Inflation dynamics in a dollarised economy: The case of Zimbabwe

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A B S T R A C T

This paper explores the dynamics of inflation in the dollarised Zimbabwean economy using the autoregressive distributed lag (ARDL) model with monthly data from 2009:1 to 2012:12. The main determinants of inflation were found to be the US dollar/South African rand exchange rate, international oil prices, lagged Zimbabwean inflation rate and South African inflation rate. During the local currency era, inflation dynamics in Zimbabwe were explained by excess growth in money supply, changes in import and administered prices, unit labour costs and output (Chhibber, Cottani, Firuzabadi & Walton 1989). According to Makochekanwa (2007), hyperinflation during the same era was attributed to excess money supply growth, lagged inflation and political factors. Coorey, Clausen, Funke, Munoz & Ould-Abdallah (2007) affirmed these findings by identifying excess money supply growth as a source of high inflation in Zimbabwe during the local currency era. In essence, the findings of this study point to a shift in inflation dynamics in Zimbabwe. This shift in inflation dynamics means that policies, which were used to respond to both internal and external shocks that have an impact on price formation, might not be applicable in a dollarised economy.

Key words: inflation, dollarisation, autoregressive distributed lag model

The objective of this paper is to analyse the dynamics of inflation in the dollarised Zimbabwean economy. In the context of the Southern African Development Community (SADC), Zimbabwe presented a problem in respect of the region's quest for attaining macro-economic convergence, because of the high inflation episodes experienced between the years 2000 and 2008. Cagan (1956: 25) arbitrarily defines "hyperinflation as beginning in the month the rise in prices exceeds 50 per

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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". Using this definition, Zimbabwe slid into hyperinflation when month-on-month inflation peaked at 50.5 per cent in March 2007.

In essence, the rapid and sustained loss in value of the Zimbabwean dollar, which began in the last quarter of 1997, led to its rejection as a medium of exchange during the second half of 2008, as inflation soared. Annual inflation reached a record 200 million per cent in July 2008. Thereafter, the Central Statistical Office was ordered to stop publishing inflation figures.

Hyperinflation, however, ended abruptly when the country abandoned the use of the local currency and adopted a multicurrency system in February 2009. The abandonment of the local currency and adoption of the multi-currency system weakened parallel market activities and arbitrage opportunities, and dissipated inflationary pressures. During 2009 to 2012, annual inflation averaged below 5 per cent, and monthly inflation was, on average, less than 0.5 per cent. Zimbabwe began to perform better than its counterparts in SADC, particularly in respect of inflation.

This study analyses the dynamics of inflation in the dollarised Zimbabwean economy, using the autoregressive distributed lag (ARDL) bounds testing estimation approach. The ARDL approach was introduced by Pesaran, Smith & Shin (2001) and applied in studies by Pahlavani and Rahimi (2009), Irefin and Yaaba (2011), Khatun and Ahamad (2012) and Shittu, Yemitan and Yaya (2012). This study used monthly data from 2009:1 to 2012:12 to analyse the inflation dynamics and the relationships between the consumer price inflation and key variables, both in the short term and in the long term. The key variables include the US dollar/South African rand exchange rate, money supply, international oil and food prices and the index of manufacturing output as a proxy for gross domestic product.

Economic developments

The Zimbabwean economy dollarised informally during the second half of 2008, when the local currency continued to lose value against the background of rising inflation. Economic agents began to covertly conduct business in foreign currency, and consequently basic goods disappeared from formal markets only to resurface in the thriving black market earning foreign currency. The Reserve Bank of Zimbabwe, in September 2008, responded to this development by partially formalising dollarisation through licensing selected wholesalers and retailers to sell goods in foreign currency. The initiative was dubbed the foreign currency licensed warehouses and retail shops (FOLIWARS) programme. While the unlicensed

traders were officially supposed to continue selling goods and services in local currency, payments were mostly made in foreign currency.

Following the disputed June 2008 presidential elections, a global political agreement was signed on 15 September 2008. This led to the formation of a Government of National Unity in February 2009. The Government of National Unity formally adopted a multicurrency system because it realised the futility of forcing some economic agents to trade in a worthless currency, while others (the licensed ones) traded in foreign currency. In addition, in order to stabilise the economy, the new government launched the short-term emergency recovery programme (STERP) in March 2009 as its economic blueprint.

STERP was implemented over a period of nine months from March 2009 to December 2009. It focused on political and governance issues, social protection programmes, supply-side reforms, and macro-economic reform. The implementation of the economic stabilisation programme resulted in significant positive benefits such as inflation reduction and positive real gross domestic product growth in the economy. Real gross domestic product rose from 5.4 per cent in 2009 to 9.6 per cent in 2010, 10.3 per cent in 2011 and 4.4 per cent in 2012, as shown in Figure 1.
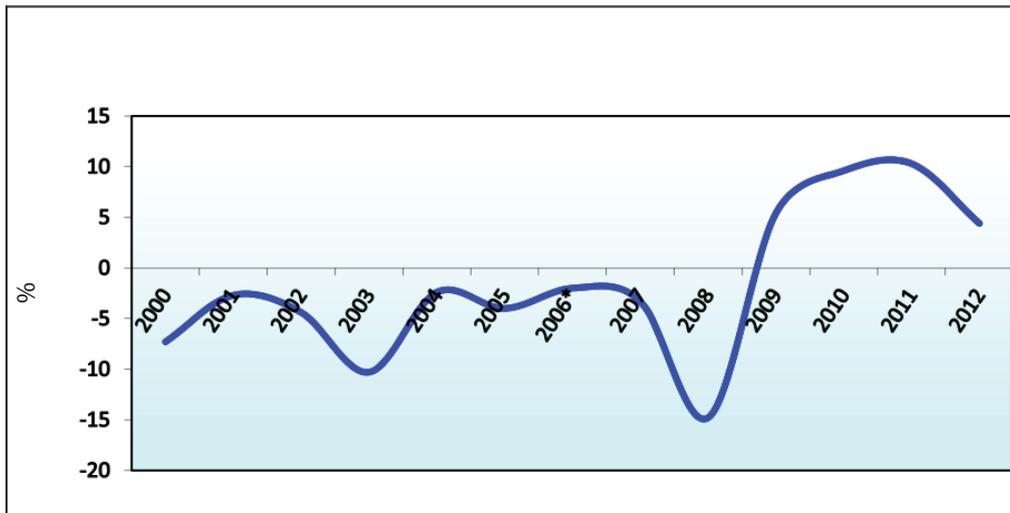
**Figure 1:** Real GDP growth, 2000–2012 (per cent)

Source: ZIMSTATS and Ministry of Finance estimates

In line with the economic stabilisation programme, the fiscal authorities adopted a strict cash budgeting system that sought to ensure that government only spent what it would have collected in revenues. The cash budget system resulted in

fewer expenditure overruns and promoted fiscal austerity. In this regard, it can be postulated that fiscal dynamics could not have explained inflation during the study period.

Reflecting higher US dollar prices that existed during the unofficial use of the multicurrency system in December 2008, year-on-year inflation stood at -7.7 per cent by the end of December 2009. However, as shown in Figure 2, the year-on-year inflation crept into positive territory and ended the years 2010, 2011 and 2012 at 3.2 per cent, 4.9 per cent and 2.9 per cent, respectively.
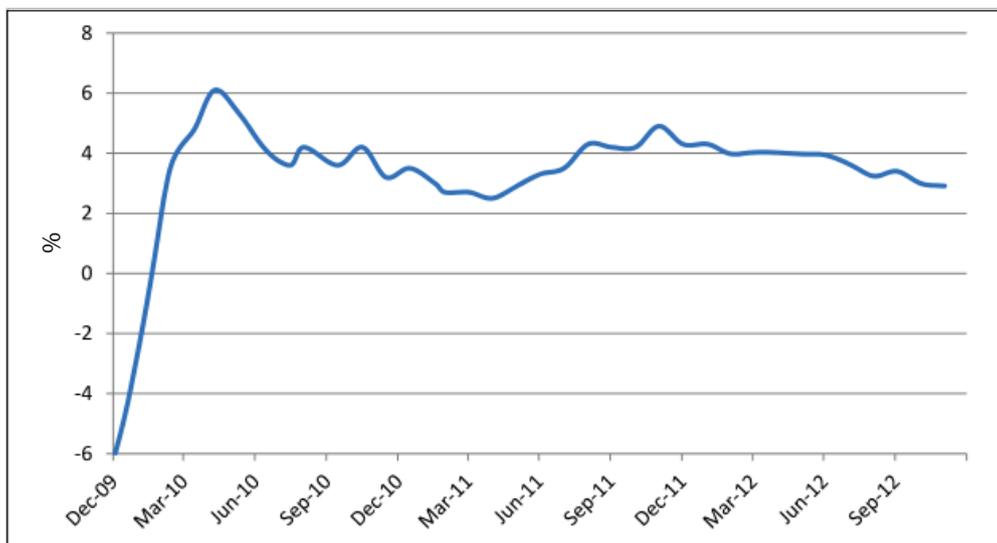
Figure 2: Annual inflation (per cent)

Source: ZIMSTAT

While the economy had stabilised, the country's balance of payments position remained under severe pressure, largely due to the adverse effects of the global financial crisis on international trade and global capital flows. Consequently, the country's current account balance posted deficits of 24.4 per cent, 15.0 per cent, 19.9 per cent, 30.9 per cent and 24.4 per cent of GDP in 2008, 2009, 2010, 2011 and 2012 respectively.

The country's foreign exchange reserves remained low, adversely affecting its capacity to service debt or meet critical import payments. Import cover stood at 1.2 months in 2009; 1 month in 2010; and 0.6 months each for 2011 and 2012. This inhibited the importation of critical raw materials for industry, adversely affecting the country's production capacity and leading to further inflationary pressures. Capacity

utilisation declined to 44.2 per cent in 2012. Concomitantly, the growth in real GDP fell from 5.4 per cent in 2011 to 4.4 per cent in 2012.

Government remained in debt distress as its public debt increased by 73.4 per cent – from US$3 269 million in 2008 to US$5 687 million as at 31 December 2009. The country's external debt reached unsustainable levels with a ratio of external debt to GDP of 85 per cent (end 2012). This was significantly above the desired international benchmark of 50 per cent. Total external payment arrears increased by 793.6 per cent from US$471.1 million in 2000 to US$5 205 million by the end of 2012, which undermined the country's creditworthiness, exacerbated the liquidity situation and further impacted upon productive activity. This reinforced the negative impact of the lack of balance of payments support, with some influence on price formation in the economy.

The Zimbabwean case is unique in that economic agents abandoned the local currency altogether, with the authorities formally endorsing its rejection and stopping its use as legal tender after the adoption of the multicurrency system. Zimbabwe adopted dollarisation as a way of dealing with hyperinflation, which was characterised by the significant loss of credibility of the country's political and monetary institutions. In addition, dollarisation was not formalised by any agreement between Zimbabwe and the Federal Reserve Bank or the South African Reserve Bank.

Literature review

Theoretical aspects of dollarisation

A situation where the holdings of foreign currency denominated assets constitute a significant proportion of the total assets of residents of a particular country is referred to as dollarisation (IMF 1999). Dollarisation could also be described as the extensive use of foreign currency, alongside the domestic currency, for the settlement of transactions by residents (Schuler & Stein 2000). When a government demonitises its own currency and legalises the exclusive use of foreign currency as legal tender, this is referred to as official or de jure dollarisation. Calvo (1999) defines the situation when governments allow their citizens to use foreign currencies alongside their domestic currencies in performing the three classical functions of money as partial or unofficial dollarisation (de facto dollarisation).

Dollarisation can also take the form of a multicurrency system, as in the case of Zimbabwe, where more than one foreign currency is used to perform the various functions of money. Indicators of dollarisation include the share of foreign currency

deposits in broad money within the domestic banking system and the share of foreign currency deposits to total assets held by domestic residents at home and externally.

Unofficial dollarisation

Under de facto or unofficial dollarisation, foreign currency does not have the same privileges pertaining to legal tender as those enjoyed by the domestic currency save that the residents of that country will have chosen to hold a significant share of their total financial assets denominated in foreign currency (Balino, Bennet & Borensztein 1999). Furthermore, domestic currency is regarded as the legal tender, while foreign currency continues to be extensively used in the settlement of private transactions.

There are a number of forms that unofficial dollarisation can take, including investments by residents in foreign currency denominated bonds, holding of foreign currency cash, as well as deposits denominated in foreign currency in both domestic and foreign banks. In some cases, unofficial dollarisation has resulted in the spontaneous substitution of deposits in local currency with deposits in foreign currency during hyperinflation periods (Balino et al. 1999; Calvo & Vegh 1996).

Official dollarisation

Official dollarisation or full dollarisation occurs when a country adopts the US dollar or any other country's currency as legal tender for all transactions. Two cases of official dollarisation are prominent: firstly, where foreign currency is legal tender and there is no local currency (e.g. Panama, Ecuador, Micronesia, East Timor and Zimbabwe); and secondly, where foreign currency is legal tender and the dollarised country also issues its own currency (e.g. El Salvador, Bahamas and Haiti). The complete abolition of the local currency gives dollarisation a more permanent character than a fixed exchange regime, where some scope to exit the peg still exists. When a country fully dollarises, the reintroduction of the local currency, though possible, would imply a much more complex and lengthy process. There is no known record of a country that had fully dollarised managing to de-dollarise.

Preconditions for dollarisation

Fabris, Vukajlović-Grba, Radunović & Janković (2004) highlight four circumstances that are beneficial for dollarisation. Firstly, the country must be small and also largely depend on international trade. Secondly, the country should have experienced macroeconomic instability, reflected by high inflation levels that

ultimately culminate in hyperinflation. Thirdly, seigniorage revenues should form a small proportion of total government revenue. Finally, the country must have a sufficient quantity of foreign reserves to cover base money to enable the switch from domestic to foreign currency. These preconditions for dollarisation are embodied in the literature on optimal currency areas (Mundell 1961; McKinnon 1963). The optimal currency area theory argues that small and open economies are more likely to benefit from dollarisation through the elimination of the cost of exchanging currencies in trade. In addition, economies that trade heavily with the USA will benefit from the reduction in transaction costs created by dollarisation.

The list of economic conditions beneficial to dollarisation should not be interpreted as preconditions for dollarisation, since some of the factors that promote stable economic growth in a dollarised setting can also emerge as a consequence of dollarisation (Starr 2001).

How to officially dollarise

A country can officially dollarise unilaterally or through a bilateral legal arrangement with the Federal Reserve Bank of America (Eichengreen 2002). Unilateral dollarisation is a situation where the US dollar is adopted independently of any formal recognition or engagement of significance with the USA government (Curutchet 2001). The major advantage of unilateral dollarisation is that it can be implemented immediately without spending time on negotiations with the USA government. Its major weakness is that in the absence of a bilateral arrangement with the USA, the dollarised country loses on sharing of seigniorage revenue and the access to the Fed Res discount window for the lender of last resort facility.

Benefits of official dollarisation

There is a fair degree of consensus on the benefits and costs of dollarisation. Schuler (1998) and Hanke and Schuler (1999), however, contend that most costs or objections associated with dollarisation are misplaced. They argue that the most passionate objection to dollarisation is not economic but political. According to Barro and Gordon (1983) and Goldfjan and Olivares (2000), the main advantage of dollarisation is that it promotes macroeconomic stability as it resolves the problem of credibility. Inflation and interest rates are expected to decline and converge to the level of the USA or the issuing country. Full dollarisation also eliminates the risk of depreciation of the domestic currency, a contributing factor to the acceleration of inflation. Dollarisation also lowers the currency risk premia associated with currency depreciation since there is no sharp and sudden devaluation of the domestic currency. In this regard, barring country risk, dollarisation is expected to improve a

country's access to international capital markets as a result of lower currency risks (Berg & Borensztein 2000) and lower information costs (Calvo 1999).

Another notable benefit of dollarisation is the elimination of transaction costs. Dollarisation eliminates costs of exchanging the domestic currency into the currency of the anchor currency (Fischer 1982; De Grauwe 2000). The reduction of transaction costs will be higher when the exchange rate volatility is high. In addition, the reduction of transaction costs will also be higher when the foreign exchange costs associated with currency conversion are high. Hausmann, Gavin, Pages-Serra and Stein (1999) argue that dollarisation is expected to support the development of a country's financial sector by ushering in a stable currency. It is further expected to reduce financial fragility by eliminating currency mismatches and by promoting integration of domestic financial firms into world markets.

Dollarisation is also expected to enhance fiscal discipline by eliminating the possibility of monetisation of fiscal deficits (Fischer 1982; Eichengreen 2001). Without the possibility of the monetisation of fiscal deficits, dollarisation encourages fiscal discipline and compels the government to look for alternative sources of revenue or reduce expenditures. Frankel and Rose (1998) and Dallas and Tavlas (2001) contend that dollarisation is likely to promote a country's economic integration with the economy of the issuing country.

Costs of official dollarisation

The main disadvantage of official dollarisation is that the country loses its exchange rate and monetary policy autonomy. The loss of independent monetary policy deprives the country of monetary and exchange rate instruments to react to asymmetric shocks as well as fluctuations in the business cycle not in line with the anchor country. Typically, the central bank of a dollarised country also loses the lender of last resort function. The country loses the ability to respond to bank runs emanating from liquidity challenges. Dollarisation prevents the injection of unlimited amounts of liquidity into the payment system to prevent a default on deposits (Berg & Borensztein 2000). This is because the amount of liquidity support to purchase bank assets and to recapitalise distressed financial institutions is restricted to the country's stock of foreign reserves. Another cost of dollarisation is the loss in seignorage revenue from issuing its own money. Bogetic (2000) found that seignorage can be as high as 7% of gross domestic product.

Empirical literature review

The literature on inflation dynamics in a dollarised environment is largely divided into two groups. The first, which is highly researched (Goujon 2006; Bahmani-

Oskooee & Domaç 2002; Del Cristo & Gómez-Puig 2012) covers inflation dynamics and stabilisation measures in partially but highly dollarised environments. The second group of literature pertains to inflation in fully dollarised economies and is limited; probably reflecting the relatively few countries that are fully dollarised.

The empirical literature on dollarisation and inflation suggests that dollarisation could affect the inflation process through several channels. Rojas-Suarez (1992) suggested that dollarisation exacerbates the resulting inflation rate for a given fiscal deficit. In addition, McNelis and Asilis (1992) argued that dollarisation increases the volatility of inflation for a given budget deficit, while Akçay, Alper & Karasulu (1997) concluded that a high degree of currency substitution renders the exchange rate not only more volatile, but also more responsive to credibility issues.

Bahmani-Oskooee and Domaç (2002) argue that the above highlighted channels do not suggest that dollarisation is the cause of inflation, but rather that dollarisation is an endogenous response of economic agents to economic instability and high inflation.

Inflation dynamics in partially dollarised economies

Partial dollarisation may take the form of foreign currency deposits and this is often referred to as financial dollarisation. Studies by Goujon (2006); Müge and Mohsen (2005); and Oomes and Ohnsorge (2005) were done to determine the impact of this type of dollarisation on inflation. The studies concentrated on countries that have experienced high inflation episodes as well as currency crises; these countries are Latin American countries, Asian countries, former Soviet Union countries as well as Turkey.

Goujon (2006) used the two-step estimation method developed by Juselius (1992), Metin (1995) and Hendry (2001) to study the determinants of inflation under partial dollarisation of the Vietnamese economy. The author concluded that inflation is explained by exchange rate changes and excess money, thereby confirming the results of earlier studies of other dollarised economies in which broad monetary aggregates show a close link to inflation. Importantly, in a dollarised economy, the relevant concept of money should include foreign currency deposits held in the domestic banking system as this increases the level of broad money and hence inflation (Goujon 2006).

Müge and Mohsen (2005) employed the auto-regressive distributed lag (ARDL) modelling and the bounds testing approach to co-integration analysis to estimate an inflation equation for Turkey, taking into consideration both monetary and fiscal variables as well as a dollarisation variable. Their results indicate the importance

of dollarisation in explaining the behaviour of inflation both in the short run and in the long run among other elements such as monetary growth and exchange rate depreciation.

Bahmani-Oskooee and Domaç (2002) also investigated the role of dollarisation in the dynamics of inflation in Turkey and found that dollarisation was important in determining inflation. The researchers employed a vector auto-regression (VAR) model that incorporates, as its endogenous variables, the consumer price index, base money, exchange rate, dollarisation ratio (foreign currency to broad money) and public sector prices. The VARs were estimated using monthly data from January 1990 through December 2001. The study concluded that shocks to the dollarisation ratio had a positive and statistically significant impact on prices in the first 29 months. The largest statistically significant impact on price occurred after 29 months with a one per cent standard deviation shock to the dollarisation ratio of foreign currency to broad money, increasing prices by approximately two per cent.

In a study by Oomes and Ohnsorge (2005) to determine the relationship between money demand and inflation in a dollarised Russian economy for the period April 1996 to January 2004, the researchers stated that a long-run error correction model that includes foreign cash holdings in the definition of money is important in understanding the relationship between money growth and inflation. The authors employed a standard approach for estimating a long-run inflation equation and concluded that nominal effective depreciation accounts for approximately 50 per cent, while growth in labour costs constitutes 40 per cent, and utility charges account for 10 per cent of inflation. The short-run dynamics revealed that excess supply of effective broad money is inflationary, and that changes in effective broad money growth have the strongest and most persistent effect on short-run inflation.

Bailey (2007) conducted research using a vector auto-regression (VAR) model that incorporated monthly data from March 1996 to December 2004 on the exchange rate, consumer price index, base money, an index of public sector prices (PSP) and the dollarisation ratio (as a ratio of foreign currency to broad money) as its endogenous variables. The study confirmed that financial dollarisation influences inflation. This occurs when exchange rate depreciation pressures arising from increased foreign currency holdings stimulate inflationary impulses due to the relatively high exchange rate pass-through to inflation.

Exchange rate pass-through and inflation in dollarised economies

Del Cristo and Gómez-Puig (2012) studied the exchange rate pass-through effect on inflation in Ecuador. The researchers estimated a structural vector error correction

model (VECM) and obtained the impulse responses of inflation to a real effective exchange rate shock and found a higher exchange rate pass-through on inflation. As an oil exporter, the higher Ecuadorian oil prices rise, the higher the inflation suffered by oil-importing countries. These countries, however, are at the same time Ecuador's trading partners, and so Ecuador imports the inflation of its main trading partners through these currency appreciations.

Carranza, Galdon-Sanchez and Biscarri (2009) utilised quarterly data of 124 countries with different levels of dollarisation for the period 1996–2004 to check for the exchange rate pass-through on inflation. The study concluded that highly dollarised economies present higher pass-through coefficients, but, when the nominal depreciation is large, this relationship changes. Large depreciations tend to reduce the extent of the pass-through.

Reinhart, Rogoff and Savastano (2003) utilised annual panel data for 89 countries from 1996 to 2001 to estimate exchange pass-through effect. The variables comprised the consumer price index, real exchange rate, gross domestic product and proxies to control for the openness of countries and other variables such as seignorage and the level of dollarisation of each country. The exchange rate pass-through to prices was greatest in economies where the degree of dollarisation was high.

Inflation dynamics in fully dollarised economies

Gachet, Maldonado and Perez (2008) studied the determinants of inflation in Ecuador. Ecuador implemented full dollarisation in 2000 following a major economic crisis, including high levels of inflation and a severe devaluation of its currency. An estimated structural vector auto-regression (SVAR) model to identify the main causes of inflation at the aggregate level in Ecuador was used. The SVAR methodology was used to account for endogenous relationships between the variables in the model, and to summarise these empirical relationships without placing too many restrictions on the data. The variance decomposition also provided information about the relative importance of each shock to the variables in the VAR. The Gachet et al. (2008) study tested the impact of seven variables on inflation, including international prices, exchange rate, public policy, weather, freights and politics. The study found that international prices, exchange rate and public policy explained 62.04 per cent, 18.49 per cent and 7.75 per cent, respectively, of inflation in Ecuador. The main conclusion drawn from the study was that in a fully dollarised environment, inflation is caused mainly by international prices, exchange rates and public policy.

Conclusion

The empirical literature reviewed leads to the general conclusion that in both partially and fully dollarised economies, inflation is largely explained by exchange rate movements, international prices and excess money. The exchange rate pass-through to prices is also greatest in economies that are highly dollarised. It is important to note that dollarisation is in most cases a response to economic instability, characterised by high levels of inflation, and influences inflation in both partially and fully dollarised economies.

Data, inflation model and methodology

Data

The data set used in this study covers the period 2009:1 to 2012:12 and was obtained from ZIMSTATS, the Reserve Bank of Zimbabwe, IMF World Economic Outlook and South African Reserve Bank.

Inflation model and estimation method

The estimation method draws on the recent developments in co-integration analysis and the error correction model (ECM) that have been used to explore several economic phenomena. However, the investigation of long-run relationship using approaches such as Engle and Granger (1987) and Johansen (1991), which assume that underlying variables need to be integrated of order 1 or I(1), are cumbersome. To solve this problem, the bounds test approach introduced by Pesaran et al. (2001), which is applicable irrespective of the order of integration of regressors, is applied to establish the long-run relationship between inflation and the explanatory variables. The autoregressive distributed lag (ARDL) bounds testing approach is desirable because it is applicable irrespective of whether the regressors are I(1) or I(0).

A general long-run inflation model is developed by hypothesising that in a small open economy (a price taker on the international market), the general price level is influenced by the average price of tradable and non-tradable goods (Goujon 2006; Nguyen & Nguyen 2010; Akinbobola 2012; Nguyen, Cavoli & Wilson 2012; Bhattacharya 2013). This can be illustrated as follows:

$$LogP_t = \emptyset(logP^N) + (1 - \emptyset)Log(P^T) \; 0 < \emptyset < 1 \tag{1}$$

Where P_t is the general price level in the economy, P^N is the general price for non-tradables, P^T is the general price for tradables and $\emptyset$ is the weight assigned to prices

of tradable goods. The price of tradable goods depends on foreign prices, particularly of major trading partners, and the exchange rate between the local currency and that of trading partners. The price of tradable goods is therefore expressed in local currency terms as follows:

$$LogP_t = Loge + P_t^f \tag{2}$$

The price of tradable goods thus depends on the exchange rate between the local currency and that of trading partners and foreign prices P_t^f, while the price of non-tradable goods is determined by aggregate demand and supply in the economy, where in equilibrium, real money supply, $\frac{M^s}{P}$ equals real money demand, $\frac{M^d}{P}$ as illustrated in equation 3:

$$\frac{M^s}{P} = \frac{M^d}{P} \tag{3}$$

Equation 3 can also be expressed as follows:

$$LogP_t^N = \beta(logM^s - log(M^d) \tag{4}$$

Where the parameter β is a scaling parameter showing the relationship aggregate demand and supply in the economy. The demand for real money balances is assumed to be a function of real output and expected inflation as follows:

$$m^d = f(y, \pi^e) \tag{5}$$

Moreover, the expected rate of inflation is determined by inflation in the previous period:

$$\pi^e = \Delta logP_{t-1} \tag{6}$$

Through substitution and rearrangement, equations 1 to 6 can be reduced to the relationship between the general price level (dependent variable) and independent variables as follows:

$$LogP_t = \beta_0 + \beta_1 logM_t^s + \beta_2 LogY_t + \beta_3 logP_{t-1} + \beta_4 Loge_t + \beta_5 logP_t^f + \varepsilon_t \tag{7}$$

Where

P_t is the general price level or consumer price index.

β_0 is a constant.

M_t^s is broad money supply (comprising demand, savings, short-term and long-term deposits in the banking sector).

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.

ε_t is the error term.

In equation 7, it is hypothesised that inflation is explained by fluctuations in money supply, real output, inflation expectations, the exchange rate and foreign prices. Theory asserts that an increase in money supply and foreign prices, and an appreciation of the exchange rate result in a rise in inflation. High inflation expectations would also drive up inflation. An increase in real output would result in a decrease in inflation, especially if the increase is driven by higher output of agricultural produce. In addition, an increase in output would probably lead to a dampening of inflationary pressures, because the current level of GDP in Zimbabwe is far below the potential GDP, and there is thus scope to increase the employment of resources without putting upward pressure on prices. Zimbabwe uses multiple currencies, with the US dollar being the dominant currency, and sources more than 60 per cent of its imports from South Africa. This renders the fluctuation of the US dollar/rand nominal exchange rate an important determinant of price formation. In this regard, an appreciation of the South African rand vis-à-vis the US dollar would result in an increase in inflation in Zimbabwe as the price of imports from South Africa increases. In the same vein, a depreciation of the South African rand against the US dollar would result in a decrease in inflation.

Other control variables such as oil and food prices are included as proxies for foreign prices. According to Reserve Bank of Zimbabwe estimates, oil and food imports accounted for an average of 20 per cent and 10 per cent of Zimbabwe's total imports, respectively, between 2009 and 2013. Furthermore, taking into consideration that Zimbabwe sources close to 60 per cent of imported commodities from South Africa, equation 7 is further augmented by including the South African consumer price index as one of the explanatory variables. Changes in the South African consumer price index are expected to influence price formation in Zimbabwe. The real output as an explanatory variable was proxied by the volume of the manufacturing sector index (VMI), because monthly real output data are not available. However, the VMI was later dropped, as it was found to be statistically insignificant.

Unit root tests

The order of integration of the dependent and independent variables was investigated using the Augmented Dickey Fuller (ADF) and Phillips Peron tests. The results in Table 1 show that all variables in equation 7 became stationary after differencing once, that is, they are integrated of order 1.

Table 1: Stationary tests

Variable	Augmented Dickey Fuller test		Phillips Peron test	
	Level	First difference	Level	First difference
Food	-1.2849	-5.0206***	-1.2849	-4.9677***
Ms	-1.8476	-9.1765***	-2.2015	-9.1765***
Sexc	-2.5641	-4.5982***	-2.5397	-4.6007***
Zcpi	0.2240	-5.2828***	-0.3568	-10.484***
Scpi	-1.5515	-6.8527***	-1.9804	-6.9242***
Oil	-1.8344	-5.7901***	-1.8556	-5.7315***

Note: * significant at 10 per cent level, ** significant at 5 per cent level, *** significant at 1 per cent level.

Wald coefficient

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 Annexure 1.

Unrestricted error correction model

Equation 7 can be expressed as an unrestricted error correction model (UECM) representation of the ARDL for Zimbabwe, following the approach taken by Pesaran et al. (2001) as follows:

$$\Delta lnP_t =$$
$$\alpha + \sum_{i=1}^{p} \beta_{0,i} \Delta lnP_{t-i} + \sum_{i=0}^{p} \beta_{1,i}\Delta ln\,M_{t-i} + \sum_{i=0}^{p} \beta_{2,i} \Delta lnOil_{t-1} + \sum_{i=0}^{p} \beta_{3,i} \Delta lnSexc_{t-i} +$$
$$\sum_{i=0}^{p} \beta_{4,i}\Delta\,lnFood_{t-i} + \sum_{i=0}^{p} \beta_{5,i}\Delta\,lnScpi_{t-i} + \delta_1 lnP_{t-1} + \delta_2 lnM_{t-1} + \delta_3 lnOil_{t-1} +$$
$$\delta_4 lnSexc_{t-1} + \delta_5 lnFood_{t-1} + \delta_6 lnScpi_{t-i} + \varepsilon_t \tag{8}$$

Under this methodology, the null hypothesis of no co-integration, that $\delta_0 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6$, against the hypothesis that $\delta_0 \neq \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6$ is to be tested. The test for co-integration is conducted using the Wald F-test. Pesaran et al. (2001) provide two adjusted critical values that establish lower and upper bounds of significance. According to this methodology, if the computed Wald F-statistic exceeds the upper critical value, it can be concluded that a long-run relationship exists. If the F-statistic falls below the lower critical value, the null hypothesis of

no co-integration cannot be rejected. A value of the F-statistic that lies within the bounds makes the test inconclusive.

According to Pesaran and Shin (1999), the long-run model derived from estimation of the conditional ECM specified above is derived as follows:

$$lnP_t = \emptyset_1 + \emptyset_2 lnms_t + \emptyset_3 lnSexc_t + \emptyset_4 lnOil_t + \emptyset_5 lnFood_t + \emptyset_6 lnScpi_t + \varepsilon_t \qquad (9)$$

Where: $\emptyset_1 = \frac{\alpha}{\beta_0}$, $\emptyset_2 = \frac{\delta_0}{\beta_0}$, $\emptyset_3 = \frac{\delta_1}{\beta_0}$, $\emptyset_4 = \frac{\delta_2}{\beta_0}$, $\emptyset_5 = \frac{\delta_4}{\beta_0}$, $\emptyset_6 = \frac{\delta_5}{\beta_0}$

Analysis of results

Estimated coefficients using ARDL approach

As shown in Table 2, the lagged consumer price index, international oil prices, the US dollar/South African rand exchange rate and South African inflation are significant determinants of inflation in the dollarised Zimbabwean economy in the long run. In the short run, inflation is determined by international oil prices, the US dollar/South African rand and South African inflation.

Table 2: Estimated coefficients using the ARDL approach

Variable	Coefficient	Standard error	t –Statistic	Probability
CONSTANT	1.670738	0.238211	7.013682	0.0000
DLOG(ZCPI(-1))	-0.105092	0.095145	-1.104540	0.2773
DLOG(MS)	0.004962	0.11628	0.426747	0.6723
DLOG(OIL)	0.029491	0.11270	2.616748	0.0133**
DLOG(SEXC)	0.059412	0.019347	3.070799	0.0043**
DLOG(FOOD)	0.001966	0.020467	0.096041	0.9241
DLOG(SCPI)	0.128139	0.059951	2.137382	0.0401**
LOG(ZCPI(-1))	-0.680787	0.081940	-8.308327	0.0000**
LOG(MS(-1))	0.008257	0.007091	1.164317	0.2526
LOG(OIL(-1))	0.036627	0.009156	4.000315	0.0003**
LOG(SEXC(-1))	0.067613	0.016604	4,072100	0.0003**
LOG(FOOD(-1))	0.02751	0.009317	0.295214	0.7697
LOG(SCPI(-1))	0.214709	0.062329	3.444752	0.0016**

Note: Significant at 5 per cent level.

Long run elasticities

The long-run elasticities of the model are calculated from the estimated coefficients of the respective lagged independent variables of the long-run ARDL equation. This is done by dividing the coefficient of each lagged independent variable by the lagged coefficient of the consumer price index (CPI) and multiplying by -1, following Bardsen (1989) and Hoque and Yusop (2010). The estimated long-run coefficients of the lagged independent variables are shown in Table 2. Computed long-run elasticities are as shown in Table 3.

Table 3: Long-run elasticities

Parameter	Variable	Coefficient
$\emptyset_1$	Constant	2.454
$\emptyset_2$	Broad money supply	0.012
$\emptyset_3$	Rand/US dollar exchange rate	0.098
$\emptyset_4$	Oil prices	0.054
$\emptyset_5$	Food prices	0.004
$\emptyset_6$	South African inflation	0.315

The computed long-run elasticities indicate that in the long run, a one per cent increase in South African inflation leads to a 0.3 per cent increase in inflation in Zimbabwe. An appreciation of one per cent in the South African rand against the US dollar results in an increase in the general price level of 0.098 per cent. In the short run, an appreciation of the exchange rate would result in a 0.06 per cent increase in inflation in Zimbabwe.

The results also show that changes in oil prices have an impact on the inflation level in the long run. A one per cent increase in oil prices would result in an increase in the general price level of about 0.05 per cent. These results imply that in the multiple-currency environment, the US dollar/South African rand exchange rate, international oil prices, South African inflation and the lagged inflation for Zimbabwe have a bearing on Zimbabwe's inflation dynamics in the long run.

Short-run error correction model (ECM)

The short-run coefficient estimates shown in Table 4 were obtained from the error correction model of the ARDL. The error correction (ECM-1) coefficient, which shows the speed of adjustment of the relationship to the equilibrium, is negative

and highly significant. This is further proof of the existence of a stable relationship between the variables in the model, as stated by Banerjee, Dolado & Mestre (1998). In this particular case, the estimated error correction coefficient is -0.5352, implying that deviation from the long-term inflation trajectory corrects itself by about 54 per cent in the following year.

Table 4: Short-run error correction model (ECM)

Dependent variable: DLOG (ZCPI)				
Variable	Coefficient	Std. error	t-Statistic	Prob.
C	0.001473	0.000660	2.232786	0.0321
DLOG(SCPI)	0.091357	0.046118	1.980965	0.0555
DLOG(SEXC)	0.065665	0.016622	3.950427	0.0004
DLOG(OIL)	0.030247	0.008827	3.426838	0.0016
DLOG(MS(-1))	0.017538	0.008128	2.157627	0.0379
DLOG(ZCPI(-1))	-0.161629	0.105206	-1.536308	0.1335
DLOG(SCPI(-1))	0.059605	0.050613	1.177655	0.2469
ECM(-1)	-0.535223	0.135971	-3.936306	0.0004
R-squared	0.598130	Mean dependent variable		0.003132
Adjusted R-squared	0.517756	S.D. dependent variable		0.003851
S.E. of regression	0.002675	Akaike info criterion		-8.843866
Sum squared resid	0.000250	Schwarz criterion		-8.516201
Log likelihood	198.1431	Hannan-Quinn criterion		-8.723033
F-statistic	7.441839	Durbin-Watson statistic		2.164013
Prob. (F-statistic)	0.000017			

Diagnostic and stability tests

The structural stability of the inflation equation is examined using the CUSUM and CUSUM SQUARE tests, which detect systematic change in the regression coefficients. The tests fall within the critical bound lines at the five per cent level of significance, implying that the coefficients in the inflation model are stable over the period under review. As such, the evidence revealed from the estimated model can be used for practical policy-making purposes. The Ramsey reset test for model

specification and CUSUM with CUSUMSQ stability tests were employed to check the validity and robustness of the standard econometric model. Figure 3 presents the plot of the CUSUM and CUSUMSQ test statistic.
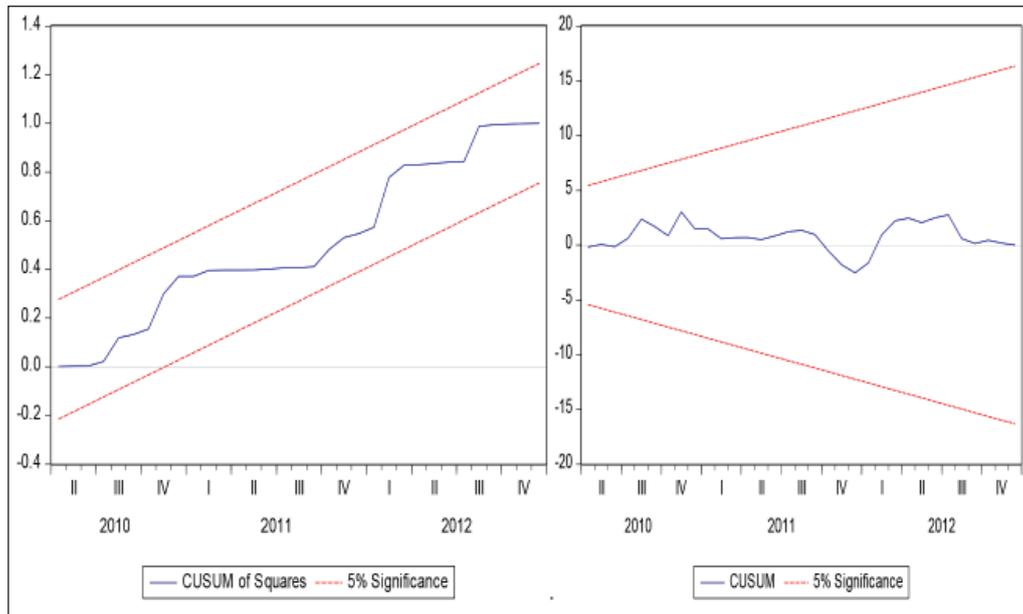
Figure 3: Plot of CUSUM and CUSUMSQ test statistic

Summary and policy recommendations

This study uses the ARDL approach on monthly time series data between 2009:1 and 2012:12 to determine the major factors that influenced inflation in the dollarised Zimbabwean economy. The existence of co-integrating relationships among the variables was confirmed by the Wald coefficient test, which rejected the null hypothesis of no co-integration.

According to the empirical findings, South African inflation has the most significant impact on inflation in the dollarised Zimbabwean economy. A one per cent increase in South African inflation results in a 0.3 per cent increase in inflation in Zimbabwe. Similarly, a one per cent appreciation in the South African rand against the US dollar induces a 0.1 per cent increase in inflation in Zimbabwe. The findings also show that a one per cent increase in the international price of oil leads to a 0.05 per cent increase in inflation. These results indicate that Zimbabwean policy-makers do not have any control over price formation in the dollarised economy, as this is largely dependent on external factors.

The loss of monetary policy autonomy typified by the lack of the exchange rate as a tool at the authorities' disposal constrains the available policy options on the exchange rate front. This notwithstanding, the country can cushion itself from imported inflation from South Africa by ending its heavy reliance on imports from South Africa. It is also important for the country to confine the import basket to critical intermediate goods that are yet to be produced domestically. In this regard, inflationary pressures emanating from finished consumer goods such as cooking oil, soap, beverages and other food items can be significantly reduced.

Furthermore, the need to improve efficiency remains critical if the country's goods are to maintain their competitiveness in both the domestic and international markets. Improvement in efficiency, however, entails the adoption of modern production technologies as well as accessing external lines of credit at internationally competitive interest rates. In addition, the expeditious resolution of the country's debt overhang remains critical in efforts geared at unlocking affordable credit lines from international capital markets. Improving the country's productive capacity and efficiency can reduce production costs, significantly improve the country's export competitiveness and also offset the negative repercussions of the appreciation of the South African rand against the US dollar. Relatedly, the meaningful attraction of both debt and non-debt creating capital flows, notably foreign direct investment, requires that supportive measures be adopted pro-actively in Zimbabwe. In this regard, the need for the alignment of the country's investment laws and procedures to international best practices cannot be over-emphasised. The realigned and investor-friendly policies should be buttressed by the upholding of the rule of law and the respect of property rights if the country is to attract the much-needed foreign direct investment. The government should also strive to improve its relations with the international community to deal with negative perceptions that have tended to increase the country's risk, making borrowing from offshore sources very expensive, even for private sector entities.

The attraction of foreign direct investment entails the review of the country's indigenisation and economic empowerment laws in such a manner that achieves the twin objectives of attracting the much-needed capital and advanced technology as well as integrating the indigenous people in mainstream economic activity. The attraction of foreign direct investment remains the cog that underpins the attainment of efficiency and export competitiveness; the effective plugging of attendant supply gaps; the permanent shedding of import dependency and the diversification of the country's export basket away from over-reliance on primary products to finished products.

It is also imperative that the country creates a land market to resuscitate the agricultural sector, which is the backbone of the economy, through its forward and backward linkages with the manufacturing sector. The resuscitation of the agriculture sector should result in an increase in output, which would help the country to increase its output of food products and thus reduce its reliance on food imports from South Africa.

References

Akinbobola, T.O. 2012. 'The dynamics of money supply, exchange rate and inflation in Nigeria', *Journal of Applied Finance and Banking,* 2(4): 117–141.

Akçay, O.C., Alper, E. & Karasulu, M. 1997. 'Currency substitution and exchange rate instability: The Turkish case', *European Economic Review,* (4): 827–835.

Bahmani-Oskooee, M. & Domaç, I. 2002. 'On the link between dollarization and inflation: Evidence from Turkey', *Comparative Economic Studies*, 45(3): 306–328.

Bailey, S.A. 2005. *Investigating the Link between Financial Dollarisation and Inflation: Evidence from Jamaica*. Financial Stability Department, Bank of Jamaica.

Balino, T., Bennet, A. & Borensztein, E. 1999. *Monetary Policy in Dollarized Economies*, Occasional Paper No. 171. Washington: International Monetary Fund.

Banerjee, A., Dolado, J.J. & Mestre, R., 1998. 'Error-correction mechanism tests for cointegration in a single equation framework', *Journal of Time Series Analysis* 19: 267–283.

Bardsen, G. 1989. 'Estimation of long run coefficients in error-correction models', *Oxford Bulletin of Economics and Statistics*, 51(3): 345–358.

Barro, R.J & Gordon, D. 1983. 'Rules, discretion and reputation in a model of monetary policy', *Journal of Monetary Economics,* 12: 101–21.

Berg, A. & Borensztein, E. 2000. *The Choice of Exchange Rate Regime and Monetary Target in Highly Dollarised Economies,* IMF Working Paper WP/00/50.

Bhattacharya, R. 2013. *Inflation Dynamics and Monetary Policy Transmission in Vietnam and Emerging Asia*, IMF Working Paper WP/13/55.

Bogetic, Z. 2000. 'Official dollarisation: Current experiences and issues', *Cato Journal,* 20(2).

Cagan, P. 1956. 'The monetary dynamics of hyperinflation in studies', In Friedman, M. (Ed.), *Quantity Theory of Money*. Chicago: University of Chicago Press.

Calvo, G.A. 1999. 'On dollarization*', Policy Notes*, April. [Online] Available at: www.bsos. umd.edu/ econ/ciecpn5.pdf.

Calvo, G.A. & Vegh, C. 1996. 'From currency substitution to dollarisation and beyond: Analytical and policy issues', In Calvo, G.A. (Ed.), Money, Exchange Rates and Output. Cambridge, MA: MIT Press.

Carranza, L., Sanchez, J.E.G. & Biscarri, J.G. 2008. *Exchange Rate and Inflation Dynamics in Dollarised Economies*. Facultad de Ciencias Economicas y Empresariales Universidad de Navarra. Working Paper No. 10/04.

Chhibber, A, Cottani, J, Firuzabadi, R. & Walton, M. 1989. *Inflation, Price Controls, and Fiscal Adjustment in Zimbabwe*', World Bank Working Paper WPS 192.

Coorey, S., Clausen, J.R., Funke, N., Munoz, S. & Ould-Abdallah, B. 2007. *Lessons from High Inflation Episodes for Stabilising the Economy of Zimbabwe*, IMF Working Papers WP/07/99. Washington, DC: International Monetary Fund.

Curutchet, A.F. 2001. The benefits and costs of official dollarisation for Argentina, Master's dissertation, Lund University.

Dallas, H. & Tavlas, G.S. 2001. 'Lessons of the euro for dollarisation: Analytical and political economy perspectives', *Journal of Policy Modelling,* 23: 333–45.

De Grauwe, P. 2000. *Economics of Monetary Union*. New York: Oxford University Press.

Del Cristo, M.L.M. & Gomez-Puig, M. 2012. *Pass-through in Dollarized Countries: Should Ecuador Abandon the US Dollar?* Research Institute of Applied Economics, Working Paper 2012/16.

Eichengreen, B. 2001. 'What problems can dollarisation solve?', *Journal of Policy Modelling*, 23(3): 267–77.

Eichengreen, B. 2002. 'When to dollarise', *Journal of Money, Credit and Banking,* 34(1).

Engle, R.F. & Granger, C.W.J. 1987. 'Cointegration and error-correction: Representation, estimation and testing', *Econometrica*, 55: 251–76.

Fabris, N., Vukajlović-Grba, D., Radunović, T. & Janković, J. 2004. *Economic Policy in Dollarised Economies with a Special Review of Montenegro*, Central Bank of Montenegro Working Paper 1.

Frankel, J.A. & Rose, A.K. 1998. 'The endogeneity of the optimum currency area criteria', *Economic Journal*, 449(July): 1009–1025.

Fischer, S. 1982. 'Seigniorage and the case for a national money', *Journal of Political Economy*, 90(2): 295–313.

Gachet, I., Maldonado, D. & Perez, W. 2008. 'Determinants of inflation in a dollarised economy: The case for Ecuador', *Cuestiones Economicas,* 24(1): 5–28.

Goldfjan, I. & Olivares, G. 2000. *Full Dollarization: The Case of Panama*, Working Paper Series. Rio de Janeiro: Pontificia Universidade Católica.

Goujon, M. 2006. 'Fighting inflation in a dollarized economy: The case of Vietnam', *Journal of Comparative Economics*, 34: 564–581.

Hanke, S.H. & Schuler, K. 1999. 'A monetary constitution for Argentina: Rules for dollarisation', *Cato Journal,* 18(3).

Hausmann, R., Gavin, M., Pages-Serra, C. & Stein, E. 1999. *Financial Turmoil and the Choice of Exchange Rate Regime*. Working Paper, Inter-American Development Bank.

Hendry, D.F. 2001. 'Modelling UK inflation 1875–1991', *Journal of Applied Econometrics,* 16: 255–275.

Hoque, M.M. & Yusop, Z. 2010. 'Impacts of trade liberalisation on aggregate imports in Bangladesh: An ARDL bounds test approach', *Journal of Asian Economics,* 21: 31–52.

IMF (International Monetary Fund). 1999. *Monetary Policy in Dollarized Economies,* IMF Occasional Paper No. 171.

Irefin, D. & Yaaba, B. 2011. 'Determinants of foreign reserves in Nigeria: An ARDL approach', *CBN Journal of Applied Statistics,* 2(2).

Johansen, S. 1991. 'Estimation and hypothesis testing of cointegrating vectors in Gaussian vector autoregressive models', *Econometrica*, 59: 1551–1580.

Juselius, K. 1992. 'Domestic and foreign price effects on prices in an open economy: The case of Denmark', *Journal of Policy Modelling*, 14: 401–428.

Khatun, F. & Ahamad, M.G. 2012. *Investigating the Determinants of Inflationary Trends in Bangladesh: An ARDL Bounds F-test Approach*, MPRA Paper No. 42572. University Library of Munich.

Makochekanwa, A. 2007. *A Dynamic Enquiry into the Causes of Hyperinflation in Zimbabwe*, Department of Economics Working Paper Series, WP 2007–10, University of Pretoria.

McNelis, P. & Asilis, C. 1992. 'A dynamic simulation analysis of currency substitution in an optimizing framework with transaction costs', *Revista de Análisis Económico,* 7.

McKinnon, R.I. 1963. 'Optimum currency areas', *American Economic Review,* 53(4).

Metin, K. 1995. 'An integrated analysis of Turkish inflation', *Oxford Bulletin of Economics and Statistics*, 57: 513–532.

Mundell, F. 1961. 'A theory of optimum currency areas', *American Economic Review*, 51: 509–517.

Nguyen, T.T.H. & Nguyen, D.T. 2010. *Macroeconomic Determinants of Vietnam's Inflation 2000–2010: Evidence and Analysis*. Hanoi: Vietnam Centre for Economic Policy Research.

Nguyen, H.M., Cavoli, T. & Wilson, J.K. 2012. 'The determinants of inflation in Vietnam, 2001–09', *ASEAN Economic Bulletin*, 29(1): 1–14.

Oomes, N. & Ohnsorge, F. 2005. *Money Demand in Dollarised Economies: The Case of Russia*. IMF Working Paper WP/05/144.

Pahlavani, M. & Rahimi, M. 2009. 'Sources of inflation in Iran: An application of the ARDL approach', *International Journal of Applied Econometrics and Quantitative Studies,* 6(1).

Pesaran, M.H. & Shin, Y. 1999. 'An autoregressive distributed lag modelling approach to cointegration analysis', In Strom, S., Holly, A. & Diamond, P. (Eds), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*. Cambridge: Cambridge University Press.

Pesaran, M.H., Smith, R.J. & Shin, Y. 2001. 'Bounds testing approaches to the analysis of level relationships', *Journal of Applied Econometrics,* 16: 289–326.

Rojas-Suarez, L. 1992. 'Currency substitution and inflation in Peru', *Revista de Análisis Económico*, 7(1): 153–176.

Reinhart, C.M., Rogoff, K.S. & Savastano, M.A. 2003. *Addicted to Dollars*. NBER Working Paper Number 10015.

Schuler, K. 1998. 'A contingency plan for dollarising Hong Kong', *HKCER Letters (Hong Kong Center for Economic Research)*, 52(September): 1–20.

Schuler, K. & Stein, R. 2000. 'The Mack dollarization plan: An analysis', Paper presented at the Federal Reserve Bank of Dallas Conference on Dollarization: A Common Currency for the Americas?, March.

Shittu, O.I., Yemitan R.A. & Yaya, O.S. 2012. 'On autoregressive distributed lag, cointegration and error correction model', *Australian Journal of Business and Management Research*, 2(8): 56–62.

Starr, P.S. 2001. 'Dollars for pesos? The political-economy of dollarisation in Latin America', *Brazilian Journal of Political Economy,* 21(1): 62–77.

Annexure 1

Wald test coefficient restriction test			
Test statistic	**Value**	**DF**	**Probability**
F-statistic	14.98482	(5, 33)	0.0000
Chi-square	74.92410	5	0.0000
Normalised restriction (= 0)		Value	Std. Err.
C(8)–C(13)		-0.593492	0.079278
C(9)–C(13)		0.055955	0.010455
C(10)–C(13)		0.069515	0.015954
C(11)–C(13)		0.121142	0.020177
C(12)–C(13)		0.027010	0.011398