On the tracks of Zimbabwe's Hyperinflation: A Quantitative Investigation

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25 January 2013

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Abstract

This paper primarily investigates and examines the relationship between money supply growth and inflation in Zimbabwe. The theoretical analysis is based on a modified form of the "Quantity Theory of Money" (QTM) - a theory developed in the classical equilibrium framework- illustrating the relationship between the money supply, velocity of money, the interest rate and the price level in the Zimbabwean economy using monthly data from 1995:1 to 2006:12.

Understanding the causes and especially the effects of inflation can provide us with policy tools to attain price stability and economic growth. The analysis rests on an error correction version of the Autoregressive Distributed Lag (ARDL) model that determines the short and the long-run trend in Zimbabwe's inflation. The results show clearly that the main determinants of inflation in Zimbabwe are parallel market premium movements and especially the change in money supply growth. The lagged change in the 3-month-deposit rate, however, seems to have a positive effect on inflation in Zimbabwean. This anomaly could be explained by the manipulation of the Treasury bill market by the Zimbabwe government.

Moreover, a Granger causality test indicates the direction of causality from money supply and parallel premium to inflation.

Keywords: Hyperinflation, Zimbabwe, inflation, parallel premium, Quantity Theory of Money, Quasi-Fiscal-Activities

JEL classification:

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1. Introduction

Zimbabwe gained independence in 1980 with single and double denominated banknotes in circulation. Three decades later bills in the thousands, millions and eventually in the trillions were in circulation with no sane tradesman willing to accept local banknotes. The deterioration of Zimbabwe's economy and subsequent hyperinflation can be traced back along many separate paths. The seizure of thousands of white-owned commercial farms played a major role in the destruction of the country's production base. Furthermore, the essentially discretionary expenditures of the government, the increasingly artificial overvaluation of the local currency and the outflow of foreign currency resulted in falling tax revenues. The erosion of national savings removed the government's access to loanable funds and consequently led to a substantial increase in domestic debt.

In response, the Reserve Bank of Zimbabwe (RBZ) was forced to cut the rates of return on Treasury Bills to figures well below the rising rate of inflation and to engage in so-called "Quasi-fiscal-activities (QFAs)". Thus, the RBZ, (working under the direct authority of President Mugabe) became every ministry's main (if not only) source of funding.

Moreover, Mr. Mugabe's falsely believed explanation for inflation encouraged the imposition of price controls and the ban on foreign currencies that had not only been ineffective but caused empty supermarket shelves and a further depreciation of the local currency.

Those policies had a profound effect on the economy with a disastrous fall in real GDP, chronic shortages of basic commodities and hard currencies, thereby inducing upwardly rising prices[2]. Consequently, the vicious circle of ever-rising prices pushed Zimbabwe's inhabitants into poverty and often forced them to emigrate to neighboring countries.

One of the manifestations of Zimbabwe's hyperinflation was that the value of the Zim dollar had fallen to such an extent that the RBZ could not print enough notes to keep up with demand. Investment was almost nonexistent as it generally requires a long-term vision. During a hyperinflationary period that "long term" is tomorrow.

As a result, the Zimbabwean dollar as a local legal tender lost 99.9 % of its face value (Hanke 2008) at the peak of the hyperinflationary period.

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[2] Such monetary phenomenon where too many local banknotes are chasing a diminishing supply of goods is called „cost-push-inflation“

Given that even the officials, civil servants and the military were refusing to accept the local currency for payment of their salaries, the Zimdollar was officially abandoned in favor of the US dollar and the South African Rand in 2009 (BBC, 2009).

The momentum behind the acceleration of the inflation rate in Zimbabwe, however, could not be countered by price controls or adverse economic policy, mainly because of a more fundamentally deeply-rooted source of hyperinflation; the massive and recurring QFAs carried out by the RZB to monetize the government's budget deficit.

Thus this study will principally be involved in the analysis of the money supply in determining Zimbabwe's inflation rate. This study is carried out within the framework of the Quantity Theory of Money (QTM) with the imposition of restrictive assumptions. The Quantity Theory of Money itself is augmented by the velocity equation, which involves the nominal interest rate and the parallel exchange rate premium. No such approach in the context of hyperinflation has been undertaken so far.

The study begins with a literature review in which the empirical and theoretical findings regarding hyperinflation are discussed in detail. Section 3 follows with the Granger causality test. Section 4 provides the theoretical model of inflation. This is followed, in Section 5, by the procedure used to model inflation in Zimbabwe, beginning with the definition of the data, followed by the model specification. Section 6 provides detailed analysis of the regression results. Section 7 ends the paper with some concluding remarks.

2. Literature Review

The cornerstone of empirical as well as theoretical examinations of hyperinflation is the model of Cagan (1956). Accordingly to his demand for money model, the demand for real balances only depends upon expected future inflation. Moreover, under a hyperinflationary environment the link between money and prices can be analyzed decoupled from the real economy. He argued that in periods of moderate inflation, desired real cash balances will advance in the same course as current real income and real wealth and in the reverse direction to changes in the return on assets other than money. Nevertheless, in the event of hyperinflation any effects apart from movements in the price level are mostly inconsiderable. Cagan studies six inter-war and post-war countries experiences of hyperinflation. The fundamental conjecture in the model of Cagan is that alterations in the current and past level of money (M), induce the hyperinflation of prices (P). During hyperinflationary periods, the large changes noted in the real money balance (ln $\frac{M}{P}$) correspond to substantial shifts in the expected rate of price change. A dynamic progression then takes its course: the movement of prices over time is defined by the current quantity of money and a weighted average of past rates of change of this quantity. The demand for money function of Cagan is:

$$lnM_t - lnP_t = -\alpha E_t[lnP_{t+1} - lnP_t] \qquad (1)$$

A money demand model has been advanced that focuses on the incorporation of rational expectations, as opposed to adaptive expectations (Sargent & Wallace (1973), Sargent (1977) and Salemi & Sargent (1979)). Salemi & Sargent (1979) demonstrated the shortfalls in the findings of Cagan under rational expectations (the confidence bands on the coefficients of interest were much wider), by utilizing the data of Cagan to estimate the rational expectation version of Cagan's model.

Nevertheless, the acknowledgment of the hypothesis of rational expectation is not always straight forward in the case of hyperinflation. Phylaktis & Taylor (1993) tested for rational expectations in Chile, Peru, Brazil, Argentina and Bolivia during the 1970s and 1980s and Christev (2005) for Ukraine and Bulgaria explicitly. On the basis of their evidence, it appeared that the Cagan model could not be linked with the rational expectations hypothesis under hyperinflation.[3].

On the other hand, it has theoretically been demonstrated that Cagan's model can be derived in an inter-temporal utility maximizing framework under rational expectations and is therefore consistent with rational behavior (Kingston,1982; Gray, 1984). It has further been shown that self-fulfilling expectations (rational bubbles) may give rise to hyperinflation as a sheer speculative phenomenon. However, the restrictions on the behaviour of such bubbles appeared to be very tight (Obstfeld and Rogoff, 1983; Diba and Grossman, 1988).

Empirically, numerous efforts have been exerted to estimate the model of Cagan and to test for bubbles. Flood & Garber (1980) made the first attempt to test for the existence of rational bubbles. They analyzed German hyperinflation (1920-23) by using Cagan's hyperinflation model and included a deterministic bubble as a bubble component within the general solution. This was substantiated by observations that in hyperinflationary times prices tend to be highly explosive and self-fulfilling. Thus, a deterministic bubble attempts precisely to capture this pattern of explosiveness. Their study found no deterministic bubble in the data during the German hyperinflation. A potential explanation is the controversial assumption made about money being exogenously determined. Further tests for rational bubbles were conducted by Goodfriend (1982), Flood, Garber and Scott (1984), Christiano (1987), and Casella (1989).

The latest approach in the study of hyperinflation is the implementation of cointegration methods in estimating the Cagan model, such as by Taylor (1991), Phylaktis and Taylor (1992, 1993), Petrovic and Vujocevic (1995), Frenkel and Taylor (1993), Engsted (1993, 1994, 1996), Michael and Nobay, and Peel (1994).

Prior analysis on the estimation of money demand in Zimbabwe that is worth a mention includes that of Munoz (2006) and Kovanen (2004). Both estimate superconsistent ordinary least squares (OLS) regression parameters in an Engle-Granger framework for money demand over the period of the country's independence. Kovanen estimates a money demand function for the period 1980-1995. Munoz finds significant parameter estimates over a shorter time period in the early 2000s.

[3] Given the rapid rise in prices level, the time information was not used rationally by agents, indicated by the prediction error from the co-integration analysis .

Furthermore, the paper by Asilis, Honohan & McNelis (1993) is applicable to a wider sample of hyperinflationary periods. They utilize time-varying and error-correction parameter estimation and also take particular account of inflation variance as a proxy for inflation uncertainty. They do this by a"General Autoregressive Conditional Heteroskedastic (GARCH)" model for inflation. This is an important aspect of expectation formation and hence the determination of the real money balance during hyperinflation.

3. Granger Causality Test

Generally, in view of the consequential fact that money engenders inflation, it could also rationally be claimed that the reverse also holds. Due to the fact, - that rising prices might quickly increase demand for nominal money, it makes it reasonable to assume that causation runs from inflation to money supply. Thus, it can be said that hyperinflation has self-perpetuating characteristics.

Equivalently, the dispute encompassing the link between the parallel market and the inflation rate is widely classified into the structuralist and neoclassical approach. This categorization is on the basis of conflicting perceptions regarding economic growth of developing countries. The neoclassical doctrine posits that inflation influences the parallel market - and thus the premium for foreign exchange - in two ways. Firstly, it induces an increasingly overvalued fixed nominal exchange rate. Secondly, inflation reduces real domestic interest rates and thus causes capital flight. In this respect both effects of inflation lead to a shortage of foreign currency and correspondingly to arise in the parallel premium for foreign exchange.

On the other side, the structuralist school of thought argues to the contrary. According to structuralism, the rise in the parallel market premium increases domestic prices due to the price pass-through from expensive imports (Degefa, 2001).

Consequently, the question of whether the parallel market premium and the money supply causes inflation or contrariwise in Zimbabwe is assayed empirically by using a paired Granger causality test. The Granger causality test investigates how much of the current value of money supply and premium is a potentially utilizable component in predicting the inflation rate.

Tables 1 and 2 report the Granger causality test results between money supply/premium and inflation. In each case, the null hypothesis is that money supply /premium does not 'Granger cause' inflation and vice versa. The results indicate a statistical discernible direction of causality from money supply to inflation from 4 lags onwards. On the other hand, there is no reverse causation thus implying that money supply is an important factor in predicting future inflation.

Furthermore, the results of the Granger causality test between the premium and inflation signifies a unilateral direction of causality that runs from premium to inflation up to 3 lags. This result seems to support the structuralist school of thought - premium as a driver of inflation.

However, it should be noted that the outcome of the Granger test in both scenarios is sensitive to the number of lags introduced in the model.

4. Theoretical Model

The theoretical advocate for this empirical exploration provides the well-known classical Quantity Theory of Money theory, described by the exchange identity:

$$MV \equiv PY \qquad (2)$$

The classical equation of exchange, originally developed by Irving Fisher in 1911, equates the velocity of money V, times the money supply M, with the real gross domestic product Y multiplied by the price level P. The controversial assumption in the classical view of the "Quantity Theory of Money" is that it treats the velocity and real output as stable in the short- and long-run[4].

The classical approach believes that the rate at which money circulates is determined by institutional factors. Moreover, the economy is steadily regarded as at or close to the natural real GDP and is therefore determined by the production function and the labour market. Thus, money growth is believed to have no effect on real GDP growth. Given both variables are fixed in the short and long term, the central implication of the classical QTM is that a given change in the growth rate of money elicits an equal change in the

[4] During hyperinflationary periods prices accelerate at such a high rate that the increase in money supply fails to stimulate output, even in the short-run. Therefore, output (Y) can be seen as negligible

rate of inflation (Brian, 2005). That prompted the monetarist Milton Friedman[5] to claim „inflation is always and everywhere a monetary phenomenon" at least in the long-run (Friedman, 1970).

This paper however, will reject the classical assumption of constant velocity of money and define it as a behavioural outcome determined as a function of the interest rate and the parallel rate premium. In fact, the approach of making the velocity a function of the interest rate, is supported by the Keynesian school of thought. In 1936, Keynes developed a theory of money demand ("Liquidity Preference Theory") that describes the motives for the holding of money. Among others, Keynes's "speculative motive" states that high interest rates make bonds more attractive than money and vice versa. Therefore, the interest rate affects the demand for money negatively (Keynes, 1936). Tobin (1956) and Baumol (1953) developed the Keynesian approach further and argued that a high interest rate increases the opportunity cost of holding cash for transactions. Therefore, the transactions part of money demand will also be adversely related to interest rates. This means, according to Keynes's Liquidity Preference Theory, velocity is far from constant in the short-run and varies with the interest rate in the same direction[6].

Equivalently, the increase in the parallel market premium was mostly associated with high inflation in Zimbabwe. Generally, inflation increases the opportunity cost of holding money and therefore reduces money demand. As a result, a change in the parallel market premium affects the velocity of money and thus including the parallel market premium as a determinate of the velocity of money might be justifiable.

Therefore, the augmented QTM can be written as:

$$MV = P \tag{3}$$

The relationship between interest rate, the parallel market premium and the velocity of money can be approximated by an exponential relationship of the form:

$$V_t = e^{\beta_1 r + \beta_2 pr} \tag{4}$$

Where, pr = parallel market premium and r = interest rate

[5] Monetarists believe (in contrast to the classical doctrine) that the economy might not always operate at the full employment in the short-run, but while still acknowledging the classical view of the long-run

[6] Keynes does not however repudiate the validity of constant velocity of money in the long-run, he just believed that in the long-run we are all dead.

Within the QTM framework, the premium is conventionally regarded as exogenously determined (such as by capital control or foreign reserves). Quantity theorists often treat the quantity of money and the interest rate as exogenous, principally on the ground that they are eventually affected by the monetary authorities. This assumption is controversial in Zimbabwe, as the money supply and the interest rate were used to serve the budget deficit. However, as there is no direct linkage between the inflation rate and the budget deficit, the results of the regression coefficients in an Ordinary Least Squares (OLS) can be considered as valid.

Additionally, one might allege that the growth rate of the money supply and the index of central bank independence are tightly linked. However, in this paper, a distinct dissociation is made between the growth rate of the money supply as an operational variable of the central bank, and the index of central bank independence as a legal framework of the central bank. Expressed in this way, these two variables are qualitatively distinguishable; the former is time-dependent while the latter is constant.

The Granger causality test conducted previously further supports the assumption of the premium and the money supply being exogenous. Therefore, treating the quantity of money, the interest rate and the premium as exogenously determined may have some validity.

Consequently, by taking the log both sides from the equation (3) yields the linear form:

$$LogP = LogM + LogV \qquad (5)$$

By differentiation of equation (5) yields the equation for inflation:

$$\frac{1}{p}\frac{dp}{dt} = \frac{1}{m}\frac{dm}{dt} + \frac{1}{v}\frac{dv}{dt}$$

or:

$$\pi = gm + gv \qquad (6)$$

By substituting (4) into (6) yields:

$$\pi = gm + \Delta\beta_1 i + \Delta\beta_2 pr \qquad (7)$$

π= Inflation Rate gm = Growth Rate in Money Supply, Δi= The Change in the Interest Rate, Δpr= The Change in the parallel market premium

5. Econometric Methodology

5.1 Data Sources and Issues

The data set used in this paper consists of monthly time series data for Zimbabwe from January 1995 to December 2006 and was derived from a number of sources. Data on inflation rates and the money supply were collected from the website of the RBZ. The 3-month deposit interest rate[7] was extracted from the IMF's website. The parallel exchange rate from 1995 to 2000 was drawn from the website of Carmen M.Reinhart, who is the Minos A. Zombanakis Professor of the International Financial System at Harvard Kennedy School. The remaining data for the parallel exchange rate was provided by John Robertson, an economist in Harare.

However, both the quality and quantity of the official Zimbabwean inflation data was in short supply, particularly data from the period of hyperinflation (2007-08) owing to data collection issues and the introduction of adequate price updating techniques by the Central Statistical Office of Zimbabwe (CSO) and the RBZ. The last procurable inflation figures were for July 2008 which were not released until October, generally surrounded with too many data gaps (RBZ, monthly review 2008).

Furthermore, many staple goods that used to measure inflation largely disappeared from shop shelves due to the price control policies implemented by the Zimbabwean government in a bid to stem galloping inflation in 2007 (BBC, 2007c). As a result, measuring a representative basket of goods was negatively affected with increasing delays in publishing the CSO's monthly consumer price index.

[7] Although the 3-month treasury and the deposit rates are closed linked, we consider the latter as it performs better in econometric tests

Moreover, the inclusion of controlled goods and the exclusion of commodities traded on the black market also adversely affected the quality of the recorded CPI (BBC, 2007d). Consequently, there are deviations between the recorded and the actual CPI from 2007 onwards.

5.2 Empirical Design

The methodology adopted in this paper is based on the ARDL co-integration approach for investigating the long and short-run relationships between inflation and its determinants (Pesaran and Shin, 1996 and Pesaran et al, 2001). The advantages of using ARDL compared to other co-integration procedures are (a) it can be introduced to time series data, regardless of whether the variables are integrated of order 0 or 1, (b) it can include sufficient numbers of lags to capture the data-generating process in a general-to-specific modeling methodology, and (c) a dynamic error correction model (ECM) can be derived through a linear transformation that integrates the short-run dynamics with the long-run relationship. The ECM pertaining to the variables in equation (10) is expressed as follows:

$$\Delta\pi_t = a_0 + \sum_{j=1}^{n} a_j \Delta\pi_{t-j} + \sum_{j=1}^{n} \beta_j \Delta gm_{t-j} + \sum_{j=1}^{n} \gamma_j \Delta i_{t-j} + \sum_{j=1}^{n} \rho_j \Delta pr_{t-j} + \delta_1 \pi_{t-1} + \delta_2 m_{t-1} + \delta_3 i_{t-1} + \delta_4 pr_{t-1} + \epsilon_t \qquad (8)$$

Where α, β, γ, ρ express the short-run dynamics, the δ's express the long-run coefficients. The random disturbance term is considered as serially independent random errors with mean a zero and finite covariance matrix. Furthermore, the Akaike Information Criterion (AIC) is employed to determine the appropriate lag length as only the optimum lag length will be able to identify the true dynamics of the model. The null of no cointegration defined by H0 : δ1 = δ2 = δ3 = δ4 = 0 is tested against the alternative of H1 : δ1 ≠ 0, δ2 ≠ 0, δ3 ≠ 0, δ4 ≠ 0 by the familiar F-test.

6. General Model Specification and Diagnostic Test

The econometric methodology of general-to-specific modeling is used to derive the final model of the short-run dynamic inflation equation. The general-to-specific determination starts with the unrestricted, congruent general model and standard testing procedures are used to extract statistically insignificant variables.

The imposed restrictions on the general specification leads to a simpler, more compact equation, shown in Table 3 that can statistically not be rejected and displays the best fit.

Various diagnostic tests are conducted to analyze the properties of the final model: we test for serial autocorrelation (AR) using the Breusch-Godfrey- Lagrange multiplier test (BG), - The ARCH, the scaled explained SS test and the White test are used to detect heteroskedasticity. Non-normal errors are tested using the Jarque-Bera test, and misspecification is tested using the RESET test.

As shown in Table 4, all of the above diagnostic tests satisfy the assumptions of OLS, with the exception of the normality assumption, whose fulfillment is, however, ensured by the Central Limit Theorem.

The robustness and stability of the model is proven using graphical diagnostics. Figures 1a, 1b, 2 depict the CUSUMQ, CUSUM and the recursive residuals, respectively. The CUSUM signifies parameter stability as it remains within the 5 % level of significance, whereas the recursive residuals and CUSUMQ, seem to exhibit some evidence of parameter instability, most notably in the period 1998 and 2004. However, Chow tests in table 5 for three different time periods and the recursive coefficient estimation in Figure 3 reveals no structural breaks.

Although, we can conclude that our model can be seen as empirically stable, some ambiguity remains regarding its stability.

7. Regression Results and Interpretation

The empirical estimation of the dynamic model is reported in Table 3. A notable outcome is that the lagged inflation, the lagged change in the inflation and the growth in money supply appear to be insignificant. As a result, we cannot interpret the results in terms of short- and long-run effects in the usual ARDL framework. However, the outcome of a nonexistent long-run dynamic adjustment relationship of inflation and the exogenous variables of interest should not be too surprising given the usual explosive nature of hyperinflationary data as the main source of the empirical problems[8].

Furthermore, the fact of rapidly ever increasing prices is not sustainable in the long-run. Consequently, hyperinflationary episodes are almost by definition short-lived and using the concept of 'long-run' relations might give the wrong impression[9].

A further issue is the degree of inflation inertia (inflation's own dynamics), measured by the coefficient on lagged inflation that turned out to be insignificant in our regression.

The inflationary inertia which is existent at moderate rates of inflation is accountable for the Phillips curve-related output costs of alleviating inflation. By contrast, it is contended that numerous high inflation levels have been reduced at no cost by a credible change in policy (Sargent, 1982). A potential interpretation of low inflation inertia during high inflationary periods is that, the depreciation (or rapid depreciation during hyperinflation) of money and the instability involving relative price movements that induces a high uncertainty, shortens the length of contracts or more contracts and prices are denominated in foreign currency.

In the extreme case, such as in Zimbabwe, almost all prices are listed in foreign currencies which, by construction, should fully extinguish inflation inertia.

Therefore, the exchange rate can be considered as an effective tool in haltering inflation and thereby making it less costly to stabilize, compared to moderate inflationary periods.

The exogenous variables will consequently be considered now as having a general impact on inflation in the short-run.

[8] Replacing the conventional measure of inflation by the cost of holding money can serve as a solution to these issues

[9] Zimbabwe's hyperinflation had a duration of less than two years

Table 3. indicates further that a change in the growth of the money supply, has a positive significant effect on inflation, at the 1% significance level. A one unit change in the percentage of the growth rate of the money supply will change the inflation rate by 0.016. The total effect of a unit change in the percentage of the growth rate of the money supply is 0.053.

The OLS estimation results confirm that the hyperinflation in Zimbabwe is explained by extremely rapid change in the growth of the supply of ”paper” money. Our findings are also consistent with the results of Muoz (2006) and Makochekanwa (2007) who found, using a money demand model, that the major driver of inflation was excess liquidity.

The parallel premium is also highly significant at only 5 %, with the expected sign in its lagged term. Thus, a unit increase in the percentage of the parallel market premium would lead to a change in the inflation rate by 0.009. Generally, a longer significant lag length could have been anticipated, since the macroeconomic effects of exchange rate movements are subject to delays in the price transmission. However, in a hyperinflationary environment with rapidly devaluing currency, the pass-through effect from imports onto domestic prices are expected to be faster, especially given that, for the most part, the parallel rate was used as a proxy for the inflation rate due to data collection issues.

The coefficient of the lagged change in the 3-month-deposit rate indicates that it has a positive effect on the inflation rate, which appears to be significant at the 5% level. This result seems rather odd. Generally, high interest rates deter borrowing and foster saving and will tend to slow the economy and thus have a disinflationary effect. One possible explanation for this anomaly is that the manipulation of the Treasury bill market by the Zimbabwean government, that turned real interest rates negative and thus discouraged saving.

Furthermore, the lack of a well-developed money market in the country means that the interest rate does not necessarily mirror the conditions in money market. In fact, studies (Darat, 1985; Dlamini et al., 2001) found that, in many developing countries, interest rates have no significant effect on inflation and thus tend to be inoperative in the analysis of money demand.

Taken as a whole, the statistical fit of the dynamic model of hyperinflation in Zimbabwe seems to be relatively acceptable, as insinuated by the adjusted R^2 (above 50%) and the relatively high F-statistic.

As a result, our model provides a valid support for the Quantity Theory of Money, showing that inflation has largely been a monetary phenomenon in Zimbabwe and the only effective way to stem inflation is to constrain the growth in the money supply.

8. Conclusion

The hyperinflation in Zimbabwe had a severe adverse economic impact on wealth, deposits and savings with basic commodities becoming out of reach to many Zimbabwean inhabitants, especially to those on fixed incomes. As a result, countermeasures such as price controls and a ban on foreign currencies had been implemented in an attempt to control the galloping inflation and the devaluation of the local currency. These measures, however, had not only been unsuitable but also markedly deteriorated Zimbabwe's economic base. A thriving black/parallel market emerged where currencies and goods were traded at premium prices.

Consequently, a tremendous decline in government revenues owing to the collapse of taxes tempted the government to print its way out of its self-created mess by forcing the RBZ to engage in QFAs to monetize the fiscal budget deficit. However, the increase in the money supply had not been backed by growth in real GDP and thus placed the Zimbabwe dollar on a self-destructive course. At the culmination of Zimbabwe's hyperinflationary period, the RBZ felt impelled to issue increasingly higher denominated banknotes which in turn reinforced the acceleration of inflation to a point where the face value of the Zim dollar diminished faster than the RBZ could keep up with printing. This is perhaps one of the paradoxes that you cannot get rich by printing money.

Ultimately, the loss of confidence in the local currency resulted in the abandonment of the Zim dollar in favour of the US dollar and the SA Rand.

The purpose of this study has therefore been to shed light on what the main determinates of inflation were in Zimbabwe, by using appropriate econometric techniques. Although we failed to express the outcomes in terms of the short- and the long-run in the usual

ARDL approach, our results nevertheless reveal that there is a positive effect of changes in the growth rate of the money supply on inflation, that is statistically significant and of an economically interesting magnitude.

Moreover, the lagged parallel market premium appears to affect inflation in a positive manner and is significant at a conventional significance level in our specifications. In other words, an increase in the parallel market premium increases the inflation rate through expensive imported inputs and the pass- through effect is rapid. Those two patterns are reinforced by the results of the Granger causality test, which shows that the money supply and the parallel market premium Granger cause inflation.

In contrast, the 3-month deposit rate appears to be statistically significant but with the wrong sign. This unexpected result could be due primarily to the manipulation of the Treasury bill market by the Zimbabwean government. Consequently, we could argue that the 3-month deposit rate does not exhibit any relationship with inflation, although the tests show to the contrary.

The empirical results presented in this paper, provide strong evidence to support the Quantity Theory of Money, in that the growth rate in the money supply is found to be a key driver of inflation in Zimbabwe. As a result, controlling money growth will be the first step to the success of any disinflation efforts in Zimbabwe.

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Appendix

Table 1. Granger Causality Test Between Inflation and Money Supply

Direction of causality	*Number of lags*	*F-value*	*P-value*	*Decision*
M ⟶ Inf	2	1.35	0.26	Do not Reject
Inf ⟶ M	2	1.67	0.19	Do not Reject
M ⟶ Inf	4	3.10	0.01	Reject
Inf ⟶ M	4	1.17	0.32	Do not Reject
M ⟶ Inf	6	2.81	0.01	Reject
Inf ⟶ M	6	1.51	0.17	Do not Reject
M ⟶ Inf	8	1.94	0.05	Reject at 10%
Inf ⟶ M	8	1.38	0.20	Do not Reject

Table 2. Granger Causality Test Between Inflation and the Premium

Direction of causality	*Number of lags*	*F-value*	*P-value*	*Decision*
Pr ⟶ Inf	1	10.89	0.001	Reject
Inf ⟶ Pr	1	2.06	0.1531	Do not Reject
Pr ⟶ Inf	2	5.01	0.007	Reject
Inf ⟶ Pr	2	0.44	0.63	Do not Reject
Pr ⟶ Inf	3	2.73	0.04	Reject
Inf ⟶ Pr	3	0.36	0.78	Do not Reject
Pr ⟶ Inf	4	1.91	0.011	Reject
Inf ⟶ Pr	4	0.84	0.50	Reject
Pr ⟶ Inf	5	1.46	0.20	Reject
Inf ⟶ Pr	5	0.75	0.58	Reject

Table 3.	***Dynamic Single-Equation Linear Model of Inflation***			
		Dependent variable: $\Delta\pi_t$		
Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*P-value*
Δgm_t	0.016	0.004	3.74	0.0003
Δgm_{t-1}	0.012	0.003	2.91	0.0033
Δgm_{t-2}	0.011	0.004	2.67	0.0081
Δgm_{t-3}	0.014	0.004	3.39	0.0009
pr_{t-1}	0.009	0.005	2.00	0.0473
Δr_{t-1}	0.0008	0.0003	2.43	0.0154
Intercept	-0.012	0.019	-0.62	0.5696
R^2	0.64			
Adj. R^2	0.61			
SER	0.107			
F-Statistic	2185.887			

Table 4.	***Diagnostic Test Results of the Final Model***			
Test	*H_0*	*Test Statistic*	*P-value*	*Conclusion*
Jarque-Bera	Normally Distributed	11.60	0.003	Non-Normally Distributed
Breutsch-Godfrey-LM	No Serial Correlation	0.82	0.66	No Serial Correlation
ARCH	No Heteroskedasticity	0.60	0.75	No Heteroskedasticity
White Explained SS	No Heteroskedasticity	4.45 6.46	0.61 0.37	No Heteroskedasticity
RESET-Test	No Misspecification	1.89	0.07	No Misspecification

Table 5. Chow Breakpoint Test; 1996M11

F-Statistic	*0.80*	*Probability*	*0.80*
Log-Likelihood ratio	*6.16*	*Probability*	*0.52*

Table 5. Chow Breakpoint Test; 1998M07

F-Statistic	*0.81*	*Probability*	*0.80*
Log-Likelihood ratio	*6.17*	*Probability*	*0.82*

Table 5. Chow Breakpoint Test; 2004M11

F-Statistic	*1.03*	*Probability*	*0.25*
Log-Likelihood ratio	*6.68*	*Probability*	*0.35*

Figure 1a

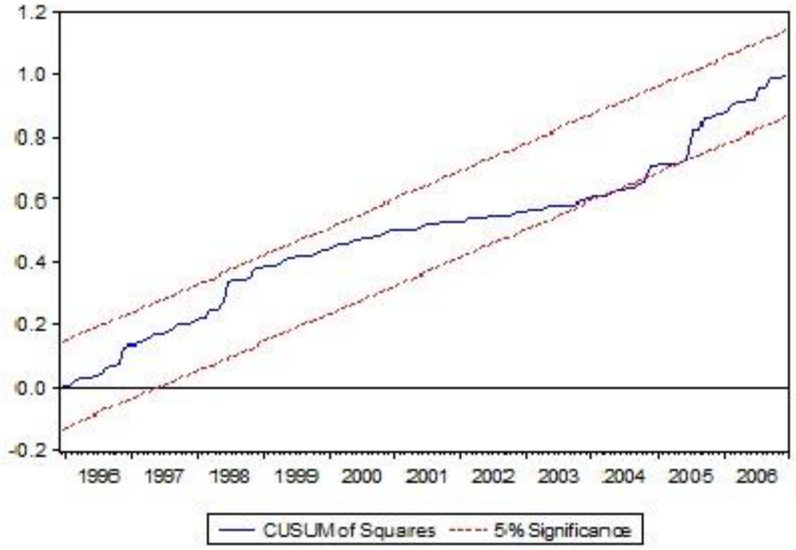

Figure 1b

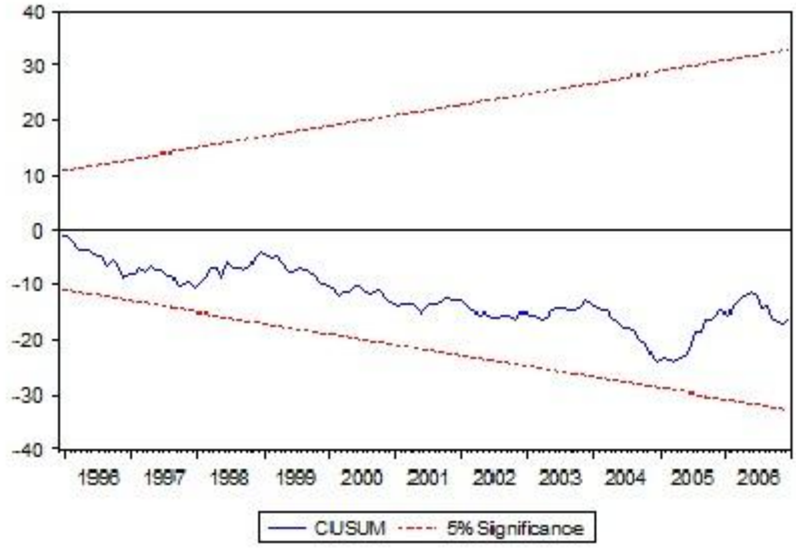

Figure 2

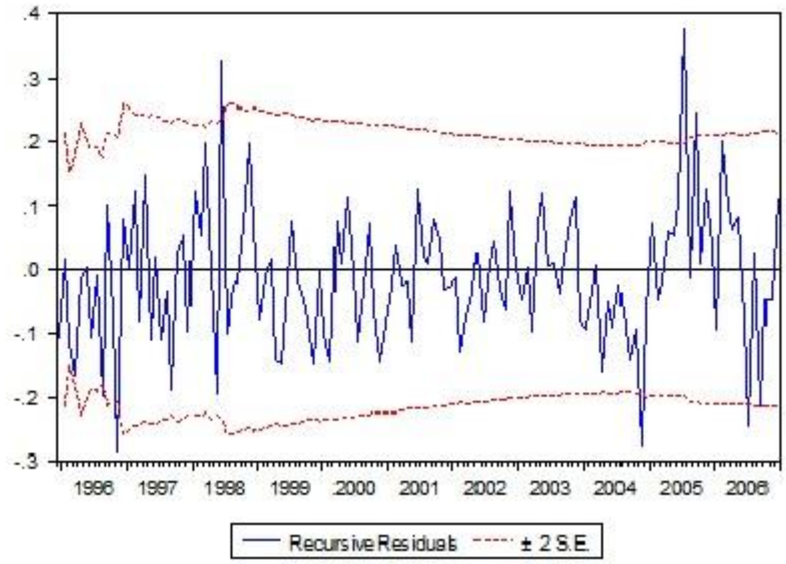

Figure 3