TESTING THE INTERNATIONAL TRANSMISSION OF INTEREST RATE SHOCKS USING VECTOR AUTO-REGRESSION: EVIDENCE FROM CAPE VERDE

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Abstract

This paper examined if interest rate shocks from the United States (U.S.) are transmitted to Cape Verde. I collected data on four Cape Verdean variables (real gross domestic product, consumer price index (CPI), exchange rate and interest rate) and two foreign variables (U.S Federal fund rate and the world CPI) for the period 1984-2012. The impulse response analysis of the VAR model shows that the country’s variables respond insignificantly to shocks from foreign variables. It was therefore concluded that macroeconomic shocks in Cape Verde are basically homemade.

Key words: Interest rate, shocks, Cape Verde, U.S.A., VAR.

1. Introduction

The global transmission of monetary policy shocks and its effects on macroeconomic environment of countries has been a long-standing debate in the field of international finance. Over the years, one of the major problems facing monetary economists across the globe, especially the developing countries has been the macroeconomic implication of interest rate changes. Interest rate is a major macroeconomic variable whose changes contribute immensely towards determining the position of every economy. Hence, it is traditionally believed that how a child behaves is always a function of how his/her parent(s) or elders behave. Consider a Cape Verdean resident entrepreneur who has enough money to invest in the home country. On the verge of making this investment, the United States’ Federal Reserve announces an increase in interest rate. Conventionally, the positive slope of the LM curve would require a corresponding increase in output of the United States. Why? Because globalisation and its accompanying openness of national borders is expected to allow into the U.S., free inflow of investment capital, due to high interest rate. Consequently, the prospective Cape Verdean investor may automatically be expected to move his investment fund to the United States. The immediate effect of this financial cross over is an increase in the output of the United States and a decrease in Cape Verde’s output. The decrease in Cape Verde’s output would immediately take the country’s supply below its demand thereby causing demand-pull inflation. However, after several macroeconomic analysis and eventual confirmation of the causes of the inflation, the Cape Verde’s monetary authorities in an attempt to curb inflation via output increase, may be expected to co-move with the United States
by also increasing its interest rate. When this is done, foreign investors are attracted into Cape Verde. This would also increase the country’s output.

In 2008, Cape Verde had her interest rate increased from 3.3% to 3.8%. During this period, the interest rate of the United States reduced from 5.02 to 1.92 percent. In 2009, during which the United States interest rate decreased further to 0.19%, Cape Verde’s interest rate decreased to 2.9%. Between 2008 and 2010, Cape Verde experienced great changes in the growth rate of her GDP (from 6.2% in 2008 to 3.7% in 2009 and then 5.4% in 2010 before falling to 5.0% in 2011). Cape Verde’s inflation rate decreased from 6.8% in 2008 to 1.0% in 2009, increased to 2.1% in 2010 and further to 4.5% in 2011.

Consequent to the analysis above, if we should follow the argument of Edwards (2010), that interest rate hikes by the Federal Reserve contributed significantly to some of the most important currency crisis in recent times, such as the Mexican Tequila crisis of 1994-1995 and the Argentine Peso crisis of 2001-2002, it may not be unwise if we suspect that the same interest rate changes in the United States have contributed to major changes (fluctuations) in Cape Verde’s macroeconomic indicators, including interest rates, prices and output.

Research wise, the macroeconomic implication of such claims made by Edwards (2010) have led to some empirical studies aimed at understanding the way in which possible reforms in the international financial architecture affect different countries. Most of these studies were carried out using data for the developed and developing countries of Europe, Asia and America. Currently there is no such study completed for the economy Cape Verde, despite huge macroeconomic volatility in the country. Hence, the problem at hand is whether or not the interest rate changes in the advanced countries are transmitted to the underdeveloped countries, in this paper proxied by Cape Verde. In responding to the above stated problem, this paper seeks to:

- ascertain if Cape Verde’s interest rates respond to interest rate shocks in the United States?
- find out if interest rate shocks in the United States affect other basic macroeconomic variables in Cape Verde.

2. Review of related literature

International transmission effects of monetary policy shocks have been tested in many empirical works with mixed results and suggestions. The small-open economy model of Mundell-Fleming-Dornbusch has continued to be of influence in academic and political circles till the mid 1990s. Theoretically, Obstfeld and Rogoff (1995) assume that the purchasing power parity (PPP) always holds. As a result, the real interest rate parity holds between two countries. They predict that the domestic monetary shocks raise the level of domestic output but show an ambiguous effect on foreign output. A large empirical literature has investigated the international transmission of monetary and non-monetary shocks using small-scale structural Vector Auto-Regression (VAR) models. Clarida and Gali (1994) identified sources of real exchange rate fluctuations for post-Bretton Woods period for U.S., Japan, Germany, and Canada. The estimation of structural VAR in their study produced consistent results with the predictions of the Mundell-Fleming model showing that demand shocks lead to appreciation and monetary shocks leading to depreciation of the home currency. Eichenbaum and Evans (1995) also found the results similar to Clarida and Gali (1994). Kim (2001), on the other hand, estimated structural VAR to identify unidirectional effect of the US monetary policy shocks to the macroeconomic variables of G-7 countries and found that the U.S. monetary expansion has a positive spillover effects on real GDP and industrial production of non-U.S. G-6 countries. Other studies that found evidence of cross border

Evidence from previous studies reviewed has shown mixed results. For a more acceptable and consensus result and conclusion, further studies need to be carried out for different economies with different economic conditions. However, since most of the existing studies in this area of international Monetary Economics were done using data for the advanced and developing countries of Europe, Asia and America, this study is an attempt at doing the same using data for the economy Cape Verde.

3. Methodological issues
3.1: The model:

It is globally argued that in the era of globalization, monetary policies implemented in one country (numeraire country) can affect some other countries, either positively or negatively. Based on this argument, Central Banks are always interested in determining the extent to which their countries’ domestic interest rates diverge from world interest rates. Hence, the vital variable in this study is the differential between the Cape Verde’s interest rate and U.S. interest rate properly adjusted by country risk and currency risk. Specifically, interest rate differential is defined as:

\[ e_t = r_t - r_t^* - \theta_t - \varepsilon_t \]  

where \( r_t \) is the domestic currency nominal interest rate for securities of a certain maturity.
\( r_t^* \) is the international, nominal interest rate on foreign currency denominated securities of the same maturity.
\( \theta_t \) is the expected rate of depreciation of the domestic currency,
\( \varepsilon_t \) is a measure of country risk.

However, the steady state equilibrium with perfect capital mobility requires that the interest rate differential should be approximately zero. In this case, the speed at which convergence to long term equilibrium takes place is purely a function of specific countries’ conditions, but under free capital mobility, should rather be very fast. Hence, in steady state equilibrium,

\[ e = e^* \]  

Where \( e^* \) is the domestic interest rate.

The possibility of finding an equation (2) that is different from zero can only be determined empirically. It is only a function of several variables such as, degree of capital mobility and other forms of market frictions and transaction costs. With full capital mobility and in the absence of transaction costs of any form, we would expect that \( e^* \) would be approximately zero.

However, the most important issue I seek to address in this study is whether \( e^* \) is actually a function of international interest rate, proxied by the United States of America (numeraire country) Federal Fund Rate. Hence,
where FFR is the level of U.S. Federal Fund Interest Rates.

\[ e_{it}^* = \beta_0 + \beta_1 FFR_t + \sum_{j=1}^{m} \rho_j K_{it} + \omega_t \]

\[ \text{where } FFR \text{ is the level of U.S. Federal Fund Interest Rates.} \]

\[ e_{it}^* \text{ is Cape Verde’s policy interest rates at time t. (i represents Cape Verde)} \]

\[ \beta_0, \beta_1 \text{ and } \rho_j \text{ are coefficients,} \]

\[ K_{it} \text{ is a vector of other possible determinants of } e_{it}^* \]

\[ \omega_t \text{ is still an error term with its usual characteristics.} \]

However, following Mojon and Peersman (2001), Frankel, et al. (2004), etc, I have decided to represent the set of other determinants of \( e_{it}^* \) (\( K_{it} \)) by world consumer price index. The use of price is important because it is related to the concept of monetary independence. Moreover, it is believed that much of the variations in nominal interest rates could just reflect variations in inflation differentials (Frankel, et al: 2004). It also helps to solve the so-called price puzzle: empirical finding in the Vector Autoregression (VAR) methodology literature that prices rise following an interest rate tightening (Mojon and Peersman, 2001). As a result, equation (3) could be transformed into:

\[ e_{it}^* = \alpha + \gamma FFR_t + \Psi WCPI_{it} + \gamma_{it} \]

Where \( WCPI_{it} \) represents the world consumer price index

\[ \gamma_{it} \text{ is still an error term with zero mean and independently distributed across countries at different times, } t. \]

\[ \alpha, \beta, \text{ and } \Psi \text{ are coefficients.} \]

However, to examine if interest rate shocks in the United States affects other macroeconomic variables in Cape Verde, I introduce the Structural Vector Autoregressive (SVAR) methodology used by Weber, et al (2011) to identify the monetary policy shocks in the Euro area.

**The Baseline VAR Model**

Vector Autoregressive (VAR) models are widely used in the empirical analysis of monetary policy transmission. This methodology has undoubtedly the merit of avoiding the need for a complete specification of a structural model of the economy (Bagliano and Favero, 1997). Evidence from literature shows the methodology to be appropriate in measuring the impact of monetary policy shocks on macroeconomic performance of countries.

In this study, my interest is in ascertaining if interest rate shocks in the United States affects other macroeconomic variables in Cape Verde. As such, I proceed on a bilateral basis with the USA on one side and Cape Verde on the other side. In this setup, any correlation between USA and Cape Verde is likely to be unidirectional. Consequent to this, the specification and the estimation of the statistical model could be significantly simplified (Canova, 2005).

In order to reflect the above setup in our model, I assume a block-exogenous VAR model in which the foreign variables (FFR and WCPI) are treated as exogenous to Cape Verdean variables. In other words, these exogenous foreign variables influence Cape Verdean variables but there is no feedback from Cape Verdean variables to these foreign variables. I therefore make allowance for a contemporaneous impact of these exogenous variables on the endogenous Cape Verdean variables. Moreover, the construction of a block-exogenous VAR model saves the degree of freedom. Therefore, using the content of equation (4) in specifying a SVAR model and introducing to the left-hand side other Cape Verdean macroeconomic variables, yields equation.
(5). In (5), $Z^{FR}_t$ is a vector of foreign variables (FFR and WCPI) while $Z^{CV}_t$ is a vector of endogenous Cape Verdan variables (we shall define these variables later).

$$Z_t = \begin{bmatrix} Z^{FR}_t \\ Z^{CV}_t \end{bmatrix}, \quad A(L) = \begin{bmatrix} A_{11}(L) & 0 \\ A_{21}(L) & A_{22}(L) \end{bmatrix}, \quad \mu_t = \begin{bmatrix} \mu_t^{FR} \\ \mu_t^{CV} \end{bmatrix} \quad \text{(5)}$$

where $Z^{FR}_t$ and $\mu_t^{FR}$ are $m_1 \times 1$ vectors, $Z^{CV}_t$ and $\mu_t^{CV}$ are $m_2 \times 1$ vectors, $A_{11}(L)$ is an $m_1 \times m_1$ matrix, $A_{21}(L)$ is an $m_2 \times m_1$ matrix, and $A_{22}(L)$ is an $m_2 \times m_2$ matrix.

$L$ is a lag operator.

However, due to parameter identification problems associated with the SVAR models, Ordinary Least Squares (OLS) estimation of the models yields inconsistent parameter estimates. This problem can be averted by re-writing the SVAR model (5) in a reduced form thus:

$$Z_t = \begin{bmatrix} RGDP_t \\ CPR_t \\ HEXR_t \\ HINT_t \end{bmatrix} = \alpha_1 + \alpha_2(L)Z_{t-1} + \beta FFR_t + \mu_t. \quad \text{(6)}$$

where HINT replaces $e^{*}$ as Cape Verde’s interest rate. $Z$ is a vector of endogenous variables and $i$ represent Cape Verde.

Here, the baseline model consists of four endogenous and two exogenous variables for the home country, Cape Verde. The endogenous variables are the country’s key macroeconomic indicators of real gross domestic product (RGDP); consumer prices (CPI); exchange rate (HEXR) and interest rate (HINT). These endogenous variables depend on their own lags and a constant term. The exogenous variables included in the model are the already defined WCPI and FFR which as indicated earlier, are expected to have contemporaneous impact on the endogenous variables.

The objectives of this study would be achieved by estimating the VAR equation (6) and analysing the Impulse Response Functions (IRF). Traditionally, the IRF have been widely used as a means of analysing an estimated VAR model (Hamilton, 1994). Here, the IRF is expected to expose the degree to which domestic interest rates responds to shocks in foreign interest rate as well as how other domestic macroeconomic variables respond to foreign interest rate.

### 3.2: Data

The all items annual averages of Consumer Price Indices (CPI) are used as proxies for measuring the price levels of Cape Verde's output. The United States is considered as the foreign country. All CPI data were obtained from the International Monetary Fund (IMF) World Economic Outlook database. The interest rate data of the USA were obtained direct from the U.S. Bureau of Labour Statistics (BLS), while all other dataset were obtained from the World Bank. All series are annual and span the period, 1984-2012. The choice of the period is based on data availability.

### 4. EMPIRICAL RESULT.

Our results reflect the Cape Verde’s response to an interest rate shock in the United States which is identified as a one-standard-error increase in the Federal Fund Rate (FFR). The result further shows the response of this country’s variables to shocks in the global consumer prices.

### Table 1: Response of Cape Verdan variables to foreign shocks

<table>
<thead>
<tr>
<th>FFR</th>
<th>RGDP</th>
<th>CPI</th>
<th>HEXR</th>
<th>HINT</th>
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Note: Two sided arrows denote insignificant responses of the endogenous variables to shocks in the exogenous variables. There were however responses (sometimes positive and other times negative but they are insignificant).

Source: Generated by the author from the IRF estimates.

Generally, an interest rate policy shock in the United States as well as a shock in the world consumer prices leads to insignificant fluctuations (increases and decreases) in Cape Verde’s macroeconomic variables. In more detail, an interest rate shock in the United States led immediately to slight increases in the Cape Verde’s real gross domestic product and consumer prices within the first three years of our sample space. After this period, these two variables decreased in values until they responded negatively (see figures A and C of the appendix). The exchange rate of the country responded negatively until the 17th year when it responded slightly positively before going down negatively once again (see figure E of the same appendix). The interest rate in Cape Verde initially did not respond to this shock. It responded after three years (though negatively). It continued on this negative but insignificant trend until the end of the period reviewed.

The Cape Verdean output had a stable insignificant negative response to the shock in global consumer prices. This lasted for about six years of the study period. After this period, the response became positive for the next nine years. This positive response may be attributed to the measures taken to fight inflation which eventually resulted in output growth. Within the first three years of the study period, figure D of the appendix shows that consumer prices in this country did not respond to global price shocks. Beyond this period, the response fluctuated between positive and negative. Figure F of the same appendix shows the response of exchange rate to global price shock. As observed, the response was negative though, insignificant almost throughout the sample period. It was after the twenty-fourth year that the variable responded positively. This however justifies the basic economic theory on the relationship between inflation and the exchange rate. Finally, interest rate in Cape Verde initially had an insignificant positive response to shocks in global consumer prices. This lasted for about three and half years. This is shown in figure H of the same appendix. After about forty-two months, interest rate started responding negatively though insignificantly until nearly the end of the sample period.

In a nutshell, the macroeconomic variables in Cape Verde responded insignificantly to foreign shocks. This is evident from the impulse response analysis conducted. By implication, the fluctuations in macroeconomic variables in the country may be a function of internal shocks arising from the implementation of wrong policies (both fiscal and monetary). This is however subject to investigation via further research.

5. Conclusion and policy recommendations

Our study investigated the transmission of United States interest rate shocks to Cape Verde using a VAR approach. We found that the macroeconomic variables of the Cape Veredian economy responded only insignificantly to the foreign variables’ shocks. Overall, our findings suggest that the Cape Veredian economy is not highly responsive to foreign shocks. However, this may imply that the huge macroeconomic volatility experienced by the country is home-made. Only an insignificant proportion of the domestic shocks can be linked to external shocks.

Based on the findings of this study and the conclusion that followed, we hereby recommend that monetary authorities in Cape Verde should continue with independent monetary policy
making, especially as it concern interest rate control. By implication, they should ignore to a large extent what happens externally. They are expected to base their policy making on domestic shocks, as considering what happens in other countries might confuse policy makers in their decision making process. This is sequel to the fact that domestic variables responds insignificantly to foreign shocks. This recommendation is indeed in line with the view that the central issue for policy making in developing countries is how to stabilize the economy in response to foreign shocks provided that those foreign shocks have impacts on the developing countries. In Cape Verde, they do have impacts but insignificantly.

References


Sahminan U. (2005), “Interest Rates and the Role of Exchange Rate Regimes in Major Southeast Asian Countries”, *Bank of Indonesia International Economics/Economic Development Seminar, March*


**ENDNOTE**

Oguanobi, Akamobi and Agu (2014) published a paper titled “cross-border transmission of interest rate shocks: a VAR analysis of the Nigerian economy. Oguanobi, Akamobi, Ifebi and Maduka (2015) also published a work titled “does interest rate shocks transmit from United States to Ghana? Evidence from vector autoregression. The only difference between these papers and this current paper is the country of study. As a result, this current paper only changed the country of study, the empirical data used and the resulting findings. All other sections of this paper remain as used in these previous papers. I therefore thank the authors (Oguanobi Chibuike, Akamobi Anthony, Agu Cletus, Ifebi Ogonna and Maduka Anne) for writing those papers and allowing me to copy parts of them.
APPENDIX: IMPULSE RESPONSE FUNCTIONS

RESPONSE TO FFR

FIG. A: RGDP

FIG. B: RGDP

FIG. C: CPI

FIG. D: CPI

FIG. E: HEXR

FIG. F: HEXR

FIG. G: HINT

FIG. H: HINT

RESPONSE TO WCPI