

The role of monetary policy in Zimbabwe's hyperinflation episode

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Abstract

This paper explores the role of monetary policy in Zimbabwe's hyperinflation episode, using the Autoregressive Distributed Lag (ARDL) and Error Correction Model (ECM) approaches with monthly data from 2006:01 to 2008:07. Results from both the ECM and ARDL approaches show that during the study period, hyperinflation was caused by expansionary monetary policy, the exchange rate premium and inflation expectations for both the short and long-term. Zimbabwe's hyperinflation episode brings to the fore the importance of ensuring that the Central Bank is independent in executing its mandate of influencing the monetary policy process in a manner that ensures price stability.

Keywords: Monetary Policy; Hyperinflation; Autoregressive Distributed Lag; Error Correction Model.

Disclaimer: The views expressed in this paper are those of the authors and do not in any way represent the views of the Reserve Bank of Zimbabwe or Nelson Mandela Metropolitan University.

1. Introduction

Zimbabwe experienced relatively low inflation levels between 1980 and 1990, partly explained by a system of administrative controls on the product, foreign exchange and labour markets (Chhibber *et al.* 1989). Inflation averaged 13 per cent between 1980 and 1990, before rising to around 20 per cent during the first phase (1991-1995) of the International Monetary Fund (IMF) supported Economic and Structural Adjustment Programme (ESAP). A combination of factors could have explained the rise in inflation during the first phase of ESAP and these were, among others, the removal of price controls; and monetisation of fiscal deficits (RBZ, 1996; Saunders, 1996; Economist Intelligence Unit, 1999).

An economic crisis set in Zimbabwe in 1997, triggered by both internal and external disequilibria (IMF, 2001; Ndelela, 2011). The economy, which had registered real gross domestic product growth of 9.6 per cent in 1996, slowed down to 1.4 per cent in 1997 and declined to an estimated -14.8 per cent in 2008. Major factors that affected economic performance included rising production costs, cash-flow difficulties, foreign exchange shortages, weakening demand due to declining real incomes, and shortages of raw materials and spare parts for machinery and equipment (RBZ 2009).

Coorey *et al.* (2007) posit that the Zimbabwean economy contracted as a result of high inflation levels and price distortions caused by extensive controls on product and foreign exchange markets, among others. In addition, the lack of external financing, coupled with the loss in investor confidence caused by policy inconsistencies also contributed to the contraction in output (Coorey *et al.*, 2007). These views were corroborated by Besada and Moyo (2008); IMF (2009) and World Bank (2009).

The sustained decline in the Zimbabwean economy, coupled with high inflation, led to the engagement in quasi-fiscal activities, by the Reserve Bank of Zimbabwe (RBZ). The quasi-fiscal activities of the RBZ included the provision of subsidised credit to productive sectors of the economy, unrealised foreign exchange losses and liquidity support to troubled banks, among others (Munoz, 2007; Munangagwa, 2009). The country's central bank engaged in quasi-fiscal activities in the belief that this would increase output and dampen inflationary pressures (RBZ, 2008). The level of money creation by the central bank was, however, unrelated to economic activity and it intensified during the period 2005 to 2008, resulting in excessive monetary expansion and a surge in inflation (Mandishara and Mupamhadzi, 2016).

Zimbabwe's inflation spiral effectively got out of control in late 2007 to early 2008 (IMF, 2009), reflecting significant recourse to the monetisation of fiscal deficits and the impact of the quasi-fiscal activities of the central bank. The RBZ also printed money to buy foreign exchange on the parallel market, eventually becoming a very active stakeholder in that market (MacGarry, 2007). Year-on-year inflation rose to unprecedented levels, peaking at 231.2 million per cent in July 2008 (ZIMSTAT, 2008) and 500 billion per cent in December 2008 (IMF, 2009). Concomitantly, annual money supply growth also increased, peaking at 431 quintillion per cent by end December 2008 (RBZ, 2008).

There have been insightful analyses on hyperinflation in Zimbabwe, for example, Coorey *et al.* (2007) and Hanke (2008), but these studies are largely qualitative and do not empirically determine the role of monetary policy in Zimbabwe's hyperinflation episode. The study by McIndoe (2009), while quantitative, also does not specifically analyse the role of monetary policy in Zimbabwe's hyperinflation episode. This, therefore, presents a gap which this study attempts to bridge.

The analyses in this paper use the Autoregressive Distributed Lag (ARDL) bounds testing estimation approach introduced by Pesaran *et al.* (2001) and applied in studies such as Pahlavani and Rahimi (2009); Irefin and Yaaba (2011); Khatun and Ahamad (2012); and Shittu, Yemitan and Yaya (2012). Monthly data from 2006:1 to 2008:07 make up the sample period of study. The relationship between the consumer price index and key variables is examined to determine the role of monetary policy in the hyperinflation episode for both the short and long run. Key independent variables include broad money supply, parallel market exchange rate premium, interest rate, output gap and lagged consumer price index.

The study finds that expansionary monetary policy, the exchange rate premium and inflation expectations caused hyperinflation in Zimbabwe during the study period. These findings are in line with other findings on causes of inflation in some African countries. In a study where they assessed whether Zambia is ready for inflation targeting, Simatele, Schaling and Alagidede (2015) found that inflation in Zambia was attributed to the monetisation of fiscal deficits, excessive money supply growth as well as exchange rate and supply side shocks. Akinbobola (2012) empirically analysed the impact of fluctuations in money supply and exchange rates on inflation in Nigeria and found that the expansion of money supply caused inflation in the short run.

The subsequent sections are presented as follows: Section 2 gives a historical perspective on Zimbabwe's road to hyperinflation; Section 3 discusses the conduct of monetary policy in Zimbabwe (1980-2012), while Section 4 covers the literature review and Section 5 the data, model and methodology. The analysis of the results is given in Section 6 and the summary and policy recommendations of the study in Section 7.

2. The road to Zimbabwe's hyperinflation episode: A historical perspective

Most hyperinflations experienced around the world were preceded by a combination of high public expenditures, low tax revenues, large debt service payments on a large stock of debt and the inability of government to continue borrowing from external sources (Sachs 1986; Cardoso 1989; Dem *et al.* 2001; Reinhart *et al.* 2003; Bittencourt 2010). Likewise, these conditions preceded Zimbabwe's hyperinflation episode. The initial shock emanated from a fall in tax revenue, following the decline in world commodity prices of gold and tobacco, the country's main export commodities, coupled with an increase in the import price of oil (RBZ, 2000).

Zimbabwe's hyperinflation episode began when the month-on-month inflation peaked at 50.5 per cent in March 2007, conforming to the Cagan (1956:25) arbitrary definition which characterises "hyperinflation as beginning in the month the rise in prices exceeds 50 per cent and as ending in the month before the monthly rise in price drops below that amount and stays there for at least a year". The onset of the hyperinflation episode followed an economic crisis which began during the last quarter of 1997. A combination of entrenched economic structural rigidities, which were not successfully addressed during the ESAP and other successive economic reform programmes, as well as inherent inconsistencies in macro-economic policies, particularly in fiscal issues, in large part, triggered the economic crisis (IMF, 1999). The economic crisis was exacerbated by external sector imbalances. Consequently, gross domestic product declined by about 30 per cent during the period 1999-2007 (Munoz, 2007; Moss and Patrick, 2007), and by more than 50 per cent between 1999 and 2008 (RBZ, 2009; IMF, 2009).

Acute balance of payments pressures began to be experienced in Zimbabwe during the last quarter of 1997, as export earnings declined (IMF, 1999). The external imbalance was worsened by the suspension of balance of payments support by the IMF (RBZ, 2006). The IMF suspended support to Zimbabwe in 1998, following the country's involvement in the Democratic Republic of Congo

conflict which undermined economic performance and investor confidence (IMF 2001; Kairiza 2012). In addition, the Government of Zimbabwe (GOZ) gave in to the demands for pay-outs by the veterans of the country's war of liberation and decided to meet the pay-outs through raising income taxes in the 1998 fiscal year. The plan of financing the pay-outs through an increase in income taxes was abandoned after the main labour union, the Zimbabwe Congress of Trade Unions, vehemently resisted it. This resulted in the unbudgeted expenditure being financed by the central bank, through printing, to the tune of Z\$2 billion or about US\$180 million (Kairiza, 2012). These large and unbudgeted pay-outs to veterans of the war of liberation subjected the local currency to speculative attacks (IMF, 1999; Kairiza, 2012).

The Zimbabwe dollar (Z\$) came under severe pressure in late 1997, following the huge injection of liquidity into the economy, coupled with uncertainties pertaining to the implementation of the land reform programme (IMF 2001; Kovanen 2004; Kairiza 2012). Consequently, the Z\$ depreciated to Z\$18.6 per US\$ by December 1997, from Z\$12.5 at the end of October 1997 and Z\$10.8 at the beginning of 1997 (IMF, 1999). The country's foreign currency reserves fell from 3 months of import cover in 1996 to 0.8 months by the end of 1997, as the central bank tried to prop up the depreciating local currency (Coomer and Gstraunthaler, 2011).

Zimbabwe's economic crisis was also partly explained by the way the country implemented its land reform programme (IMF, 2001; Sachikonye, 2002; Raftopoulos and Phimister, 2003). The land reform programme was meant to address the historical imbalance in land ownership, where the minority white commercial farmers owned large tracts of productive land, while the indigenous black majority were largely peasant farmers who owned small and unproductive pieces of land (GOZ, 1983; 1986 and 1998; Moyo and Skalness, 1990; Human Rights Watch, 2002; Chitiyo, 2000; UNDP, 2002; Richardson, 2005; Embassy of Zimbabwe, 2009). In view of this, the GOZ and international donors convened a Land Donor Conference on land reform in Zimbabwe in September 1998. The outcome of the conference was the commitment by the GOZ to implement the land reform programme in an orderly manner, with international donor assistance (IMF, 2001). The donors and the GOZ agreed that land reform would be guided by some basic principles which included poverty alleviation, adherence to the rule of law, involvement of beneficiaries and consultation with concerned stakeholders (IMF, 2001).

In a move against what had been agreed at the September 1998 Land Donor Conference, the GOZ implemented a “Fast Track” land reform programme in 2000, in a manner often characterised by violence against white commercial farmers and their workers (Sachikonye, 2002; Dansereau, Zamponi and Melber, 2005; Besada and Moyo, 2008; Munangagwa, 2011). This followed the April 2000 commercial farm invasions led by veterans of the war of liberation (Raftopoulos and Phimister, 2003; Saunders, 2011).

The Fast Track land reform programme was also launched as a reaction to the defeat of the government in the February 2000 Referendum on a proposed new constitution (IMF, 2001; Dansereau, Zamponi and Melber, 2005; Besada and Moyo, 2008). The GOZ viewed the defeat as having been caused by the support given to the main opposition party, the Movement for Democratic Change, by the white commercial farmers backed by Western governments, with the aim of reversing the gains of the war of liberation (Raftopoulos and Phimister, 2003).

The disruption of production on the commercial farms adversely affected agricultural output, with multiplier effects on other sectors of the economy, including manufacturing, mining and tourism (Zimbabwe Democracy Institute, 2015). According to Richardson (2005), Zimbabwe’s land reform programme led to a 12.5 per cent annual fall in gross domestic product, on average, during the period 2000 to 2003. The IMF (2009); Montier (2013) and the World Bank (2016) estimate that agricultural output fell by more than 50 per cent between 2000 and 2008, following the implementation of the land reform programme.

As a result of the low agriculture output, the manufacturing sector, which is mainly composed of agro-processing, took a huge knock. The shortages of food and other necessities due to the decreased output from farming and manufacturing ratcheted up the inflation level, as the economy was forced to rely on imports to feed the country (Umer, 2010). The collapse of the agriculture system impacted negatively on foreign currency generation, precipitating an external debt overhang (Umer, 2010). In addition, the often violent manner in which the land reform programme was implemented also resulted in the suspension of aid by Western donor nations and organisations (IMF, 2001; Besada and Moyo, 2008), deepening the economic crisis.

The economic crisis was also characterised by high levels of money supply growth. An accelerated growth in monetary aggregates occurred during the first half of 1999, due to the monetisation of fiscal deficits. The RBZ responded by tightening monetary policy through the doubling of statutory reserve requirements for commercial banks to 30 per cent, to be met on a daily basis,

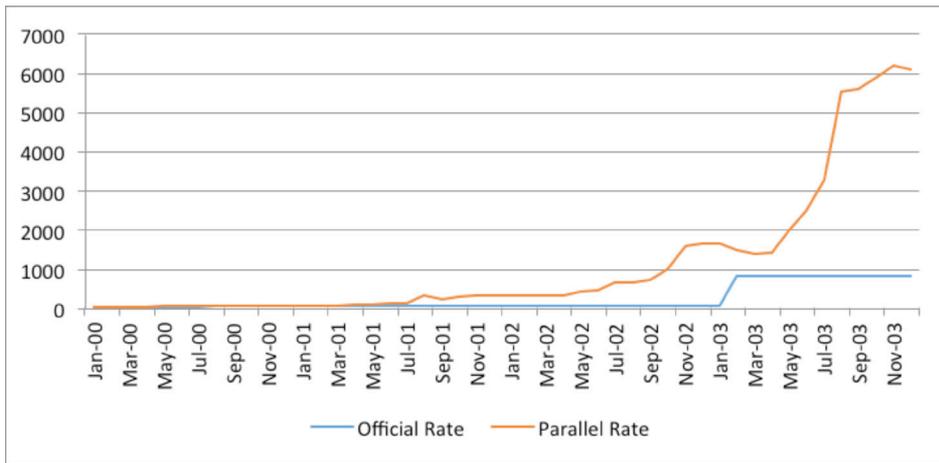
as opposed to weekly averaging (RBZ, 1999). In addition, the margin between the rate at which commercial banks borrowed from the RBZ and the effective Treasury bill rate was increased by 5 percentage points to prevent arbitrage opportunities (RBZ, 1999; IMF, 2001). The tightening of monetary policy resulted in a slowdown in broad money growth from 54 per cent in July 1999 to 30 per cent by end of 1999 (RBZ, 2000).

Monetary policy was, however, substantially eased during the year 2000, resulting in the growth in broad money from 30 per cent by end 1999 to 59.9 per cent by end 2000 (RBZ, 2001; IMF, 2001). The monetisation of fiscal deficits by the GOZ also continued in 2000, against the background of the lack of access to foreign lines of credit by government, severely constraining the conduct of monetary policy (IMF, 2001). The relaxation of monetary policy included the capping of the Bank rate at 2.5 percentage points above the year-on-year inflation and capping of Treasury bill yields at 1 per cent below the Bank rate. In addition, the RBZ directed commercial and merchant banks to on-lend half of their statutory reserve requirements to exporters at 30 per cent. This was against a Bank rate and annual inflation of 56 per cent and 54 per cent, respectively (IMF, 2001). Productive sectors of the economy also accessed loans from statutory reserves at 30 per cent through the Productive Sector Facility (RBZ, 2000; IMF, 2001).

As the economic crisis deepened, the Z\$ was devalued by 24 per cent in August 2000 to trade at Z\$50 per US\$1. The RBZ promised to make periodic adjustments to the exchange rate, in line with inflation differentials between Zimbabwe and her major trading partners. However, the pace of adjustments was not in line with inflation differentials, resulting in the sharp depreciation of the Z\$ on the parallel market (IMF, 2001). While the exchange rate was adjusted to Z\$55 per US\$1 in August 2000, on the official foreign exchange market, the parallel exchange rate was about Z\$300 per US\$1. The high parallel market premium put pressure on prices since the majority of firms in the productive sectors of the economy sourced foreign currency from the parallel market, to import raw materials.

Figure 1 shows a widening gap between the parallel and official exchange rate as the official rate was fixed at Z\$55 per US\$1, from August 2000 to January 2003, before being adjusted to Z\$824 per US\$1, from February 2003 to December 2003. The parallel market rate, however, continued on an upward trend, increasing from Z\$69 per US\$1 in August 2000 to Z\$6 100 per US\$1 by end December 2003.

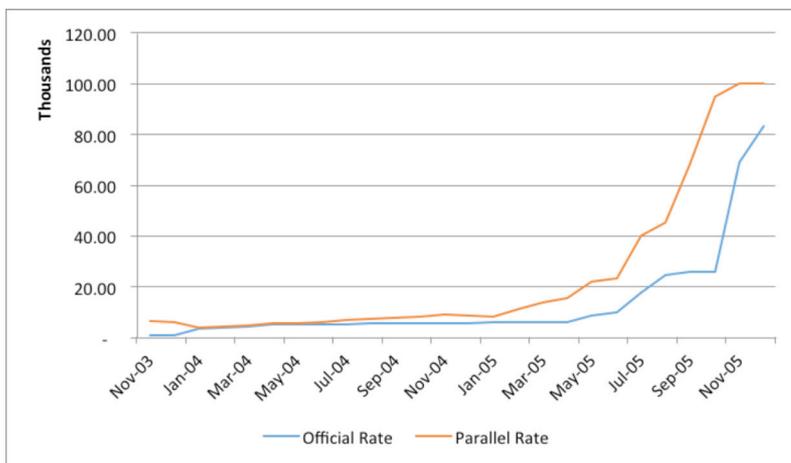
FIGURE 1: Z\$/US\$ EXCHANGE RATE DEVELOPMENTS (JAN 2000 - DEC 2003)



Source: Reserve Bank of Zimbabwe, 2004

The Z\$ depreciated by more than 300 per cent in January 2004, following the introduction of the foreign exchange auction system, a transitional measure towards the introduction of a market determined exchange rate system. As shown in Figure 2, the gap between the parallel and official exchange rate widened during the period November 2004 and December 2005, as the official exchange rate was, to some extent, managed by the central bank.

FIGURE 2: Z\$/US\$ EXCHANGE RATE DEVELOPMENTS (JAN 2004 - DEC 2005)



Source: Reserve Bank of Zimbabwe, 2006

The economy experienced expansionary monetary policy in 2001, following the unilateral restructuring of domestic debt by government (IMF, 2001). The GOZ made the unilateral decision to involuntarily redeem 91- day Treasury

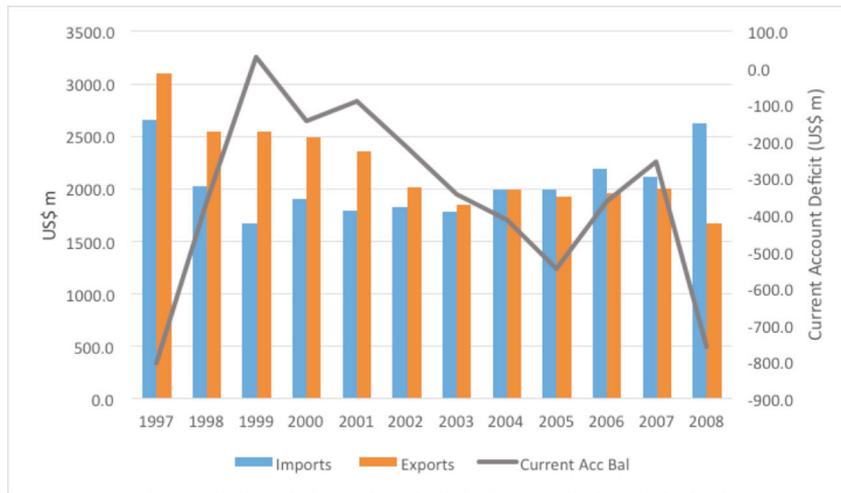
Bills held by the banking system and individuals, resulting in a steep increase in liquidity. This, coupled with the heavy monetisation of fiscal deficits, led to the collapse of interest rates from 65 per cent at end of 2000 to 14 per cent in January 2001 (IMF, 2001). Consequently, inflation accelerated from 55.2 per cent by end December 2000 to 112.1 per cent by end December 2001. Reserve money expanded by 150 per cent as at end September 2001, a seven fold increase compared to the same period in 2000 (IMF, 2001). The GOZ attempted to contain inflation by introducing direct price controls in 2001, resulting in the shortage of basic commodities.

The economic crises deepened, with economic conditions continuing to deteriorate during 2002 and 2003. There was also political turmoil following the disputed March 2002 presidential elections, viewed by the international community as not free and fair. A confluence of factors that included expansionary fiscal and monetary policies, imposition of administrative controls and the maintenance of a fixed exchange exacerbated the economic crisis (IMF, 2003). In addition, highly negative real interest rates fuelled credit expansion and inflation. Broad money grew by 165 per cent in 2002, up from 20 per cent in 2001, as a result of loose monetary policy (IMF, 2003).

Liquidity expansion also emanated from quasi-fiscal operations of the RBZ, which provided a subsidy to tobacco and gold producers in the form of preferential exchange rates. The foreign exchange subsidies provided by the RBZ amounted to 5 per cent of GDP in 2002 (IMF, 2003). Real interest rates remained highly negative, despite attempts by the RBZ to raise them between February and March 2003. Private sector credit also expanded, following the maintenance of a dual interest policy where credit to productive sectors was availed at highly negative real rates (IMF, 2003). Parallel market exchange rates depreciated sharply, against the background of deteriorating macroeconomic conditions.

The country's external sector position remained precarious during the period 1997 to 2008, against the background of declining export performance, increased imports and declining capital inflows (RBZ, 2012). As a result, the country was unable to settle its external debt obligations, resulting in the accumulation of external payment arrears which stood at US\$3 071.4 million by the end of 2008 (RBZ, 2010). The current account remained under tremendous pressure, with the country recording a deficit of US\$818.9 million in 1997 and US\$778.6 million in 2008 (RBZ, 2010). Figure 3 shows export and import values and the current account balance for the period 1997 to 2008. The unfavourable external position had an adverse impact on the external value of the local currency which continued to fall.

FIGURE 3: CURRENT ACCOUNT BALANCE (1997 - 2008)



Source: Reserve Bank of Zimbabwe, 2009

A new governor took over at the RBZ in December 2003, announcing a raft of monetary policy tightening measures. Access to RBZ liquidity support was tightened and reserve requirements increased from 20 to 30 per cent for commercial and merchant banks and 5 to 15 per cent for finance houses, effective January 2004 (RBZ, 2003). The new measures resulted in an increase in interbank rates and a collapse of the stock market. Inflation declined from 598.7 per cent in December 2003 to 132.8 per cent in December 2004. The tight monetary stance was, however, not sustained as the RBZ simultaneously injected liquidity into the financial system through the Productive Sector Finance (PSF) facility at a concessional rate of 30 per cent. A Troubled Bank Fund (TBF) was also introduced with effective interest rates of 800 to 1 150 per cent (IMF, 2004), as some banks began to experience significant stress situations, following the tight monetary policy stance. The TBF came second to exchange losses as a major contributor to reserve money growth in 2004 (Munoz, 2007).

Quasi-fiscal operations of the central bank, which were extended to include the Parastatal Reorientation Program (PARP); Local Authorities Reorientation Program (LARP); Productive Sector Facility (PSF); Agricultural Sector Productivity Enhancement Facility (ASPEF); and Tobacco, Gold and Cotton Support programs intensified in 2005. Funding for the PSF, which was introduced in 2003, was from statutory reserves at interest rates of 30 per cent, compared to market rates of 600 per cent (IMF, 2004). The inception of ASPEF took place in June 2005 and was available at an interest rate of 20 per cent, before the

rate was reviewed upwards to 50 per cent in April 2006. ASPEF and PSF were effectively financed through printing as the statutory reserves from which the lending was supposed to be sourced fell short of the financing requirements of the programs (Munoz, 2007). The RBZ incurred quasi-fiscal losses estimated at 75 per cent of GDP, compared to the not more than 10 per cent in most countries (Munoz, 2007).

The huge outlays of quasi-fiscal activities of the RBZ overtook conventional government deficits as a source of soaring inflation, jeopardising the control of monetary expansion (Munoz, 2007). Credit creation by the central bank led to rapid expansion in both reserve and broad money. Reserve money expanded from 147.4 per cent in January 2005 to 454.1 per cent in December 2005, while broad money grew from 176 per cent in January 2005 to 520 per cent in December 2005 (RBZ, 2006). Inflation also rose from 133.6 per cent in January 2005 to 585 per cent in December 2005 (ZIMSTAT, 2006).

The response of the GOZ to rising inflation included price and wage freezes, the most famous of which was the decree instituted in June 2007, forcing businesses to slash prices by 50 per cent. This resulted in acute shortages of basic goods in formal shops which became only available in the informal market at higher prices, elevating inflation. In his famous speech, "How Not to Stop Inflation", Milton Friedman (1966) posited that quick fixes such as wage and price freezes, without solving the fundamental problem of excessive money printing only lead to higher inflation. Price control in Zimbabwe led to even higher levels of inflation.

Monetary expansion continued through 2006, 2007 and 2008, as the Central Bank printed money to finance all sectors of the economy. Annual money supply growth expanded from 1 416 per cent in December 2006 to 64 113 per cent in December 2007, before peaking at 431 quintillion per cent in December 2008 (RBZ, 2009). Concomitantly, inflation also rose from 1 281.1 per cent in December 2006 to 66 212.3 per cent in December 2007 and 231 million per cent by end July 2008 (ZIMSTAT, 2008). According to IMF (2009) estimates, inflation peaked at 500 billion per cent in December 2008.

Hyperinflation eroded the value of the Z\$, creating serious transactional challenges which forced the RBZ to rebase it. The currency was rebased three times through the removal of three, ten and twelve zeros in August 2006, August 2008 and January 2009, respectively. Zimbabwe made history by issuing a

one hundred trillion dollars note in early 2009, the largest denomination ever issued, as hyperinflation rendered the Z\$ worthless (Federal Reserve Bank of Dallas, 2011). The one hundred trillion dollar note was, however, rejected by the transacting public as the informal use of foreign currencies intensified.

The latter half of 2008 saw the unofficial replacement of the Z\$ by foreign currencies in transactions amid the hyperinflation episode (Ndlela, 2008; IMF, 2009; Federal Reserve Bank of Dallas, 2011; Coomer and Gastraunthaler, 2011; Kairiza, 2012). The GOZ realised that it had lost the battle of forcing economic agents to transact in a currency that could not fulfil any of the functions of money and adopted the multi-currency system in February 2009. The adoption of the multi-currency system brought both the quasi-fiscal operations of the central bank and the hyperinflation episode to an abrupt end.

3. The conduct of monetary policy in Zimbabwe (1980-2012)

The evolution of Zimbabwe's monetary policy framework in the post-independence period from 1980 to 2012 can be categorised into five distinct phases, namely; the control regime of the 1980s, when monetary policy was passive; the shift in monetary policy strategy from controls towards monetary targeting of the early 1990s, where the operational target was net domestic assets; the shift towards reserve money targeting in the mid-1990s (Muzulu and Mkwebu, 1986; Mabika, 2001; Tarinda, 2002); the central bank quasi-fiscal activities of 2004 to 2008; and formalisation of dollarisation in February 2009 (Chigumira and Makochekanwa, 2014). Notwithstanding the shifts to various monetary policy stances, the RBZ did not have operational independence because it was required by statute (Reserve Bank of Zimbabwe Act [Chapter 22:15] to consult with the Ministry of Finance in formulating and implementing monetary policy.

The control regime of the period 1980 to early 1990s was characterised by financial repression which advocated for, among other things, controls on interest rates and foreign exchange allocation (Mabugu and Mumbengegwi, 2002; Ndlela, 2011; Mpfu and Matsika, 2013; Kararach *et al*, 2016). The RBZ used interest rate policy to control credit expansion and in this regard would use the Bank rate, to influence the level of lending rates (Mabika, 2001). Despite being heavily suppressed by controls, money supply and inflation grew steadily, partially reflecting the monetisation of fiscal budget deficits. Average growth in broad money supply and year-on-year inflation were 17 per cent and 12.8 per cent, respectively, during the period 1980 to 1990 (Mabika, 2001).

The First Phase of the ESAP, implemented from 1991 to 1995, saw the removal of direct controls on interest rates, with prominence being given to the use of indirect instruments of monetary policy (RBZ, 1996). The RBZ's monetary policy strategy shifted to one based on targeting intermediate monetary aggregates, such as M1, M2 and M3. M1 consists of notes and coins in circulation and demand deposits, M2 is M1 plus savings and short term deposits, and M3 is M2 plus long term deposits. Open market operations and a flexible interest-rate policy became the principal instruments through which monetary policy was implemented. Variances in day to day money market conditions were indicated by the overnight accommodation rate. The rediscount rate reflected the RBZ's medium term view of inflationary trends (RBZ, 1996).

The RBZ, however, observed that targeting net domestic assets could not contain inflation because of the weak link between net domestic assets and domestic inflation. In this regard, the central bank shifted to reserve-money targeting, drawing from empirical evidence in other countries that indicated a stable relationship between reserve money and broad money supply (M3). This monetary policy stance had also been agreed with the IMF under the 1998/1999 Stand-By Facility. Under the reserve money targeting regime, the central bank fixed the level of reserve money consistent with the targeted level of M3. Notwithstanding the change in the monetary policy stance, inflation continued to increase, reaching nearly 60 per cent by 1999. The use of reserve-money targets was short-lived because government spending exceeded agreed targets, forcing the RBZ to finance the fiscal deficits and abandon reserve-money targeting.

The abandonment of monetary reforms was conspicuous in 2001, when the GOZ manipulated the yield on Treasury bills in an endeavour to contain the rising fiscal deficit. As shown in Figure 4, the 90 day Treasury bill rate and the inflation rate had been moving in tandem before the GOZ made the unilateral decision to redeem the Treasury bills held by the banking system and members of the public in January 2001. This resulted in a steep increase in liquidity which caused the Treasury bill rate to fall drastically. The 90-day Treasury bill rate which stood at around 48 per cent in early January 2001 fell to 10 per cent by the end of April 2001. This was against an annual inflation rate of 70 per cent, thus pushing real interest rates into strongly negative territory.

FIGURE 4: INFLATION AND 91 DAY TREASURY BILL RATE (1997 - 2002)



Source: Reserve Bank of Zimbabwe, 2003

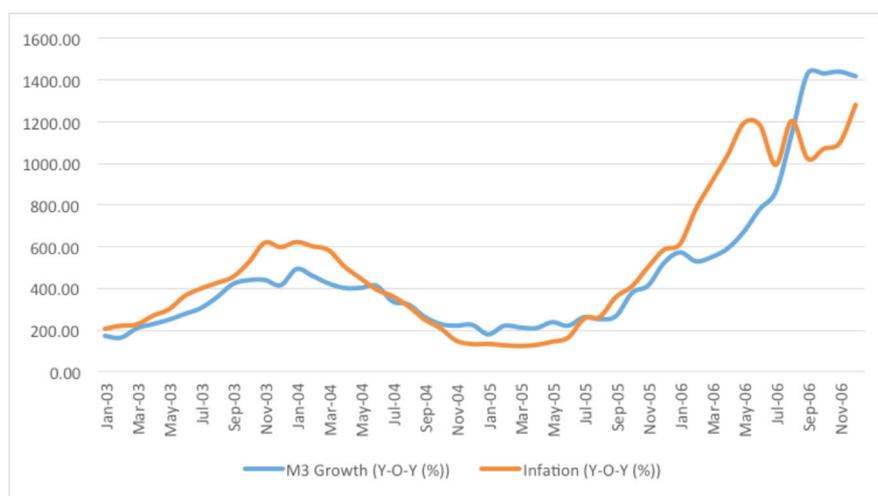
The RBZ continued implementing expansionary monetary policies in 2001, against a background of rising inflation and rapid expansion in money supply. Figures 5 and 6 show that money supply and inflation both on an upward trend, were closely correlated during the period from 1997 to 2006. Money supply grew from 83.5 per cent in September 2001 to 124.3 per cent in September 2002 (RBZ, 2002). Annual inflation was also on upward trend, rising from 86.2 per cent in September 2001 to 144.2 per cent in September 2002 (ZIMSTAT, 2002). The expansion in money supply was also attributed to increased public sector recourse to financing by the banking sector.

FIGURE 5: MONEY SUPPLY GROWTH AND INFLATION (1997 - 2002)



Source: Reserve Bank of Zimbabwe, 2003

FIGURE 6: MONEY SUPPLY GROWTH AND INFLATION (2003 - 2006)



Source: Reserve Bank of Zimbabwe, 2007

Concessionary financing in the form of the Productive Sector Finance Facility and Export Finance Facility which had been introduced in 2001 continued into 2002 (IMF, 2003). The interest rate on the facilities was reduced from 30 per cent to 15 per cent for productive sectors and from 20 per cent to 5 per cent for exporters (IMF, 2002; RBZ, 2002). There was effectively a dual interest rate policy, with low interest rates continuing to apply to export and productive sectors, while interest rates on consumption borrowing would be market determined (IMF, 2002; RBZ, 2002). The Bank rate which had been fixed at 57.2 per cent in 2001 became irrelevant, against a background of high inflation and was thus abandoned as a monetary policy tool (IMF, 2002).

The period 2004 to 2008 saw the abandonment of indirect monetary control as the central bank took a developmental approach. In this regard, the central bank embarked on quasi-fiscal activities aimed at evoking the supply side of the economy through the provision of concessionary financing to productive sectors and direct interventions to public enterprises and local authorities (RBZ, 2004). The rapid expansion in broad money underpinned by the central bank's quasi-fiscal activities rendered the use of ordinary monetary policy tools ineffective.

Zimbabwe's migration to the multi-currency system commenced informally in September 2008 and was formalised in February 2009, after the marginalisation of the local currency had gathered pace, against the backdrop of hyperinflation. The adoption of the multi-currency system resulted in the abandonment of the local currency as a medium of exchange, signalling the end of domestic monetary policy autonomy.

4. Literature review

4.1. Theoretical issues

Monetary policy is a tool which a nation's central bank can use to control money supply in order to achieve and maintain price stability and other goals such as to contribute to economic growth, low levels of unemployment and stable exchange rates with other currencies (Friedman, 1967). In another sense, monetary policy can be viewed as a process through which a central bank manages money and interest rates (Mishkin, 2004; Lipsey and Chrystal, 2007) to influence output or inflation. Monetary policy is often conducted through inflation targeting; interest rate targeting; reserve money targeting; open market operations; and adjustments in the bank rate (rate at which central banks lend money to other banks) or reserve requirements (Mishkin, 2004; Lipsey and Chrystal, 2007).

According to Petursson (2007), monetary policy contributes to sustainable economic growth and social welfare through its promotion of price stability, depending among other things, on clear institutional support from the government. Extensive debate, however, still continues both in the academic and policy fields about monetary policy and the extent to which a central bank can influence the behaviour of real variables using policy instruments at its disposal.

The notion that monetary policy affects inflation dynamics is anchored in Friedman's dictum that inflation is always everywhere a monetary phenomenon, as a result of the quantity of money increasing more than output (Friedman, 1968; 1972). In the long-term, therefore, the main objective of monetary policy should be the attainment of a desirable rate and form of inflation (Friedman, 1972). Monetarism as a school of thought asserts that money supply is important in determining nominal gross domestic product and the level of prices (Brunner and Meltzer, 1964; Laidler, 1977; Haffer, 2001; Meltzer, 2004; Jahan and Papageorgiou, 2014). The Quantity Theory of Money (QTM), whose building block is the equation of exchange, is the theoretical foundation of monetarism. The equation of exchange is expressed as follows: $MV = PT$.

Where: M is the quantity of money
 V is the velocity of circulation of money
 P is the price level
 T is real output

The relationship expressed by the equation of exchange implies that any increase in money supply will impact on the price level given that T and V are taken as constant. In the long run, changes in money supply lead to an increase in prices.

In this regard, the rate of growth in money supply will be equal to rate of increase in inflation. The validity of the equation of exchange is not in dispute to both Keynesians and Monetarists. Keynesians, however, disagree with Monetarists on the assumption that velocity is stable and predictable in the short-term.

The other version of the QTM is the Cambridge Cash-Balance approach, which is attributed to Robertson, Pigou, Marshall and Keynes (Humphrey, 2004; Suman, 2015). This version postulates that the value of money is determined by the supply of and demand for money, in the same manner the price of any commodity represents an equilibrium point, where the supply of and demand for the commodity are equal.

According to the Cambridge Cash-Balance approach, the public prefers to hold a given proportion of nominal income 'k' in the form of cash balances. In this regard, the cash balance approach can be illustrated as follows:

$$M^d = kPY \quad (1)$$

Where:

M^d = money demand

Y = real national income

P = price level

PY = nominal national income

k = proportion of nominal income held as cash balances

In equilibrium:

Money supply equals money demand: $M^s = M^d$

Since $M^d = kPY$ from equation 1 (2)

$M^s = kPY$

From equation 2, if 'k' and 'Y' are held constant, the demand for money for transaction purposes increases as the price level increases. An increase in money supply with 'k' and 'Y' constant implies that people increase their expenditure on goods and services. Concomitantly, firms respond to the increase in expenditure by households by raising the prices of the goods and services they supply.

The 'k' in equation 1 and 2 is related to the velocity of circulation of money (V) in Fisher's Equation of Exchange ($MV=PT$). A higher proportion of nominal income held in the form of cash balances, that is, a higher 'k' implies that 'V' declines. A lower 'k' implies a higher velocity of circulation of money (V).

Therefore:

$$k = 1/V \quad (3)$$

Making 'P' the dependent variable in equation 2, the cash balance approach can be represented as follows:

$$P = 1/k M/Y \quad (4)$$

The Cambridge version of the QTM assumes that 'k' and 'Y' are constant, implying that 'P' is determined by the quantity of money (M). In this regard, a given change in the quantity of money results in a proportionate change in the price level (Hafer, 2001).

The velocity of circulation of money became highly unstable and unpredictable during the 1980's and 1990's, with the relationship between money supply and nominal GDP breaking down. This brought into question the efficacy of the QTM and led to the abandonment of monetarism by many of its disciples. However, while the quantity theory of money may no longer be appealing to many economists, some important aspects of monetarism still remain important in modern non-monetarist analyses today and the control of money supply growth remains a priority for central banks in the fight against inflation (Bordo and Schwartz 2004; Jahan and Papageorgiou, 2014). Bordo and Schwartz (2004) summarised their view on monetarism by positing that money influences output in the short run and prices in the long run and that it remains an important variable in central banks' quest to achieve price stability.

4.2 Empirical literature review

The impact of monetary policy on inflation dynamics in Zimbabwe has been studied in the context of the country's hyperinflation episode, for example, Munoz (2007); Hanke (2008); and McIndoe (2009). The studies by Munoz (2007) and Hanke (2008) were, however, qualitative. The quantitative study by McIndoe (2009) utilised an ARDL money demand model to analyse hyperinflation in Zimbabwe and found that both speculative behaviour and negative shocks from sanctions were not significant in driving hyperinflation, instead, real money balances were found to be co-integrated with changes in the price level. The finding by McIndoe (2009), however, does not imply a causal relationship between real money demand and inflation.

In a qualitative study, Hanke (2008) argued that the source of Zimbabwe's hyperinflation was the printing of money by the RBZ, where government spent and the central bank financed the spending by printing. Hanke (2008) pointed out that from January 2005 to May 2007, the RBZ issued currency at a rate that even exceeded that of Germany's Central Bank from January 1921 to May

1923, the ramp-up phase of the great German hyperinflation. Robinson (2006), corroborated this view by arguing that the RBZ fed hyperinflation in Zimbabwe through financing government expenditure by printing money and engaging in quasi-fiscal activities. The quasi-fiscal losses comprised subsidies, realised exchange losses, and interest costs of open market operations.

Munoz (2007) argued that central bank losses incurred from printing and quasi-fiscal activities endangered the control of monetary targets. This is because losses led to an injection of money with an immediate impact on domestic liquidity and also influenced expectations about future monetary growth. Munoz (2007) noted that the escalation of inflation in Zimbabwe from 2005 to 2007 was fuelled by rapid money growth arising from the central bank's quasi-fiscal activities in financing conventional government budget deficits. The realised quasi-fiscal losses of the central bank were financed through money creation or issuance of central bank securities, pushing the economy into hyperinflation (Munoz, 2007).

There have been similar studies elsewhere in Africa and beyond. Bonga-Bonga and Kabundi (2009) assessed the effectiveness of monetary policy in South Africa using a Structural Vector Error Correction Model (SVECM) to characterise the dynamics of inflation to monetary policy shocks. The results of the impulse response function showed that positive shocks to monetary policy decrease output but do not decrease credit demand and inflation in South Africa.

In a study on the impact of money and exchange rate fluctuations on inflation in Nigeria, Akinbobola (2012) concluded that in the short-term expansion in money supply leads to inflation. In the long-term, however, the impact of money supply growth on inflation became insignificant. The author advocates for the coordination of both monetary policy and fiscal policy to clamp down on excessive monetary expansion.

Neugebauer (2013) estimated a Taylor rule model for Brazil to determine the degree to which economic growth and inflation are driven by monetary policy. The model identifies a strong impact of monetary policy on GDP growth, amounting to 25 per cent of total absolute GDP growth changes. On the other hand, inflation is explained by a high degree of endogenous feedback with a dominant impact of lagged GDP growth vis-à-vis the direct impact of monetary policy.

Zhang (2013) analysed the dynamics of money and inflation in China using multivariate dynamic models in the context of Friedman's Quantity Theory of Money and the monetarist framework of Meltzer. The author concluded that

growth in money supply granger-caused inflation for both the short and long-term. In this regard, Zhang (2013) advocated for the control of monetary growth in order to effectively manage and control inflation in China.

De Grauwe and Polan (2001) studied the relationship between the quantity of money and inflation of a 60 country sample for a 30 year series and found that money supply growth had a strong and positive relationship with the rate of inflation in the long run. This, according to the authors, was explained by the inclusion of countries that had experienced hyperinflation. For countries with average inflation rates of less than 10 per cent per annum, there was a weak relationship between money growth and inflation. The strength of the relationship was, however, also influenced by country specific conditions or factors. These findings are corroborated by Thornton (2006) who, in a cross section and panel data analysis found that in low inflation countries the long run relationship between money supply growth and inflation is weak. For high inflation countries, however, money growth strongly influenced inflation.

Bonato (2007) studied the determinants of inflation in Iran for both the short and long -term for the period 1988/89-2005/06. The results indicated that money played the most prominent role in influencing the long-term general price level, compared to other factors such as real output, exchange rate and rate of return on money. It was also the author's conclusion that in the short run, inflation was largely driven by money, albeit with up to four quarter lags.

The relationship between monetary policy and inflation has also been empirically tested in developed countries. Ferroni and Canova (2010) examined the contribution of monetary policy shocks to the dynamics of inflation using a medium scale structural model estimated with US post-world War II data and Bayesian techniques over rolling samples. The results showed a decline in inflation volatility and attributed a portion of the changes to monetary policy shocks. In addition, the researchers concluded that variations in the level of inflation are qualitatively related to monetary policy shocks.

Vašíček (2009) explored the relationship between monetary policy rules and inflation dynamics in small open economies, using evidence from 12 European Union (EU) members. The study confirms a significant response of the short-term nominal interest rate to domestic inflation mostly for the countries using inflation targeting. The author concluded that the nexus between the estimated monetary policy rules and the sources of the inflation process pointed to the viability of the monetary policy setting for price stability.

The foregoing empirical literature review motivates the development of a standard, simple small open economy inflation model for Zimbabwe, given that the country is a price taker on the international market, with constraints pertaining to the availability of data. This study is thus a quantitative analysis of the role of monetary policy in Zimbabwe's hyperinflation episode, which bridges the gaps in the qualitative analyses of the studies reviewed in this section.

5. The data, model and methodology

The methodology of this study entails estimating an inflation equation for Zimbabwe during the hyperinflation period, based on the empirical and theoretical underpinnings reviewed. Following Goujon (2006); Nguyen and Nguyen, (2010); Akinbobola (2012); Nguyen, Cavoli and Wilson (2012); and Bhattacharya, (2013), a long run inflation model is developed by hypothesising that in a small, open price-taking economy, the average price of tradable and non-tradable goods influences the general price level. This can be illustrated as follows:

$$\text{Log}P_t = \phi(\text{log}P^T) + (1 - \phi)\text{Log}(P^N) \quad 0 < \phi < 1 \quad (5)$$

Where:

P_t is the general price level in the economy

P^N is the general price for non-tradable goods

P^T is the general price for tradables

ϕ is the proportion of tradable goods in the total consumption basket.

The price of tradable goods is determined by foreign prices (P_t^f) of major trading partners and the exchange rate (e) of the local currency vis-a vis that of trading partners. The price of tradable goods is therefore, expressed in local currency terms as follows:

$$\text{Log}P_t^T = \text{Log}e + P_t^f \quad (6)$$

On the other hand, the price of non-tradable goods is determined by demand and supply of money in the economy. In equilibrium, real money supply,

$\frac{M^s}{P}$ equals real money demand, $\frac{M^d}{P}$ as illustrated in equation 7:

$$\frac{M^s}{P} = \frac{M^d}{P} \quad (7)$$

The demand for real money balances (m^d) is assumed to be a function of real output (y) and expected inflation (π^e) and the nominal interest rate (i).

$$\frac{M^d}{P} = m^d = f(y, \pi^e, i) \quad (8)$$

Equation 8 can also be expressed as follows:

$$\frac{M^s}{P} = m^d = f(y, \pi^e, i) \quad (9)$$

Equilibrium in the non-tradable goods sector can be expressed as follows:

$$\text{Log}P_t^N = \beta(\text{log}M^s - \text{log}(M^d)) \quad (10)$$

β is a scaling parameter which shows the relationship between aggregate demand in the economy and the demand for non-tradable goods.

The expected rate of inflation, assuming adaptive expectations, is determined by inflation in the previous period as follows:

$$\pi^e = \Delta \text{log}P_{t-1} \quad (11)$$

A relationship between the general price level, as the dependent variable and independent variables is determined through substitution and rearrangement of equations 5 to 11 as follows:

$$\text{Log}P_t = \beta_0 + \beta_1 \text{log}M_t^s + \beta_2 \text{Log}Y_t + \beta_3 \text{log}P_{t-1} + \beta_4 \text{Log}e_t + \beta_5 \text{log}P_t^f + \beta_6 \text{Log}i_t + \varepsilon_t \quad (12)$$

Where

P_t is the general price level or consumer price index

β_0 is a constant

M_t^s is money supply

Y_t is real output

P_{t-1} is the lagged general price level

e_t is exchange rate

P_t^f is foreign prices

i_t is nominal interest rate

ε_t is the error term

Equation 12 is modified to take into account the fact that in the hyperinflation period the impact of foreign prices could be captured by the exchange rate premium as the country printed money to buy foreign exchange to import commodities. In this regard, an increase in foreign prices would result in an increase in the demand for foreign exchange to import commodities and this would in turn increase the exchange rate premium, as the parallel market was the major source of foreign exchange. Foreign prices are, therefore, replaced by the exchange rate premium ($EXRP_t$) Real output (Y_t) is proxied by the

volume of manufacturing index (VMI_t) as the data on gross domestic product is only available on an annual basis. The nominal interest rate is proxied by the Treasury bill (TB_t) rate which reflected the direction which the central bank wanted interest rates to follow. Equation 12 is now expressed as follows:

$$\text{Log}P_t = \beta_0 + \beta_1 \text{log}M_t^s + \beta_2 \text{Log}VMI_t + \beta_3 \text{log}P_{t-1} + \beta_4 \text{LogEXRP}_t + \beta_5 \text{Log}TB_t + \varepsilon_t \quad (13)$$

The effects of monetary policy on inflation are presumed to be captured by the coefficients of money supply and the Treasury bill rate.

5.1. The unrestricted error correction model

To apply the ARDL approach, the variables in equation 13 are used in an Unrestricted Error Correction Model (UECM), following Pesaran, Shin and Smith (2001) as follows:

$$\begin{aligned} \Delta \ln P_t = & \alpha + \sum_{i=1}^p \beta_{0,i} \Delta \ln P_{t-i} + \sum_{i=0}^p \beta_{1,i} \Delta \ln M3_{t-i} + \sum_{i=0}^p \beta_{2,i} \Delta \ln VMI_{t-1} \\ & + \sum_{i=0}^p \beta_{3,i} \Delta \ln EXRP_{t-i} + \sum_{i=0}^p \beta_{4,i} \Delta \ln TB_{t-i} + \delta_1 \ln P_{t-1} + \delta_2 \ln M3_{t-1} \\ & + \delta_3 \ln VMI_{t-1} + \delta_4 \ln EXRP_{t-1} + \delta_5 \ln TB_{t-i} + \varepsilon_t \end{aligned} \quad (14)$$

The null hypothesis of no co-integration, that $\delta_0 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$, against the hypothesis that $\delta_0 \neq \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$ is tested under this methodology. The Wald F Test is used to test for cointegration. Lower and upper bounds of significance are established by two adjusted critical values provided by Pesaran *et al.* (2001). In this study, the conclusion was that a long-run relationship exists because the computed Wald F-statistic exceeded the upper critical value. The null hypothesis of no co-integration could have not been rejected if the F-statistic had fallen below the lower critical value. The test is inconclusive if the value of the F-statistic lies within the bounds.

6. Empirical results and analysis

6.1. Stationarity test results

As a preliminary analysis, the statistical properties of the data were examined using unit root tests. The results in Table 1 show that all variables in equation 13 became stationary after differencing once, that is, they are integrated of order (1).

TABLE 1: RESULTS OF UNIT ROOT TESTS - AUGMENTED DICKEY FULLER TEST

Variable	Level	First Difference	Order of integration
Consumer Price Index	-1.437215 (0.5607)	5.808827*** (0.0001)	I(1)
Broad Money	-0.375786 (0.9081)	5.362533*** (0.0001)	I(1)
Treasury Bill Rate	1.335240 (0.9987)	-9.958166*** (0.0000)	I(1)
Volume of Manufacturing Index	-1.887729 (0.3369)	-11.72381*** (0.0001)	I(1)
Exchange Rate Premium	2.068260 (0.9999)	-3.6785721*** (0.0059)	I(1)

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%

The Wald coefficient test was applied to test for co-integration. The results reject the hypothesis of no co-integration as shown by a low probability of 0.00 in Table 2.

TABLE 2: WALD COEFFICIENT TEST RESULTS

Test Statistic	Value	Probability
F-statistic	10.58739	0.0000***
Chi-square	42.34955	0.0000***

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%

6.2. Estimated coefficients using the ARDL model

The results tabulated in Table 3 indicate that expansionary monetary policy and inflation expectations determined hyperinflation developments in the Zimbabwean economy for both the short and long run periods. The long run impact of expansionary monetary policy of the RBZ is evidenced by the high coefficient of 0.41 for money supply. As per *a priori* expectations an increase in money supply resulted in an increase in inflation, thus confirming the positive relationship between money supply growth and inflation, which supports many empirical studies (for example, Kuijs, 1998; Durevall and Ndungu, 1999; Sacerdoti and Xiao, 2001; and Blavy, 2004). In the same vein, higher inflation expectations resulted in an increase in the general price level as economic agents believed that inflation would continue to soar. The role of inflation expectations in influencing price formation is shown by the high and positive coefficient of the

lagged consumer price index. In addition, the Treasury bill rate was also found to influence price formation in the long run but had an insignificant impact in the short run. The coefficient of the proxy for output, the volume of manufacturing index, was found to be statistically insignificant for both the short run and long run periods.

TABLE 3: ARDL MODEL RESULTS

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-3.034780	1.677255	-1.809372	0.0854
DLOG(CPI(-1))	0.463095	0.200546	2.309174	0.0317**
DLOG(EXRP)	0.046752	0.041350	1.130656	0.2716
DLOG(M3)	0.326507	0.109493	2.981991	0.0074***
DLOG(VMI)	-0.068824	0.302325	-0.227649	0.8222
DLOG(TB)	0.186391	0.130094	1.432740	0.1674
LOG(CPI(-1))	0.360205	0.144203	2.497898	0.0213**
LOG(EXRP(-1))	-0.045548	0.038572	-1.180872	0.2515
LOG(M3(-1))	0.405782	0.101599	3.993944	0.0007***
LOG(VMI(-1))	0.337575	0.279913	1.205999	0.2419
LOG(TB(-1))	0.252630	0.134528	1.877898	0.0751*

Notes: * significant at 10 per cent, ** significant at 5 per cent, *** significant at 1 per cent

6.3. Error correction model results

Table 4 shows the estimates of short run coefficients obtained from the error correction (ECM) version of the ARDL model. The results indicate that in the short run hyperinflation was explained by inflation expectations, money supply and the exchange rate premium. The coefficients of these variables are statistically significant and also carry the correct signs as per *a priori* expectations. The coefficient of the lagged dependent variable is positive, an indication that the short run dynamics of inflation were positively influenced by the past values of the consumer price index. Similarly, an increase in money supply and the exchange rate premium resulted in an increase in inflation in the short run, as indicated by their positive coefficients.

The short run significance of money supply as a determinant of inflation is consistent with the empirical findings of Bonato (2007); Akinbobola (2012); and Zhang (2013). The results also confirm the qualitative assessments of causes of hyperinflation in Zimbabwe by Munoz (2007) and Hanke (2008). The

coefficient of the volume of manufacturing index, a proxy of output, was found to be statistically insignificant and had the wrong sign, most probably because of the possibilities of inaccuracies of the data. In a hyperinflation environment, inflation feeds on itself, while on the other hand, monetary authorities try to chase inflation by printing more money to finance economic activity as the real value of money continues to decline, thus creating an inflation-money supply spiral. This would possibly relegate the influence of changes in output on inflation.

TABLE 4: ERROR CORRECTION MODEL RESULTS

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-0.084403	0.049422	-1.707793	0.1017
DLOG(CPI(-1))	0.527605	0.154556	3.413670	0.0025***
DLOG(M3)	0.305280	0.097685	3.125142	0.0049***
DLOG(VMI(-1))	0.013221	0.277443	0.047651	0.9624
DLOG(TB)	0.213106	0.119745	1.779669	0.0889*
DLOG(EXRP)	0.092508	0.034379	2.690854	0.0133**
DLOG(M3(-1))	0.301057	0.141070	2.134097	0.0442**
EC2(-1)	-0.347570	0.147309	-2.359468	0.0276
Adjusted R2 = 0.94 F - statistic (67.6) Probability (0.00000) D.W statistic (1.8)				

Notes: * significant at 10 per cent, ** significant at 5 per cent, *** significant at 1 per cent

The coefficient of the ECM measures the speed of adjustment of the relationship back to equilibrium. In this case, the coefficient of the ECM is highly significant and negative and as stated by Banerjee *et al.* (1998), this is also proof that there is a stable relationship between the variables in the model. The estimated error correction coefficient of -0.347570, as shown in Table 4 implies that deviance from the long-term inflation course corrects itself by about 35 per cent in the following year.

6.4. Pairwise Granger causality tests

The nature of causality between changes in hyperinflation and broad money supply is analysed by applying the Granger causality test. Results in Table 5 show bi-directional causality between hyperinflation and broad money supply. This is an indication that excess monetary expansion caused hyper-inflation which in turn led to a higher demand for money as the money balances held by economic agents continued to be eroded by higher inflation. The central bank

was compelled to increase money supply to cope with increased demand for money at higher prices, creating an inflation-money supply spiral.

TABLE 5: PAIRWISE GRANGER CAUSALITY TEST RESULTS

Null Hypothesis	F-statistic	Probability
M3 does not Granger cause CPI	7.75194	0.0025***
CPI does not Granger cause M3	6.68232	0.0049***

Notes: * significant at 10 per cent, ** significant at 5 per cent, *** significant at 1 per cent

6.5. Diagnostic tests

The results from diagnostic tests confirmed that there was no serial correlation among the variables after the residuals were subjected to the Breusch-Godfrey Serial Correlation LM test. Tests for hetero-skedasticity were undertaken using the Breusch-Pagan-Godfrey test and results confirmed that there is no hetero-skedasticity. Model specification is tested by subjecting the residuals to the Ramsey RESET test and the results indicate that the model is well specified.

6.6. Stability of model

Parameter stability is assessed by applying the cumulative sum of the recursive residuals (CUSUM) test, following Pesaran and Pesaran (1997), while the CUSUM of square (CUSUMSQ) test proposed by Brown *et al.* (1975), is applied to the residuals to test for parameter constancy. The CUSUM and CUSUMSQ tests have the advantage that unlike the Chow test that require the specification of the structural break points, they can be utilised without *a priori* knowledge of the exact dates the structural breaks occurred.

The null hypothesis being tested, in both the CUSUM and CUSUMSQ, is that all coefficients are stable. If either of the parallel lines in the plots is crossed, the null hypothesis of parameter stability is rejected at the 5 percent level of significance. In Figure 7 and 8, the plots of the CUSUM and CUSUMSQ statistics are confined within the 5 percent critical value bounds and this indicates the stability of the coefficients. In this regard, the parameters of the model do not have any structural instability.

FIGURE 7: PLOT OF CUMULATIVE SUM OF RECURSIVE RESIDUALS

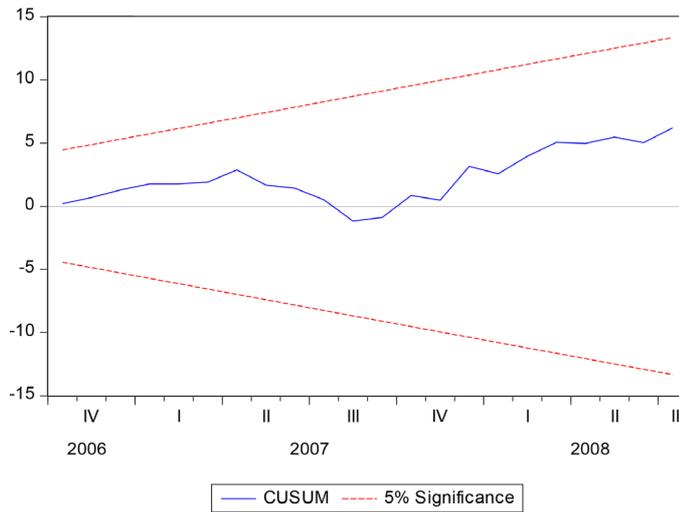
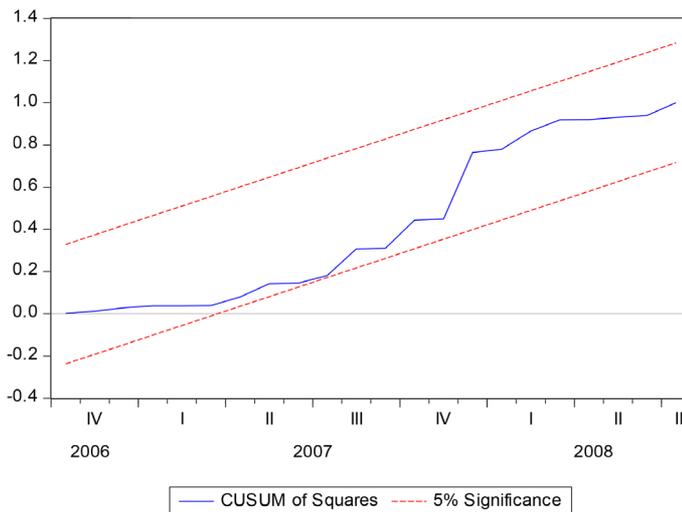


FIGURE 8: PLOT OF CUMULATIVE SUM OF SQUARES OF RECURSIVE RESIDUALS



7. Summary and policy recommendations

The high significance of broad money and lagged consumer price index in explaining the variation of inflation during the study period confirmed that hyperinflation in Zimbabwe was largely caused by expansionary monetary policy and inflation expectations. The unrestrained printing of money by the central bank of Zimbabwe led to an exponential growth in money supply feeding into the inflation spiral. As inflation got out of control, high inflation expectations were induced resulting in inflation feeding on itself. A money supply growth-infla-

tion spiral was created, resulting in even higher levels of inflation. As inflation spiralled out of control the amount of money in circulation became increasingly short of the requirements to finance economic activity, resulting in pressure on the central bank to print more money.

Zimbabwe's hyperinflation episode brings to the fore the importance of ensuring that a country has strong institutional arrangements that play a crucial role in influencing the monetary policy process in a manner that ensures that there is price stability. At the centre of the institutional arrangements is the issue of central bank independence. Central bank independence refers to the freedom of the central bank to formulate and implement monetary policy without undue influence from politicians or central government (Woolley, 1984; Fraser, 1994; Walsh, 2003).

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- This strand of literature is also connected to the "resource curse" literature such as Sachs and Warner (1999, 2001); Gylfason *et al.* (1999) and the Dutch disease (Corden and Neary 1982; Torvik, 2001).