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Research Article

Exchange Rate Pass-Through in Malawi: Evidence from Augmented Phillips Curve and Vector Autoregressive Approaches

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Abstract

This study analyses the degree of exchange rate pass-through to consumer prices in Malawi using the augmented Phillips curve and vector auto regression approaches. The pass-through elasticity of 0.15 as estimated by the the Phillips curve suggests a modest influence of exchange rate movements on domestic prices. However, the dynamic pass-through elasticity of 0.2 still puts exchange rate as a potentially important source of inflation in Malawi. The policy implication arising from these findings is that the monetary authority must be vigilant and closely monitor exchange rate movements so as to take a prompt monetary policy action and focus on exchange rate interventions which stem inflation pressure from the external sector.

Keywords: Pass-through, exchange rate, Phillips curve, VAR
JEL Classification: E31, E37

INTRODUCTION

One of the most challenging problems in the conduct of monetary policy in developing countries, especially small open economies like Malawi, is exchange rate pass-through (ERPT). ERPT refers to the change in local currency domestic prices resulting from 1 percent change in the exchange rate.

Currency depreciation can affect domestic prices directly by increasing the domestic currency price of tradables, and indirectly through changes in economic activity when the price of foreign goods increases relative to domestic goods. The extent to which currency fluctuations pass through to domestic prices depend on the weight of imported goods and services in the production process and many other factors, including the degree to which imports are priced to the market in the importing country's currency. The relationship between exchange rate and prices has been extensively analysed. But only a few studies pertain to sub-Saharan Africa (SSA). Most country-specific studies find low exchange rate pass-through and in some cases even zero. For instance, Anguyo (2008) using vector error correction model (VECM) found that the ERPT to inflation in Uganda is low, a finding that is consistent with a number of other studies. Mwase (2006) and Nkunde (2006) using a structural vector auto-regression (SVAR) find low ERPT for Tanzania.

Similarly, for Ghana, two studies, Frimpong and Adam (2010), and Devereux and Yetman (2003), the former based on vector auto-regression (VAR) models and the latter a single equation approach find low ERPT. Chaoudhri and Hakura (2001) also report low pass-through for a number of SSA countries (Ghana, South Africa, Zimbabwe), while for Tunisia and Ethiopia, the pass-through is zero.

On the other hand Sanusi (2010), using SVAR model finds substantially large, although incomplete pass-through for Ghana, with a dynamic pass-through elasticity of 0.79. Chaoudhri and Hakura (2001) also find modest pass-through elasticity for Kenya, Cameroon and Zambia. The conflicting findings of empirical studies on the size of ERPT call for further studies especially considering the recent change in the macroeconomic environment following the 2008 financial and economic crisis in developing countries including Malawi. This paper estimates the ERPT in Malawi using an augmented Phillips Curve and vector autoregressive approaches to track pass-through from exchange rate fluctuations to each stage of the distribution chain in a simple integrated framework.

To the best of our knowledge, no explicit study has been carried out to investigate exchange rate pass-through to domestic prices in Malawi. However, related studies have attempted to find the determinants of inflation in Malawi. For instance, Simwaka, et al.(2011) discovered persistence of inflation, as past inflation is found to be a significant determinant of inflation in the short run and the existence of a high impact of exchange rate to domestic price. In fact the nominal exchange rate appeared to have a stronger impact on inflation than money supply growth. Mangani (2008) found that prices in Malawi were largely influenced by the exchange rate (hence open-economy effects).

The objective of this paper is to econometrically estimate the degree of exchange rate pass through in Malawi using the Phillips curve and vector autoregression. The knowledge of the empirical estimate of the degree and speed of the exchange rate pass-though, is important for the Malawian monetary authorities for several reasons. It has important implications for monetary policy because in addition to its effect on the transmission mechanism of monetary policy, exchange rate pass-through also has implications for external adjustment. Large exchange rate pass-through implies that the response of trade balance to nominal exchange rate changes will be large (IMF, 2006).

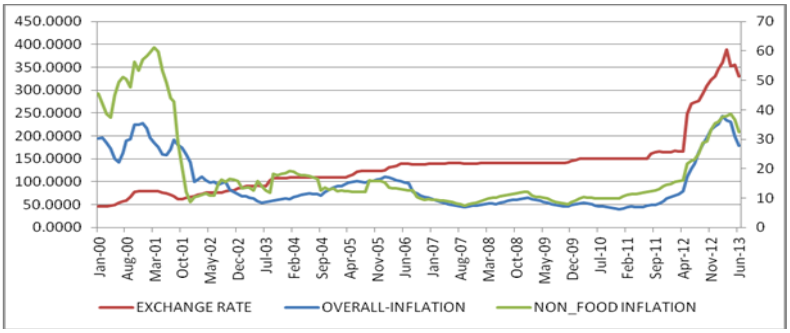
Exchange Rate Trends and inflation in Malawi 2000-2013

The effects of exchange rate movements are transmitted to consumer prices via three major channels: (i) prices of imported consumption goods, (ii) domestically produced goods priced in foreign currency, and (iii) prices of imported intermediate goods. While the effect of exchange rate movements is direct in the first two channels, in the last channel exchange rate movements affect domestic prices less directly by changing the costs of production (Sahminan, 2002).

Many monetary models of the exchange rate and balance of payments assume a one-to-one relationship between the exchange rate and domestic prices, based on the law of one price (or purchasing power parity, PPP). However, empirical evidence almost unanimously concludes that the exchange rate pass-through is incomplete. The literature suggests that pass-through to import prices (the first-stage) tends to be greater, albeit incomplete, than the pass-through to consumer prices. These findings have motivated numerous theoretical models aimed at explaining the incompleteness of the exchange rate pass-through. One of the reasons Malawi was clinging to a pegged exchange rate regime before a flexible regime in May 2012 was the thinking that a devaluation and subsequent depreciation would be inflationary. Since the Malawi is a net importer, there were fears that devaluing the local currency would immediately lead to high domestic prices.

Chart 1 shows the relationship between exchange rate and inflation. By inspection, it can be seen that periods of depreciation coincides with periods of increasing inflation. In particular, beginning around 2005 when the exchange rate was *de facto* fixed, inflation was also stable and in single digits. However, when the exchange rate was devalued by 49.7 percent in May 2012, both food and non-food inflation mimicked the exchange rate and increased sharply. There is therefore a strong case to argue that exchange rate changes have an impact on inflation in Malawi.

Figure 1. Exchange rate (MK/US$) and Inflation



METHODOLOGY

In terms of estimation approaches, both the popular ordinary least squares (OLS) and vector autoregressive (VAR) approaches are used

The Phillips Curve

The objective of this paper is to measure exchange rate pass-through to domestic inflation. The original Phillips curve as specified by Phillips himself in 1958 captured the tradeoff between wage inflation and unemployment as in equation 1:

$$\pi_t = \underset{t}{E}\pi_{t+1} - f_u\tilde{u}_t + f_z\tilde{\zeta}_t \quad (1)$$

Where u_t is unemployment and π_t are inflation respectively. However, overtime the Phillips curve has evolved to include more explanatory variables. For example Malikane and Mokoka (2012) specified the Phillips curve in equation (2) below in their quest to estimate the credibility of monetary policies from selected central banks:

$$\pi_t = \pi_t^e + \beta x_{t-1} + \vartheta\Delta q_{t-1} + \gamma z_{t-1} + \varphi m_{t-1} + \theta\tilde{\pi}_{t-1}^{fuel} + \psi\tilde{\pi}_{t-1}^{food} + \varepsilon_t \quad (2)$$

Where π_t is the actual inflation rate, π_t^e is the expected inflation rate, x_t represents lagged demand pressure measured by the output gap, q_t is the log of the price of imports denominated in domestic currency, z_t is the labour share which represents cost push from the labour market, m_t is the deviation of money supply from trend, $\tilde{\pi}^{fuel}$ and $\tilde{\pi}^{food}$ are real fuel price and food price inflation respectively and ε_t represents a disturbance term. the equation assumed, as noted by Rudebusch (2005), that there are inertial lagged responses of inflation to its determinants due to the prevalence of contracts and menu-costs.

This paper specifies an all encompassing empirical augmented Phillips curve, which includes a measure of demand pressure (output gap), money supply, fuel price, and food price inflation. Specifically, we modify Phillips curves as specified by Blinder (2000) and Malikane (2012) in that ours adds exchange rate to the list of determinants of inflation.

We therefore specify the following equation:

$$inf_t = \delta_0 + \sum_{i=0}^{k}\delta_{1i}\, m_{t-i} + \sum_{i=0}^{k}\delta_{2i}\, ygap_{t-i} + \sum_{i=0}^{k}\delta_{3i}\, inf_{t-i}^{food} + \sum_{i=0}^{k}\delta_{4i}\, inf_{t-i}^{fuel} + \sum_{i=0}^{k}\delta_{5i}\, exr_{t-i} + \sum_{i=0}^{k}\delta_{6i}\, inf_{t-i} + \delta_{7i}\tilde{D}_{t-i} + \varepsilon_t \quad (3)$$

Where *inf* is inflation rate, m_t is money supply, *ygap* is output gap, inf^{food} is food inflation, and inf^{fuel} is fuel prices, *exr* is nominal exchange rate measured by Malawi kwacha per US dollar and $\tilde{D}$ is a linear combination of relevant dummy variables.

Exchange rate is included as a variable in the above equation because Malawi as a small open economy that has limited manufacturing capacity, and that it relies heavily on imported manufactured items (and fuel) for both consumption and as intermediate goods, exchange rate is expected to be chief suspect of influencing domestic prices. We also hypothesize that inflation rate in Malawi is persistent due to, among other factors, rigidities arising from backward-looking expectations. We include money supply and output gap because of the usual theoretical reasons.

The Vector Auto regression

We estimate an unrestricted VAR to track down impulse responses and variance decomposition of inflation.
The simplest case of a VAR model is the reduced form VAR model, where each variable is a linear function of its own past values and past values of all other variables. A reduced form VAR of order *p* in levels of the variables can be expressed as follows:

$$x_t = Ay_t + \Omega_1 x_{t-1} + ... + \Omega_i x_{t-i} + ... + \Omega_p x_{t-p} + \varepsilon_t \quad (4)$$

Where y_t is a vector of deterministic variables such as constant, trend and seasonal variables, Ω and A are matrices of coefficients to be estimated, x_t is an k x1 of exogenous variables, ε_t is an n x1 vector of error terms. Unfortunately, the reduced-form VAR model does not resolve the identification problem because it typically yields error terms that exhibit cross-equation contemporaneous correlations.

Two main procedures are proposed to resolve the identification problem in a VAR framework. The first is to diagonalise the variance-covarince matrix of the VAR system using a triangular orthogonalisation process. This is achieved by estimating the reduced-form VAR model, then computing the Cholesky factorisation of the models' covariance matrix (Lutkepohl, 1993). Although this so-called recursive VAR modelling procedure can resolve the identification by ensuring that shocks to the VAR system can be identified as shocks to the endogenous variables in each equation (as in a reduced-form VAR), it has the general disadvantage of being sensitive to the ordering of variables in the computation of the shocks. The approach adopted in the literature is to place policy variables first in the ordering. The basis for this is the assumption that policy variables can influence non-policy variables contemporaneously as well as with a lag, while the non-policy variables themselves can only be influenced by the policy variables after a time-lag due, for instance, to delays in the availability of economic data (Bernanke and Blinder, 1992, Stock and Watson, 2001). This approach is quite reliable when the off-diagonal elements of the variance-covarince matrix are small (i.e., when the contemporaneous correlations among the relevant innovations are low; see Bacchetta and Ballabriga, 2000). However, Perasan and Shin (1998) have provided a framework for applying the Cholesky decomposition procedure that is insensitive to the ordering of variables.

Data and data sources

We use quarterly data from Research and Statistics database of the Reserve Bank of Malawi from 1990q1 to 2013q2. Output gap is estimated by using HP filter and quarterly GDP is interpolated from annual figures using quadratic match sum technique. This paper uses bilateral Malawi kwacha/ US dollar exchange rate as an exchange rate variable. We have used this exchange rate unlike effective exchange rates because MK/US is both significant and an invoice foreign currency. Money supply is measured by its deviation from the trend to capture excess money supply. Inflation is calculated by consumer price index (CPI).

EMPIRICAL RESULTS

Unit Root Tests

Subjecting each variable to the popular Augmented Fuller test shows that all the variables are stationary at I(1) except the the output gap. We therefore estimate the equation (3) with differenced variables but output gap.

Table 1. Augmented Dickey-Fuller Unit Root Test

	LEVEL	FIRST DIFFERENCE	
VARIABLE	**ADF**	**ADF**	**COMMENT**
CONSUMER PRICE INDEX	-0.3284	-4.2694	I(1)
BROAD MONEY	-1.1453	-3.4383	I(1)
EXCHANGE RATE	-1.9301	-6.8005	I(1)
OUTPUT GAP	-3.59	-	I(0)
CPI FOOD	-2.5276	-3.3630	I(1)
PETROL	-1.1018	-6.7291	I(1)

The Phillips Curve Model

$$inf_t = 0.01 + 0.79\ inf_{t-1} + 0.22 ygap + 0.15\ exr + 0.23\ inf^{food} \quad \textbf{(5)}$$

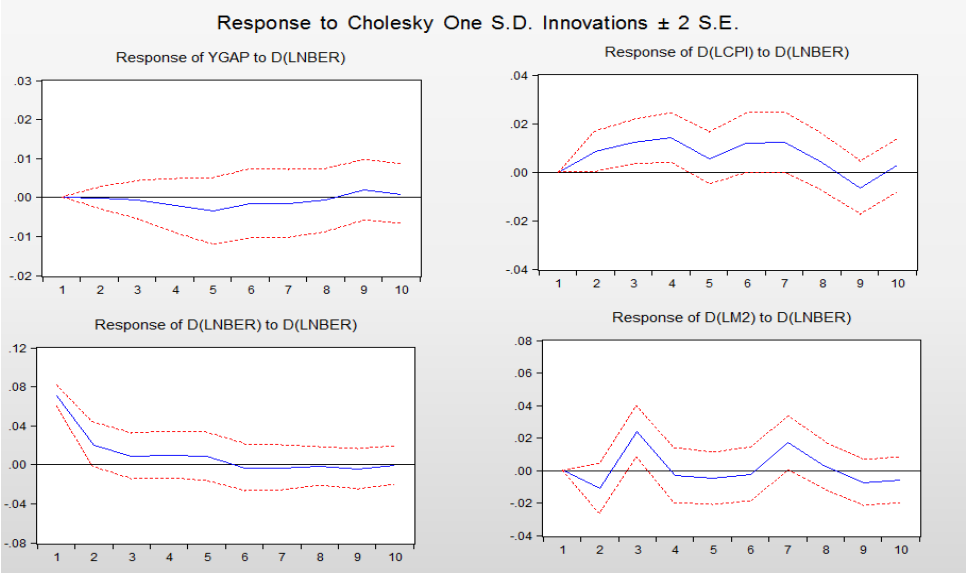
Estimating equation (3) leads into a parsimonious equation (5) above. From the results, inflation indicates to be highly persistent with most of its current changes emanating from its previous values. A one unit change in output gap leads to a contemporaneous 0.22 percent change in inflation. A one percent change in exchange rate leads to a 0.15 percent change in inflation. This indicates an incomplete pass-through of exchange rate. This is similar to results by selected

studies in developing countries including sub-Saharan countries. Chaoudhri and Hakura (2001) found zero elasticity of pass-through to inflation in Bahrain, Canada, Finland, Singapore, Ethiopia and Tunisia, 0.09 for Kenya, 0.02 for South Africa, 0.06 for Zimbabwe, 0.22 for Cameroon, 0.14 for Ghana, and 0.16 for Burkina Faso.

The Vector Auto regression

The results of the exchange rate shock under the unrestricted VAR scheme described above are shown in figure 2. Specifically, figure 2 shows the impact of a one standard deviation shock, defined as an exogenous, unexpected, temporary depreciation in the exchange rate with a 95 percent confidence level on domestic price inflation, output gap and money supply. The solid line in each graph is the estimated response while the dashed lines denote a two standard error confidence band around the estimate. Since the data are in first differences of logarithms, the IRFs need to be regarded as measuring a proportional change in the rest of the macro variables due to one standard innovation (at the initial period) in the exchange rate.

Figure 2. Responses to Exchange rate shocks



It is unambiguous from the figure that the effect of an exchange rate shock on domestic price is fairly gradual (taking about 4 quarters to reach the full impact) and the effects finally vanish after 9 quarters (over 2 year). Based on the numbers in figure 2, the full effect of a structural one standard deviation shock to the exchange rate of 0.071 (or 7.1%) depreciation is about 0.014 (or 1.4%) increase in the domestic price level. This suggests a dynamic exchange rate pass-through elasticity of 0.20[1]. The output gap responds to exchange rate shock by declining, with the volatility dying out after the fifth quarter. Money supply weakly responds to exchange rate by initially declining but impact dies out in the second quarter. The cycles in the money supply responses could be explained by frequent monetary policy injections and withdrawals of liquidity in the system. To summarise, the IRFs indicate that the exchange rate pass-through in Malawi is fairly modest and incomplete.

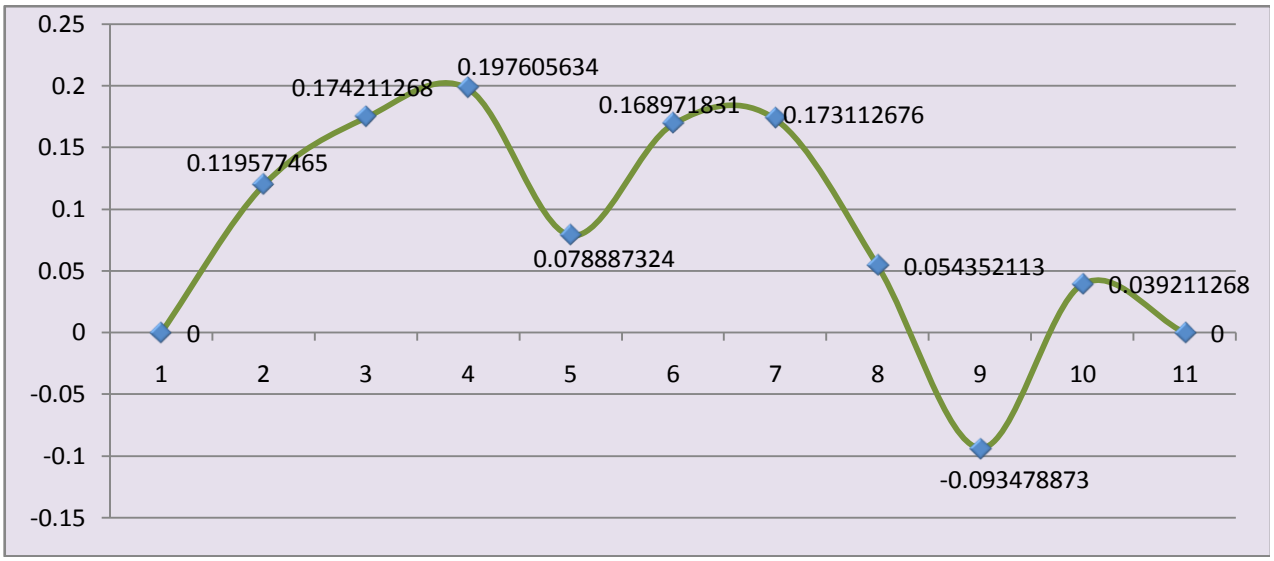
Table 2. Effect of Cholesky (d.f. adjusted) One S.D. Exr Innovation

Period	YGAP	CPI	M2	EXR
T=1	-0.002802	0.052438	0.027205	0.071089
T=2	-0.024084	0.021636	0.005166	0.02027
T=3	-0.010442	0.010686	-0.01153	0.008862
T=4	-0.037727	0.002072	0.011325	0.010087

Source: Author

[1] Pass-through elasticity = $\frac{\%\Delta CPI\,(t)}{\%\Delta exr\,(0)}$, Where the denominator is the initial shock of exchange rate (assuming we only have one shock in the system)

Figure 3. Dynamic Elasticity of Exchange rate pass-through



Source: Author

It is timely at this juncture to mention that once again the two methods used in this paper have found money supply not to adequately explain inflationary developments. This paper therefore is in harmony with findings by Simwaka et al (2011), Lungu et al (2012), Mangani (2008) Ngalawa (2011) that the link between money supply and inflation is weak effectively putting the quantity theory of money of no consequence in Malawi.

Variance Decomposition

Variance decomposition gives insights into the relative contribution of the structural shocks in explaining volatilities in inflation. The variance decomposition is shown in Table 3 below.

Table 4. Variance Decomposition of inflation

Period	YGAP	INF	M2	EXR
T=1	0.044517	99.95548	0	0
T=2	0.678518	92.5353	1.9386	4.847583
T=3	5.603694	79.18859	2.274161	12.93356
T=4	13.56034	63.31432	3.743979	19.38137
T=5	12.529	68.55116	2.902224	16.01761
T=6	12.02092	65.26722	3.482576	19.22929
T=7	12.11809	61.27856	4.378	22.22535
T=8	11.89716	61.03574	4.824911	22.24219
T=9	11.67027	61.16332	4.97709	22.18932
T=10	12.95705	60.12497	4.925313	21.99266
T=11	13.20628	60.14353	5.27596	21.37423
T=12	13.14227	59.90512	5.530872	21.42174

Source: Computed by author

Consistent with the IRFs discussed above, variance decomposition reveals that exchange rate shocks have a modest contribution to inflation variance, but inflation is mainly driven by own shocks especially at shorter horizons. Specifically, exchange rate shocks account for 0 to 21 percent (at 1 to 12 quarters horizon respectively), while own shocks account for about 99.9 to 60 percent over the same horizon, suggesting as in (Choudhri and Hakura, 2001) that the level of inflation dominates the volatility of inflation.

CONCLUSION AND POLICY IMPLICATIONS

Using the augmented Phillips curve and vector auto regression approaches, this paper estimates the exchange rate pass-through to domestic inflation. The pass-throughs of 0.15 and 0.20 elasticities as estimated by the above methods

above suggests a modest influence of exchange rate movements on domestic prices. Perhaps this is why despite exchange rate moved around 168 per US$ to scaring levels of 420 per US$, inflation only crawled from 17.3 percent to 37.9 before it started declining. However the dynamic exchange rate pass-through of 0.2 still put exchange rate as a potentially important source of inflation in Malawi. The policy implication arising from these findings is that the monetary authority must be vigilant at exchange rate movements so as to take a prompt monetary policy action and focus on exchange rate interventions which stem inflation pressure from the external sector.

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