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Monetary Conditions Index and Economic Activity in Dollarized Zimbabwe

Gift Mupunga†[1,2]

[1]Institute of South-South Cooperation and Development, Peking University, Beijing, China. https://orcid.org/0000-0002-3510-3574
[2]Bindura University of Science Education, Economics Department

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ABSTRACT

Purpose:
Zimbabwe has experienced a chronic inflationary crisis whose roots can be traced back to 1997. Various macroeconomic instruments have been suggested to stabilize the country's prices and foster economic growth but evidence on how they interplay to influence policy is lacking. This study developed a monetary conditions index (MCI) for Zimbabwe during the 10-year dollarization period, 2009 to 2018, and measured its correlation with economic activity. The aim of the MCI is to inform monetary policy making in Zimbabwe.

Design/methodology/approach:
Using monthly time series data, the MCI series from 2009 to 2018 was calculated using real interest rates and exchange rates. The relationship between the MCI, GDP, inflation, money supply and private sector credit was analysed using the Auto Regressive Distributed Lag (ARDL) model for the long-term relationship and Granger causality for the short term.

Findings:
Results showed MCI weights of 1:1.54 implying that exchange rates dominate the interest rate in Zimbabwe's monetary policy. A long run relationship between the MCI and economic variables was statistically significant while short term relationships were established for private sector credit, GDP, and foreign interest rates.

Research implications:
The study concludes that the MCI is a useful indicator of the central bank's monetary policy position for economic analysts while the central bank can also adopt it for inflation and growth targeting.

Originality/value:
Unlike previous research which has proffered monetary solutions based on specific variables, this study took into consideration the interplay between interest rates and exchange rates in determining economic activity in Zimbabwe. The constructed MCI captured the interplay between these two key variables and the study established its relationship with economic activity. On this basis, the study recommends the adoption of the MCI in guiding monetary policy in Zimbabwe.

1. Introduction

Zimbabwe has faced a chronic inflationary crisis since year 1997 when its currency crashed(Southall, 2020). Inflation peaked at 231 million% in the year 2008 (Njokwe, 2016) coinciding with negative GDP growth rates (Masiyandima et al., 2018). Although the country's economy stabilized in 2009 after dollarization, it faced a liquidity crunch (Mugari and Olutola, 2021) and deflation (Saungweme and Odhiambo, 2021) from 2012. After reintroducing a local currency in 2016, inflation soon spiralled as the foreign exchange rate deteriorated since the local currency was rushed before meeting the requisite fundamentals such as sufficient US$ reserves to defend the currency (Makena, 2020; Saungweme and Odhiambo, 2021). By mid-2019, inflation had breached triple figures at 230% and the central bank ceased publishing the economic statistic to contain inflationary expectations from economic agents (Maumbe and Chikoko, 2022).

The inflationary problem seems related to monetary policy and exchange rate challenges which can be explained within the Mundel-Flemming model. The model posits that a country can only simultaneously implement at most two of the following: monetary policy independence, free capital mobility and a fixed exchange rate. This has been

†Corresponding Author: Gift Mupunga
Email:givmupunga@gmail.com, gift2016@isscad.pku.edu.cn

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popularised as the financial policy trilemma or the impossibility trinity (Aizenman, 2019). Before 2009, the policy trilemma implied that Zimbabwe focused on monetary policy independence and exchange rate stability as the economy was relatively closed. After experiencing a hyperinflationary environment between 2007 and 2008 (Strike et al., 2021), Zimbabwe dollarised its economy to restore financial stability (Chidakwa and Munhupedzi, 2017). Dollarisation refers to the adoption of another country's currency such as US$, Euro and Renminbi (Lyzun et al., 2019).Monetary policy and exchange rate policies became officially unavailable as policy tools since dollarisation effectively removed the possibility of money printing by the central bank.

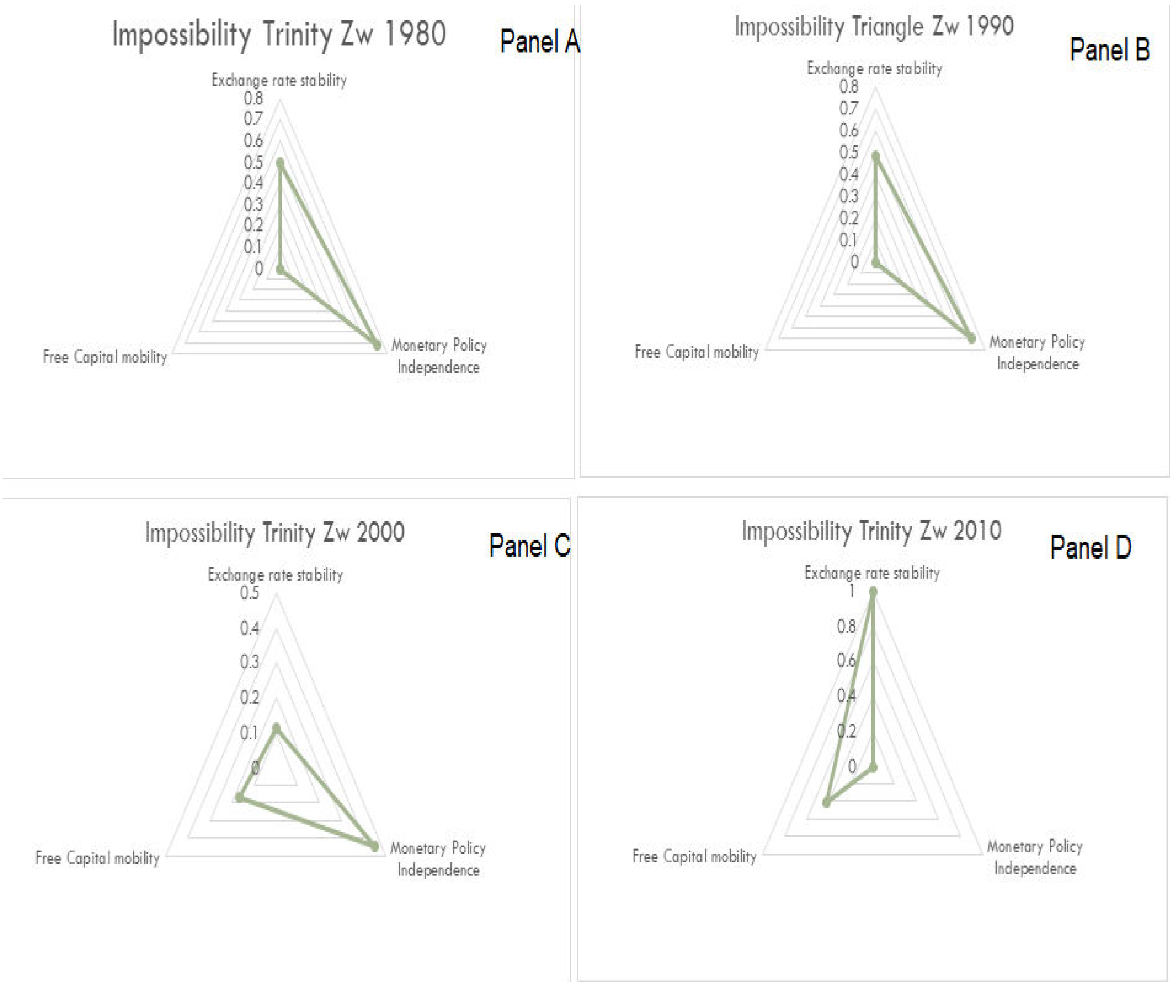

Figure 1: Impossibility Trinity: Zimbabwe characterization
Source: RBZ data (RBZ, 2021)

Figure 1 shows the degree to which the Zimbabwean government had control of monetary policy, exchange rate and capital mobility since 1990. Panel A to C show that the Zimbabwean government had total control over monetary policy for three decades from independence in 1980 until 2009 when the economy dollarized. Panel D refers to the period 2010 to 2016 when Zimbabwe had very little monetary policy control due to dollarisation. Zimbabwe had a fixed exchange rate for two decades as shown in panels A and B, but floated it in 2000 as shown in panel C. When the economy dollarized in 2009, it fixed its currency to the adopted US dollar as shown in panel D.

The country earned most of its US dollars in circulation from raw material exports mostly from mining (Sanderson et al., 2021; Muzurura, 2019; Chirwa and Kader, 2018). Other sources included foreign capital inflows, developmental aid and migrant remittances. The exporting of raw materials generated low export earnings and the accumulation of foreign currency reserves was lower than demand for imports which led to the depletion of the reserves. The depletion was exacerbated by unregulated capital outflows and unchecked money laundering activities that saw a number of foreign and domestic residents shipping money, mostly in form of cash, out of the country. The US dollar appreciated relative to other currencies especially the South African Rand which compromised the competitiveness of Zimbabwean exports (Pasara and Garidzirai, 2020). The South African Rand was a key component of the multi-currency regime especially for smaller denominations and coins that served for change purposes for small transactions. The South African Rand was gradually rejected for local transactions leaving the stronger US$ as the preferred currency amongst the basket of officially accepted currencies as shown in figure 2.

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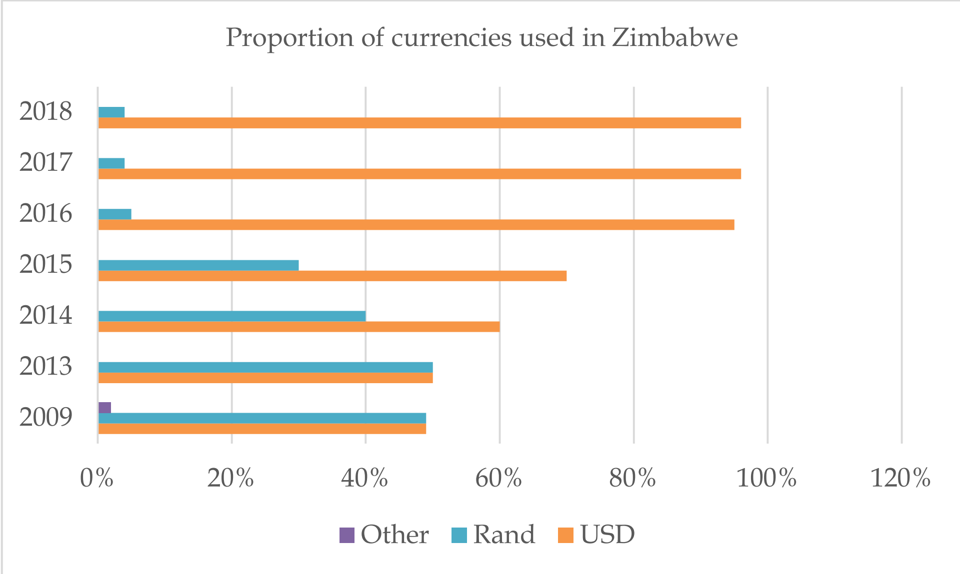

Figure 2: Composition of Foreign Currency Reserves in Zimbabwe 2009 to 2018
Source: (Mandeya, 2017; RBZ, 2021)

To deal with change for large notes, the central bank introduced 1, 5, 10, 25, and 50 cents token coins pegged at par to the US$. The central bank later on added a two-dollar token called bond notes and started to issue their electronic equivalents beginning in September 2016 thereby ushering in a new way of gaining monetary policy independence. By 2018, substantial monetary policy autonomy was gained through electronic money supply growth. As the electronic money balances grew, they began attracting an exchange rate with the US$ on the parallel market which eventually forced Government to abandon the fixed exchange rate that was one to one with the US$. In February 2019, dollarisation officially ended.

Against this background, this study investigates whether a Monetary Conditions Index (MCI) for Zimbabwe can be developed and used as a monetary policy tool in pursuit of economic growth. The MCI is a univariate measure of the effects of interest rates and exchange rates on economic performance (Eika et al., 1996). The correlation between MCI and economic activity helps to inform whether the MCI can be used as a monetary policy tool to influence the level of economic activity in a dollarised economy in which the Central Bank lacks monetary policy control.

Monetary conditions refer to a combination of financial variables that influence monetary policy (Costa, 2000; Osborne-Kinch and Holton, 2010). The rationale of the MCI is that monetary policy pressurizes the economy through interest rate and exchange rate leading to inflation(Lattie, 2000). An increase in the MCI resembles the loosening of monetary conditions and thus inflationary pressure and vice versa is true. MCI considers the impact of the exchange rate on small open economies like Zimbabwe. The combination of interest rate and exchange rate in its calculation ensures that the two variables can be targeted to loosen or tighten monetary policy to stimulate the economy.

2. Literature Review

The MCI is an empirical construct developed by aggregating interest rates and exchange rates into a single index for use in guiding monetary policy. The two components are weighted in comparison to a given initial state to reflect their importance on national output as informed by econometric evidence on the determinants of aggregate demand (Ericsson et al., 1997). The index is grounded in Monetarist and Keynesian schools of thought on the role of interest rate, exchange rate, and government spending in stimulating economic activity. The MCI has been established as a monetary policy anchor useful for tracking inflation and economic growth by central banks of countries such as Canada and New Zealand (Mohseni et al., 2019; Ericsson et al., 1998). An increase in the MCI implies loose monetary conditions and the vice versa is true (Osborne-Kinch and Holton, 2010) for an indirectly quoted exchange rate where the local unit is the base currency.

Previous MCI studies have shown that the interest rate and exchange rate channels need to be jointly evaluated when studying monetary policy and changes to the monetary conditions (Qayyum, 2002). Amador et al. (2020) have shown that policies that do not simultaneously address interest rate and exchange rate channels affect capital flows. Consequently, the central bank would need foreign currency reserves to maintain financial stability which can be unsustainable (Amador et al., 2020; Cavoli et al., 2019). Some variants of the MCI add changes in credit and money supply to the two traditional variables(Kannan et al., 2007). Another variant of the MCI considers asset prices leading to an alternative term called the financial conditions index (Zheng and Yu, 2014).

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The Bank of Canada used the MCI by determining its optimal growth path, using interest and exchange rates predicted by a quarterly projection model. The projection model also estimates output and inflation simultaneously. It also has a monetary response function that determines the optimal inflation path towards the central bank's inflation target. The model thus estimates interest and exchange rate paths consistent with the inflation target. The major factor guiding the Bank of Canada regarding this is that under a flexible exchange rate regime, monetary policy arrangements have their influence through both interest rates and the exchange rate. The current study uses the MCI to capture the degree of tightening or easing of monetary policy and as a monetary policy target.

The MCI has been adopted by other economies such as Sweden and Norway to guide monetary policy (Eika et al., 1996) but yet to be examined for Zimbabwe whose exchange rate has become a key parameter in its output and prices. The index closest to the MCI to have been calculated for Zimbabwe was the Macro-Financial Conditions Index (MFCI) estimated by Machirinani et al. (2020). An MFCIs aggregates several macroeconomic and financial indicators weighted by their regression coefficients (Kapetanios et al., 2018).

Machirinani et al. (2020) found that a declining MFCI indicating improved financial stability is negatively related to GDP growth in Zimbabwe. Other variables found influencing growth include inflation, interest and debt. The inclusion of monetary variables such as interest rate and debt which have short and long run granger causality relationships makes their piecemeal consideration as monetary policy instruments complex. Previous researchers on Zimbabwean monetary policy have proffered monetary interventions based on specific variables ignoring this interaction. For instance, Saungweme and Odhiambo (2021) found public debt as the most important tool in managing inflation and economic performance in Zimbabwe. They thus argue for the government to focus on public debt in order to control inflation and economic growth without considering the interplay between public debt, resultant interest rates and exchange rates.

On the other hand, Madesha et al. (2013) discovered the effect that the exchange rate has on inflation in Zimbabwe and proffered recommendations involving support measures that the government could consider without factoring the interplay with interest rates. Researchers like Makena (2020) managed to establish that the exchange rate influences Zimbabwe's inflation but they have no meaningful solution since it depends on the performance of the US$/Rand exchange rate. Makena (2020) acknowledges that the country needs to attract domestic and foreign capital without emphasizing the importance of the interest rate in attracting the funds or its interplay with the exchange rate as captured by the MCI. The present is conducted cognizant of the interplay between interest rates and the exchange rate as captured by the MCI. Such an insight has been lacking in prior studies attempting to proffer evidence-based solutions to the chronic economic challenges facing Zimbabwe which will be attempted in this paper.

3. Methodology

Monthly data between 2009 and 2018 were collected from government and international organizations as shown in table 1. Data relating to taxation was obtained from ZIMRA. Foreign interest rate data was obtained from international institutions namely the IMF, World Bank, and Trading Economics. Inflation data was obtained from ZIMSTAT. While the rest of the data was obtained from the Zimbabwean central bank (RBZ). Data analysis was performed using E-Views 11.

Table 1: Data Sources

Variable	Calculation	Data Source
Interest rate	As published by central bank	Reserve Bank of Zimbabwe (RBZ)
Real Exchange rate	As published by RBZ using the South African Rand (ZAR), the currency of the largest neighbouring trading partner of Zimbabwe.	RBZ
Inflation	Monthly CPI as published by ZIMSTAT	Zimbabwe National Statistical Agency,ZIMSTAT
GDP	estimated from monthly value added tax	Zimbabwe Revenue Authority (ZIMRA)
Money supply	M3 as published by RBZ	Reserve Bank of Zimbabwe (RBZ)
Foreign interest rate	As published by secondary sources	IMF, World Bank, Trading Economics
Tax	As published by ZIMRA	ZIMRA
Private sector credit	As published by RBZ	RBZ

The MCI for each month (t) was computed using a formulation developed by Kannan et al. (2007) which aggregates the real interest rate (r) weighted by w_r and the real exchange rate (e) weighted by w_e as shown in equation (1):

$$MCI_t = w_r(r_t - r_{2009m03}) + w_e(e_t - e_{2009m03}) \quad (1)$$

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The third month of year 2009 was the base period. The real exchange rate was obtained using equation (2):

$$e_t = E_t.\frac{P_t}{P_t^*} \quad (2)$$

where E_t is the nominal exchange rate, p_t is the overall price level for Zimbabwe; p* refers to the general price level for South Africa[1].

$$w_r + w_e = 1 \qquad (3)$$

Freedman and Luxton (2009) argued that inflationary pressure depends on the output gap and that monetary policy affects output through interest rate and exchange rate. The weights, w_r and w_e were thus obtained from coefficients of the real exchange rate and interest rate in equation (4) which estimates the output gap:

$$GDPGap_t = \propto + \propto_1\ interest\ rate + \propto_2\ real\ exchange\ rate + \propto_3\ Money\ supply + \propto_4\ Domestic\ inflation + + \propto_5\ foreign\ interest\ rate + \propto_6\ Tax + U_t \qquad (4)$$

4. Results

4.1 Development of the Monetary Conditions index

Equation (4) was regressed using the ordinary least squares regression to estimate coefficients for use as weights in the calculation of the MCI. Table 2 shows OLS estimates of the coefficients.

Table 2: Regression of GDP gap on real interest rate and real exchange rate

Variable	Coefficient	Std. Error	t-statistic	p-value
Real Interest rate	-0.300***	0.094	-3.181	0.001
Real exchange rate	0.463**	0.194	2.390	0.019
Constant	-5.286***	1.108	-4.773	0.000
Money supply	0.111	0.081	1.380	0.171
Inflation	-0.003	0.024	-0.130	0.897
Foreign interest rate	0.038**	0.017	2.212	0.029
Tax	0.476***	0.122	3.905	0.000
Observations				190
R-squared				0.220
Adjusted R-squared				0.175
F-statistic		4.808	p-value	0.000
Durbin-Watson stat				1.277

The ratio of the MCI weights was calculated as in equation (5):

$$Ratio = real\ interest\ rate\ coefficient/real\ exchange\ rate\ coefficient \qquad (5)$$

= 0.300/0.463
= 65/100
= 1:100/65
= 1:1.54

This ratio indicates that, a percentage rise in interest rate is met by a 1.54% decline in the real exchange rate. From, equation (3), w_r and w_e add up to 1 so that:

$$w_r = 1/2.54 = 0.394$$

and

$$w_e = 1.54/2.54 = 0.606$$

[1] Real Exchange rate is based on South African Rand (ZAR), the currency of the largest neighbouring trading partner of Zimbabwe. RBZ calculates the monthly real exchange rate

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Substituting these weights into equation (1) gives equation (6):

$$MCI_t = 0.394(r_t - r_{2009m03}) + 0.606(e_t - e_{2009m03}) \qquad (6)$$

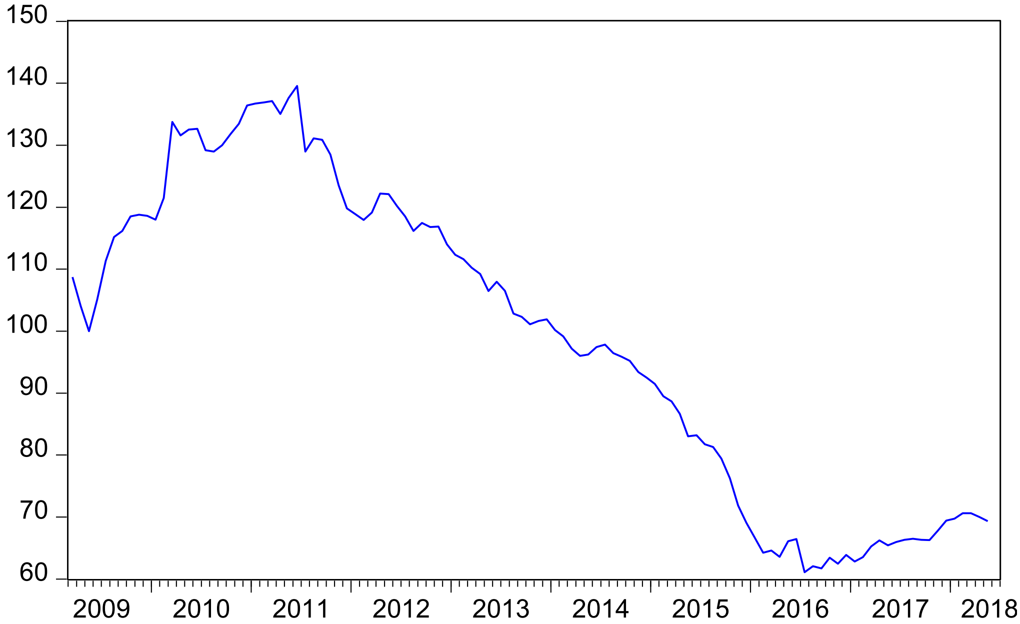

Figure 3: Monetary Conditions Indices for Zimbabwe, 2009 to 2018
Source: Calculated by Researcher using RBZ and other data

The MCI series resulting from equation (6) is plotted in figure 3. The series shows that the monetary conditions index loosened from 2009 but began tightening in 2011. It then loosened in 2016 before marginally tightening until 2018. The correlation matrix shown in appendix 1 indicates that there is a negative association between monetary conditions index and output growth. Loose monetary conditions are associated with increasing GDP and tight monetary conditions are associated with declining GDP.

4.2 Descriptive statistics

Descriptive statistics are presented in table 3. The data consisted of 109 monthly observations during the period of dollarisation in Zimbabwe. The MCI index ranges between 1.936 and 2.094. Its skewness lies between -1 and +1 expected of a normally distributed variable. The kurtosis value is also within the expected values of normality between -2 and +2. The GDP of Zimbabwe ranged between US$8.686 billion and US$9.901 billion with a mean of US$9.093 billion. The skewness statistic is greater than 1 implying positively skewed data and the kurtosis of more than 2 implies heavier tails than expected of a normal distribution. The same skewness pattern is noted for variables CRP and M3. Comparable conclusions can also be drawn for kurtosis values of CRP, FIR, M3 and CPI. Removing extreme values and data transformation can result in better distribution of data towards normality. The data was log transformed to reduce the effects of size of values given that some variables were observable in billions while some like the MCI were only single digits.

Table 3: Descriptive statistics

Parameter	GDP	MCI	CRP	FIR	M3	CPI
Mean	9.093	2.012	6.378	13.634	6.528	101.829
Median	9.086	2.011	6.537	13.510	6.585	102.219
Maximum	9.901	2.094	6.576	15.400	6.909	106.594
Minimum	8.686	1.936	5.138	12.740	5.602	92.016
Std. Dev.	0.167	0.050	0.319	0.692	0.263	3.796
Skewness	2.094	-0.131	-2.135	0.710	-1.402	-0.919
Kurtosis	12.433	1.778	6.988	2.570	5.090	2.981
Jarque-Bera	483.779	7.094	155.051	9.987	55.561	15.337
Probability	0.000	0.029	0.000	0.007	0.000	0.000

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Sum	991.110	219.356	695.229	1486.055	711.601	11099.34
Sum Sq. Dev.	3.028	0.264	10.961	51.720	7.451	1555.995
Observations	109	109	109	109	109	109

4.3 Stationarity

Time series data is usually non-stationary leading to spurious regression results and a very high R^2. A stationary variable is one whose mean and variance are constant overtime. Stationarity and order of integration were determined using the augmented Dickey-Fuller (ADF) unit root test. If a variable was not stationary at its initial level, I(0), first order differencing I(1) was conducted to make it stationary.

Table 4: Augmented Dickey Fuller (ADF) Unit root test results

Variable	Level		First difference		Order of integration
	Intercept	Intercept and Trend	Intercept	Intercept and trend	
Log GDP	-3.459 ** (0.009)	-5.337*** (0.000)	-16.181*** (0.000)	-16.160*** (0.000)	I(0)
Log MCI	-0.156 (0.944)	-2.812 (0.193)	-8.733*** (0.000)	-8.897*** (0.000)	I(1)
Log CRP	-15.624*** (0.000)	-9.926*** (0.000)	-4.514 ** (0.000)	-5.974 *** (0.000)	I(0)
Log FIR	-0.744 (0.835)	-0.880 (0.958)	-11.971*** (0.000)	-12.116*** (0.000)	I(1)
Log M3	-9.768*** (0.000)	-9.242*** (0.000)	-8.356*** (0.000)	-9.482*** (0.000)	I(0)
Log CPI	-0.686 (0.850)	-1.167 (0.917)	-7.249*** (0.000)	-7.199*** (0.000)	I(1)

P-values in parentheses; *, **, and *** represents significance at 10%, 5% and 1% level of significance respectively.

Table 4 shows the stationarity results using the ADF test while appendix A2 presents results of a Philips-Perron test. Logarithms of GDP, CRP, and M3 were stationary in levels while logarithms of MCI, FIR, and CPI were integrated of the first order.

4.4 Long run relationship

The ARDL model was used to analyse long run relationships among I(0) and I(1) variables. Table 5 shows that the null hypothesis of no relationship between MCI and economic growth is rejected at the 5% level of statistical significance.

Table 5: Relationship between MCI and GDP growth

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.336379	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	107		Finite Sample: n=80	
		10%	2.474	3.312
		5%	2.92	3.838
		1%	3.908	5.044

4.5 Granger causality

The causality test developed by Engle and Granger (1987)was used to evaluate for short run causal relationships between the MCI and output represented GDP. The model is as follows:

$$MCI_t = \alpha_0 + \sum_{i=1}^{t} \alpha_{1i} MCI_{t-i} + \sum_{i=1}^{t} \alpha_{2i} GDP_{t-i} + e_t \qquad (7)$$

$$GDP_t = \beta_0 + \sum_{i=1}^{t} \beta_{1i} GDP_{t-i} + \sum_{i=1}^{t} \beta_{2i} MCI_{t-i} + \varepsilon_t \qquad (8)$$

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where MCI is the monetary conditions index, GDP is the gross domestic product, where $e_t$and ε_t represent white noise. The statistical significance of parameters α_{2i} and $\beta_{2i}$are used to evaluate the null hypothesis that GDP granger causes MCI and vice versa respectively.

Table 6: Granger Causality Test between MCI and GDP and other variables

Hypothesis	Observations	F-Statistic	P-Values
MCI does not cause GDP**		3.49905	0.0339
GDP does not cause MCI	107	1.43984	0.2417
CRP does not cause GDP		0.00883	0.9912
GDP does not cause CRP	107	1.36094	0.2610
FIR does not cause GDP	107	1.67487	0.1924
GDP does not cause FIR		0.11844	0.8884
M3 does not cause GDP*		2.50151	0.0870
GDP does not cause M3	107	1.15936	0.3178
CPI does not cause GDP		1.09256	0.3392
GDP does not cause CPI	107	0.27892	0.7572
CRP does not cause MCI***		5.75999	0.0042
MCI does not cause CRP	109	0.18538	0.8311
FIR does not cause MCI		1.29513	0.2782
MCI does not cause FIR***	109	6.05875	0.0032

*, **, and *** represents significance at 10%, 5% and 1% level of significance respectively.

Table 6 shows the granger causality results between MCI and GDP and other variables. It shows that MCI granger causes GDP statistically significant at the 5% level but GDP does not granger cause MCI. This result is important in that it implies that the MCI can be used to guide monetary policy that supports economic growth.

The correlation matrix showed a negative relationship meaning that tightening the monetary conditions discourages economic activity. The other variable that MCI granger causes is FIR statistically significant at the 1% level, but FIR does not granger cause MCI. This result suggests that South Africa, Zimbabwe's main trading partner, might use its interest rates to react to policy changes in Zimbabwe to protect its own economy. CRP granger causes MCI statistically significant at the 1% level, but MCI does not granger cause CRP. This result suggests that private sector credit influences monetary policy in Zimbabwe. The table also shows that M3 granger causes GDP for Zimbabwe, statistically significant at the 10% level. This means that optimal money supply growth can be used to support economic growth, and when taken in conjunction with the earlier finding, M3 needs to be informed by the MCI.

4.6 Diagnostic tests

Tests for serial correlation were conducted using the Breusch-Godfrey Serial Correlation LM Test. As shown in Appendix A3, there was no evidence of serial correlation. The test for the null hypothesis of homoscedasticity, showed the models did not suffer from the problem of heteroscedasticity as shown in Appendix A4.

5. Discussion

This study successfully developed an MCI for Zimbabwe. It went on to show that the index has a long run corelation with GDP, private sector credit, foreign interest rate, money supply and inflation. Furthermore, the study showed that the MCI granger causes economic growth and foreign interest rate while private sector credit granger causes the MCI. The MCI weights ratio of 1:1.54 (alternative expression 0.649:1) established in this study is smaller than the 1.9:1 established by Knedlik (2006) for South Africa. These two ratios mean that the Zimbabwean MCI is dominated by the exchange rate while that of South Africa is dominated by interest rate. The MCI series (figure 3) rose sharply between 2009 and 2011. This upward trend dovetails with the loosening monetary and fiscal conditions that existed as the government sought to boost an economy from recession. The tightening of monetary policy since 2011 is in line with the cash budgeting approach implemented to curb government spending within its means. The Zimbabwean MCI weights are comparative to other small economies with double digit billion-dollar GDP figures such as Jamaica and Croatia that have ratios of 0.019:1 and 0.649:1 respectively (Lattie, 2000; Benazić, 2012). South African weights on the other hand are comparative to triple digit billion-dollar GDP economies such as Romania with ratio of 1.5:1 and 3:1 for Czech Republic (Nucu and Anton, 2018).

The current study established that the MCI is well connected with economic growth in Zimbabwe and has causal relationship with economic variables such as GDP, private sector credit and foreign interest rate. This result supports

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the finding that the Zimbabwean MFCI has a long run relationship with GDP growth, CPI, Interest and Leverage ratio established by Machirinani et al. (2020). This means that the MCI can be used as an indicator of the central bank's monetary policy stance by economic analysts (Hong, 2017). The Zimbabwean central bank can also use the MCI for targeting the inflation and GDP output gap. Countries such as Canada, New Zealand, Norway and Sweden have used the MCI as an operational target (Ericsson et al., 1998; Eika et al., 1996). Canada determines the optimal MCI path such that when the actual MCI is above the target, the market views this as monetary conditions tightening and vice versa and it makes the necessary adjustments (Ericsson et al., 1998). Most recently constructed MCIs include Turkey, Hungary, Poland, Romania, Czech Republic, and India. Akdeniz (2021) calculated an MCI for Turkey and showed that when weights were properly adjusted over time, it closely predicted the developments of the country's economic fluctuations. Nucu and Anton (2018) showed that the MCI of Hungary, Poland, Romania, Czech Republic were able to track the economies monetary tightening. Sharma et al. (2021) recently developed an MCI for India and also established that it tracked monetary conditions well if properly adjusted for changes in weights over time. The MCI was also discovered to estimate GDP growth and inflation.

Observations similar to the present study have been made for Sub Saharan African economies such as Nigeria and South Africa. Yaaba (2013) established that similar to the present study, the exchange rate dominates the Nigerian MCI and that the MCI is consistent with economic output for the country. In contrast, Sharma et al. (2021) and Knedlik (2006) found that the interest rate dominates the Indian and South African MCI respectively, but also that there were certain differences between the MCI and monetary policy targets in the latter. The explanation of the differences was that the model used for calculating the MCI was a bit simplistic as it did not consider other key economic fundamentals such as technology, regulations and fiscal policy. This suggests that future studies may consider multiple variables in estimating the MCI. The current paper, however, has shown that the MCI constructed with interest rates and exchange rates is sufficient to guide monetary policy.

The current study finds private sector credit to have a causal effect on the MCI. This is in consistence with previous studies like Machirinani et al. (2020) who found the MCI was negatively related to banking sector leverage ratio in Zimbabwe. Guillaumin and Vallet (2017) also found bank credit negatively related to MCI but positively related to economic growth in Switzerland. More recently, Sharma et al. (2021) found monetary conditions tightening such as increases in interest rates and real exchange rates linked to increase in bank credit in India. While the current study found the relationship using Granger causality, there are previous studies which incorporated credit in the MCI (Guillaumin and Vallet, 2017; Sharma et al., 2021; Nucu and Anton, 2018; Kannan et al., 2007; Yaaba, 2013). The argument was to address the simplicity of the two factor MCI as highlighted above. Kannan et al. (2007) found bank credit offsetting the effect of real interest rate and real exchange rate on aggregate demand for India. Yaaba (2013) on the other hand found interest rate offsetting both variables. These two studies seem to suggest that for exchange rate dominated MCIs, credit reinforces exchange rate but countering interest rates. On the other hand, for interest rate dominated MCIs, it counters both interest and exchange rates.

Although this study has shown that the MCI components can be managed to target output growth in Zimbabwe, previous studies suggest that the interest rate and exchange rate components can be used to specifically target inflation. Knedlik (2006) showed that the MCI for South Africa is useful in targeting inflation through these components. Sharma et al. (2021) showed that monetary tightening through raising interest rates and exchange rate was negatively related to inflation in India. (Machirinani et al., 2020) showed that the MFCI components including interest rates have a bidirectional causal relationship with inflation. Since Zimbabwe has a recurring problem with inflation, further research is required to explore the effectiveness of the MCI in informing inflation targeting especially in the post dollarized economy. The period of analysis was easier to analyse because Zimbabwe was using the US dollar. Under the current economic environment that would be a challenge since the economy uses two exchange rates namely the official rate controlled by the central bank and used for government transactions and the parallel rate used by private individuals and businesses. The choice of interest rate and exchange rate used has a bearing on the MCI values as well as its relationship with output (Ericsson et al., 1998). Future research is thus needed to examine which particular exchange rate or hybrid is more appropriate. In addition to that, Kavila and Le Roux (2016) and Makena (2020) find major trading partner exchange rate and inflation affecting Zimbabwe's inflation. This means that future researchers may need to consider more than two variables to derive weights for the MCI components.

6. Conclusion and policy recommendations

This study aimed at developing an MCI for Zimbabwe and evaluating if it can be of any use as an indicator of the central bank's monetary policy stance. The paper successfully developed the MCI and showed that the exchange rate dominates interest rates in determining output in Zimbabwe. The paper also showed that the MCI is related to economic growth and other variables such as private sector credit and foreign interest rates. The study therefore concludes that the MCI is a tool that Zimbabwe could use as a monetary policy anchor for monitoring inflation and stimulate or curtail economic activity in line with desired levels.

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Appendices

A1: Correlation Matrix

	Log GDP	Log MCI	Log M3	Log FIR	Log CRP	Log CPI
Log GDP	1.000000					
Log MCI	-0.538220	1.000000				
Log M3	0.619629	-0.597755	1.000000			
Log FIR	0.271627	-0.248912	-0.083770	1.000000		
Log CRP	0.499188	-0.405603	0.944197	-0.355012	1.000000	
Log CPI	0.449286	-0.288850	0.793265	-0.482901	0.891031	1.000000

A2: Phillip-Perron Unit root test results

Variable	Level		First difference		Order of Integration
	Intercept	Intercept and Trend	Intercept	Intercept and trend	
Log GDP	-3.236** (0.018)	-5.494*** (0.000)	-16.969*** (0.000)	-17.044 *** (0.000)	I(0)
Log MCI	-0.314 (0.923)	-2.804 (0.195)	-8.729*** (0.000)	-8.868*** (0.000)	I(1)
Log CRP	-17.053*** (0.000)	-10.873 *** (0.000)	-4.248 ** (0.000)	-6.156 *** (0.000)	I(0)
Log FIR	-0.616 (0.867)	-0.695 (0.974)	-11.928*** (0.000)	-12.115*** (0.000)	I(1)
Log M3	-8.740 *** (0.000)	-10.624 *** (0.000)	-8.527 *** (0.000)	-9.696 *** (0.000)	I(0)
Log CPI	-1.139 (0.699)	-1.658 (0.769)	-7.433*** (0.000)	-7.485*** (0.000)	I(1)

A3: Test for Serial correlation

F-statistic	**0.683058**	**Prob. F(2,97)**	**0.5075**
Obs*R-squared	1.486024	Prob. Chi-Square(2)	0.4757

A4: Test for heteroscedasticity

F-statistic	**1.188528**	**Prob. F(7,99)**	**0.3164**
Obs*R-squared	8.294911	Prob. Chi-Square(7)	0.3073
Scaled explained SS	84.23537	Prob. Chi-Square(7)	0.0000

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