are also in line with the much-agreed fact that, to fight inflation, one of the steps or policy should

involve reducing money supply. Thus, as has been shown, money supply has long-run effect on hyperinflation trend in Zimbabwe and as such its decline will result in fall in hyperinflation rate.

Thus it goes without much emphasis that, among other policy endeavours to seriously deal with hyperinflation, Zimbabwean authorities needs to seriously reduce money supply. Although such an action may result in government failing to meet some of its expenditures, the RBZ need to stop financing the government deficits through money printing as it has been doing in recent years. On the other hand, government can reduce the severity of its deficit and expenditures if it can take a serious initiative of reduce some of its enlarged expenditure outlay. Otherwise, any failure to reduce money supply will prove disastrous as far as reducing hyperinflation is concerned.

Added to the sensitivity tests and the generally upheld idea of the theoretical positive relationship between money supply and hyperinflation, practical evidence in dealing with hyperinflation has shown reduction of money supply as one of the prerequisite. For instance, more than 99 percent of all the successful hyperinflation stabilization programs that were instituted by once hyperinflationary countries such as Germany, Hungary, China, Greek, Georgia, Bolivia, Angola and Taiwan, to mention a few countries, money supply reduction was one of the major actions. In most of these case studies, stabilization programs gave monetary authorities (i.e., central banks) autonomy such that, on the first day of implementation of stabilization program, the central bank could even announce its immediate withdrawal of government deficit financing by means of money printing. The fact that such policy action did worked in almost all countries were it was fully implemented means that Zimbabwe can not be an exception if the authorities are seriously committed to terminating hyperinflation.

6   CONCLUSION

The purpose of this study was to determine the causes of hyperinflation in Zimbabwe for the period February 1999 to December 2006 using appropriate econometric techniques.

The impact of the money supply variable on hyperinflation was found to be significant, suggesting that money supply growth in Zimbabwe does accord with normal behavioural expectations towards inflation trend. This pattern is also reinforced by the Granger causality test, which showed that, among other possible relational directions between hyperinflation and money supply, the latter Granger causes the former, while the former also Granger causes the latter. This relationship, were money supply causes hyperinflation in Zimbabwe is explained by the use of money printing as one of the major source for financing government deficits, especially since the beginning of the new millennium. Thus to break this vicious circle, as suggested by the sensitivity test as well as other countries' successful hyperinflation stabilization programs, Zimbabwe need to seriously reduce its money supply, among other stabilization actions. This can however be achieved if the central bank is given autonomy.

Foreign exchange black market premium, an offshoot of misaligned exchange rate between the official fixed and parallel/black market exchange rates seems to play a significant role in the hyperinflation function for Zimbabwe. The premium affects the inflation rate indirectly through expensive imported inputs. Given that most potential traditional (external or exogenous) sources of foreign currency inflow are currently shut, for instance, sources such as foreign direct investment (FDI); loans, aid/grants and donations, and capital inflow, the country has one main (relatively endogenous) source, exports, which it can encourage. Nevertheless, the drive to stimulate exports is complicated by overvalued fixed exchange rate. Thus, exchange rate policy also has to be framed in such a way that it does not discourage exportation; otherwise the severity of black market premium will continue propagating hyperinflation.

The study found that lagged values of hyperinflation have a significant long run and short-run influence on current hyperinflation. This is in line with both adapted and rational expectations, that buyers will use both previous hyperinflation figures as well as all the relevant available information to forecast future inflation trends. For Zimbabwe, the hyperinflation forecast has mainly been in an upward fashion. To deal with the impact of inflation expectations, monetary authorities need to put serious credible measures aimed to ameliorate hyperinflationary trend, otherwise expectations will continue to influence hyperinflation in an upward direction.

The study also found that political rights have a significant long-run influence on the level of prices of Zimbabwe. Although the variable has shown a negative relationship with prices, this maybe so only for a limited time. Thus the country need to improve its political environment across the spectrum, from international relations, internal governance (perceived fair legal environment), and restoration of all the basic human rights as defined by the United Nations Human Rights Declaration of 1948. The stability of this variable is important, as evidence from other countries have shown political instability of any form to be positively associated with higher inflation.

ENDNOTES

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2 Trillion and Octillion are numerically written as 10^{12} and 10^{27}, respectively according to USA and Morden British (short) scales.

3 On 16 February 2006, the governor of the Reserve Bank of Zimbabwe announced that the government had printed ZWD 21 trillion in order to buy foreign currency to pay off IMF arrears. In early May 2006, Zimbabwe's government began rolling the printing presses (once again) to produce about 60 trillion Zimbabwean dollars. The additional currency was required to finance the recent 300% increase in salaries for soldiers and policemen and 200% for other civil servants. The money was not budgeted for the current fiscal year, and the government did not say where it would come from (Wikipedia).

4 Both ratings are calculated on a scale of $1 - 7$, with a score of 7 indicating the most repressive societies. Zimbabwe's political rights and civil liberties' rates has been oscillating between 3 and 4 for the period 1980 to 1986, while from 1987 upwards, both categories' indexes were oscillating between 6 ad 7, hence indicating repressive environment. Freedom House's annual survey of freedom in the world publishes data on all countries in the world beginning from 1972. More information is available at http://www.freedomhouse.org.

5 The black market premium for foreign exchange is the percentage by which the parallel exchange rate exceeds the official exchange rate, i.e., $Z = [(P_E/O_E) - 1]*100$, where Z, Pe and Oe, respectively, stand for parallel premium, parallel exchange rate and nominal official exchange rate

6 Besides Granger causality, one can also use Sims (1972) causality test

7 Letter D or Δ symbol can denote differenced series, i.e., differenced inflation series becomes D_inflation or Δinflation.

8 Newspapers, including the country's government controlled paper (Herald) were awash with news about managers of big supermarkets being fined for 'overcharging' a range of products, especially beginning 2005.

9

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http://www.wikipedia.org

APPENDIX

Table A1: Hyperinflations, 1956 – 96 (Cagan Definition)[1]

Country	Dates of Episodes	Duration in Months	Cumulative inflation	Highest monthly inflation rate
Angola	Dec 94-June 96	19	62,445.9	84.1
Nicaragua	June 86- Marc91	58	11,895,866,143	261.2
DRC	Oct. 91 – Sept. 92	12	7,689.2	114.2
DRC	Nov. 93 – Sept. 94	11	69,502.4	250.0
Armenia	Oct. 93 – Dec. 94	15	34,258.2	437.8
Azerbaijan	Dec. 92 – Dec. 94	25	41,742.1	64.4
Tajikistan	Apr. 93 – Dec. 93	9	3,636.7	176.9
Tajikistan	Aug. 95 – Dec. 95	5	839.2	78.1
Turkmenistan	Nov. 95 – Jan. 96	3	291.4	62.5
Serbia	Feb. 93 – Jan. 94	12	156,312,790.0	175,092.8

Source: Adapted from Stanley Fischer; Ratna Sahay and Carlos A. Végh. (2002:840-841). Modern Hyper- and High Inflations. *Journal of Economic Literature*, Vol. 40, No. 3. (Sep., 2002), pp. 837-880.

Table A2: Zimbabwe's Monthly Inflation Rate: 1999(2) – 2007(3)- percentage (%)

1999:02	50	**2001:03**	56	**2003:04**	269	**2005:05**	144
1999:03	53	**2001:04**	57	**2003:05**	300	**2005:06**	164
1999:04	53	**2001:05**	55	**2003:06**	364	**2005:07**	255
1999:05	53	**2001:06**	64	**2003:07**	400	**2005:08**	265
1999:06	55	**2001:07**	70	**2003:08**	427	**2005:09**	360
1999:07	64	**2001:08**	76	**2003:09**	456	**2005:10**	411
1999:08	69	**2001:09**	86	**2003:10**	526	**2005:11**	502
1999:09	70	**2001:10**	98	**2003:11**	619	**2005:12**	586
1999:10	70	**2001:11**	104	**2003:12**	599	**2006:01**	613
1999:11	61	**2001:12**	112	**2004:01**	623	**2006:02**	782
1999:12	57	**2002:01**	117	**2004:02**	602	**2006:03**	914
2000:01	56	**2002:02**	116	**2004:03**	584	**2006:04**	1043
2000:02	49	**2002:03**	113	**2004:04**	505	**2006:05**	1193
2000:03	51	**2002:04**	114	**2004:05**	449	**2006:06**	1185
2000:04	54	**2002:05**	123	**2004:06**	395	**2006:07**	994
2000:05	59	**2002:06**	115	**2004:07**	363	**2006:08**	1205

[1] Exclutles the following one- antl two-month episocles. In the market economies, Chile (Oct. 1973) 'ind Peru (Sep. 1988, July-Ang. 1990). In the transition economies, Estonia (Jan.-Feh. 1992), Lahia (Jan. 1992), Lithuania (Jan. 1992),Klyg).z Republic (Jan. 1992),ant1 Moldova (Jan.-Feh. 1992).In atltlition, n7e also excluded Belarus (April 1991,Jan.-Feh. 1992),Kazakstan (April 1991,Jan. 1992),Russia (April 1991,Jan. 1992),and. Uzbekistan (April 1991,Jan.-Feh. 1992)even though by Cagan's clefinition these episodes lastetl Inore than m o months, as they appear related to two price jumps (April 1991, and. Jan.-Feh. 1992).

2000:06	59	2002:07	124	2004:08	314	2006:09	1023
2000:07	53	2002:08	135	2004:09	252	2006:10	1070
2000:08	54	2002:09	140	2004:10	209	2006:11	1099
2000:09	62	2002:10	144	2004:11	149	2006:12	1281
2000:10	61	2002:11	176	2004:12	133	2007:01	1594
2000:11	56	2002:12	199	2005:01	134	2007:02	1729.9
2000:12	55	2003:01	208	2005:02	127	2007:03	2200.2
2001:01	57	2003:02	221	2005:03	124		
2001:02	58	2003:03	228	2005:04	129		

Source: Reserve Bank of Zimbabwe (RBZ)

Table A3: Univariate characteristics of all the variables

Series	Model	ADF			PP		Conclusion
		Lags	$\tau\ \tau_\mu\ \tau_\tau$	$\phi_3\ \phi_1$	Lags		
LN_INFL	τ_τ	3	-3.18*	11.4***	3	-1.7	Non-Stationary
	τ_μ	2	-0.82	14.3	3	-0.20	
	τ	2	0.98	------	3	1.79	
LN_M2	τ_τ	2	-2.38	11.94***	3	-2.17	Non-stationary
	τ_μ	2	1.36	12.48	3	2.77	
	τ	2	3.25	------	3	10.5	
LN_PREM	τ_τ	0	-2.12	2.27	3	-2.16	Non-Stationary
	τ_μ	0	-1.98	3.91	3	-1.98	
	τ	0	-0.45	------	3	-0.44	
LN_NW	τ_τ	1	-2.79	27.83***	3	-2.79	Non-Stationary
	τ_μ	1	1.99	34.32	3	3.05	
	τ	1	4.79	------	3	20.07	
ΔLN_INFL	τ_τ	1	-3.3*	17***	3	-5.87***	Stationary
	τ_μ	1	-3.27**	25.5***	3	-5.82***	
	τ	1	-3.1***	-------	3	-5.47***	
LN_GDP	τ_τ	3	-3.42*	22.46***	3	-1.79	Non-Stationary
	τ_μ	1	0.09	44.88	3	0.44	
	τ	1	-3.5***	-----	3	-9.56***	
ΔLN_PREM	τ_τ	4	-4.75***	15.06***	3	-9.92***	Stationary
	τ_μ	4	-4.75	18.1***	3	-9.95***	
	τ	0	-9.9***	-------	3	-9.91***	
ΔLN_M2	τ_τ	1	3.94**	27.9***	3	-8.12***	Stationary
	τ_μ	4	-2.34	16.51***	3	-7.04***	
	τ	4	-0.98	------	3	-3.09***	
ΔLN_NW	τ_τ	0	-5.14***	13.2***	3	-5.19***	Stationary
	τ_μ	0	-4.53***	20.53***	3	-4.51***	
	τ	0	-0.89	------	3	-0.92	
	τ_τ	0	-3.97**	7.89***	3	-3.88**	

ΔLN_GDP	τ_μ	0	-3.98***	15.82***	3	-3.88***	Stationary
	τ	1	-1.31	-----	3	-1.43	

*(**)[***] Statistically significant at a 10(5)[1] % level

Key: τ_τ: Means Trend and Intercept

τ_μ Means intercept

τ Means None

(LN_MINFL = log of monthly inflation rate, LN_M2 = log of money supply, LN_PREM =log of foreign currency (US$) black market premium, LN_NW = log of nominal wage, and LN_GDP=log of GDP)

The Augmented Dickey-Fuller and Phillips Peron results tests for non-stationarity shows that all the variables appear to be integrated of order one that is stationary after first differencing.

Table A4: ECM's Diagnostic Tests

Test	H_0	Test Statistic	p-Value	Conclusion
Jarque-Bera	Normally distributed	JB = 4.24	0.12	Normally distributed
Ljung-Box Q	No Serial Correlation	$LB_Q = 1.08$	0.98	No Serial Correlation
Breusch-Godfrey	No Serial Correlation	$nR^2 = 1.35$	0.51	No Serial Correlation
ARCH LM	No Heteroskedasticity	$nR^2 = 3.45$	0.18	No Heteroskedasticity
White	No Heteroskedasticity	$nR^2 = 6.14$	0.80	No Heteroskedasticity

Stability Test

Test	H_0	Test Statistic	p-Value	Conclusion
Ramsey RESET	No Misspecification	LR = 1.88	0.39	No Misspecification

The diagnostic tests for the ECM show that the ECM satisfies all the requirements or assumptions of OLS estimation procedure.

Figure A1: Cusum stability test
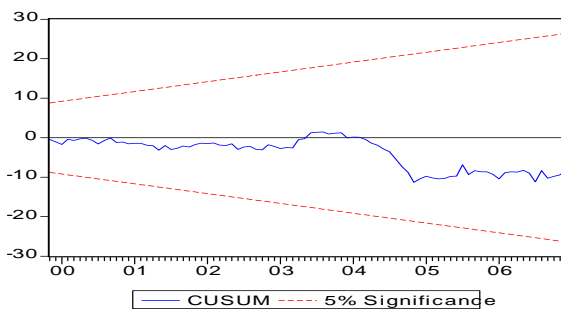
Cusum stability test indicates the absence of structural break in the ECM model.