Cross-Correlation Analysis of Interest Rates and Inflation in Namibia

Johannes Hatutale,
Johannes Peyavali Sheefeni Sheefeni,
Department of Economics,
University of Namibia,
Windhoek, Namibia.
E-mail: peyavali@gmail.com

Abstract

This paper analyses the relationship between inflation and interest rate in Namibia. The objective is to test whether there is causality among these variables. Using logarithmically transformed monthly data for the period 2005:01 to 2012:12, the paper employed time series technique unit root tests. Furthermore, the study also employed cross-correlation function as it is applicable to periods not longer than 20 years. The results for cross-correlation analysis show a trivial causality from interest rate to inflation in Namibia.

Keywords: Causality, Nominal Interest Rate, Inflation, Unit root test, Cross-correlation, Namibia
JEL Classification: E43
1. Introduction

There appear to be an intimate relationship between inflation and interest rates. This is due to the fact that both variables are viewed through the same lens and in the same breath. These two macroeconomic variables are important and are closely monitored by both economists and policymakers all over the world. The relationship between them has been subject to extensive research and studies have shown that the two are actually linked, although, ambiguously (Gul and Ekinci, 2006).

In general, as interest rates are lowered, more people are able to borrow more money (encouraged by the low cost of borrowing). The ultimate result is that consumers have more money at their disposal and are, therefore, able to spend more on goods and services. If the economy is operating at full employment, lower interest rates means there will be more money “chasing” too few goods and services. This excess of demand over supply leads to what is termed: demand-pull inflation (Blecher, Thomas, Muradzikwa, Smith, & de Villiers, 2010).

The opposite is true for rising interest rates. As interest rates are increased, the cost of borrowing is increased too. That means consumers will tend to have less money to spend. With less money to spend, the demand for goods and services contracts; ultimately depressing the general level of prices (i.e. deflation). This is the general relationship between interest rates and inflation as it is known. Given the importance of these two variables, one might also be interested in knowing the causal relationship between them. Over the years, several studies have been carried out in various countries with the aim of explaining the causal relationship between interest rates and inflation. Results from those attempts, however, appears to be contradictory and confusing (Voznyuk, 2010); owing partly, to the “complexity of theoretical channels that explain the impact of interest rate on price” (Gul & Ekinci, 2006).

Having clear expectations about inflation is particularly important to investors, financial service firms (i.e. pension funds, insurance companies, e.tc) and households. It provides a basis for making decisions pertaining to investments and the uncertainty thereof could significantly discourage such decisions (Voznyuk, 2010). Investors want to ensure a positive real return on their investments. Households also want to have some idea about the future purchasing power of their money. So if it is possible to predict the rate of inflation based on interest rates, then this would eliminate the problem of uncertainty regarding inflation.

In Namibia, both interest rates and inflation have tended to be relatively stable over the years. This seems to suggest that the two variables have a special relationship. In other words, this relationship is not as stipulated by economic theory. This study, therefore, draws interest from this relationship. This paper empirically investigates the causal relationship (i.e.
causality) between interest rates and inflation in Namibia. The article is organized as follows: the next section presents a literature review. Section 3 discusses the methodology. The empirical analysis and results are presented in section 4. Section 5 concludes the study.

2. Literature Review

The relationship between interest rates and inflation has been of interest to researchers. The famous Fisher hypothesis seems to be the starting point; in the attempt to understand the link between interest rates and inflation. The hypothesis, proposed by Irvin Fisher (1930) states that in the long run, “nominal interest rates move one-for-one with expected inflation, leaving the real rate of interest unaffected” (Innes, 2006:1). That is, a 10% increase in the nominal rate of interest, for example, translates into a 10% increase in the rate of inflation – leaving the real rate of interest unchanged (Blanchard, 2009).

The Fisher equation is:

\[ i_t = \pi_t^e + r_t \]  

Where: \( i_t \) is the rate of nominal interest; \( \pi_t^e \) is the expected rate of inflation and, \( r_t \) is the rate of real interest. If the Fisher hypothesis is correct (i.e. the Fisher effect is real), then \( i_t \) and \( \pi_t^e \) move together, which means \( r_t \) is stable in the long term (unaffected).

Equation (1) is an approximation. The accurate statement is:

\[ 1+i_t = (1+\pi_t^e) (1+r_t) \]

The difference between equation (1) and equation (2) is very small; unless either the interest rate or inflation is very high, or is being applied over a long period of time (Blanchard, 2009).

The Fisher hypothesis has maintained such a key position in economic literature. There are reasons for its prominence. Innes (2006) asserts that, firstly, the real rate of interest plays an important role in any country’s economic growth, savings and investments. It also affects trade and capital flows through its influence on the exchange rate. Secondly, empirical studies have shown that nominal interest rates can be used to determine future inflation expectations. Thirdly, the Fisher hypothesis is widely considered by central banks.

Payne and Ewing (1997) advances that should a “long-run Fisherian link be established between interest rates and expected inflation, this would suggest that the real interest rate is not affected by monetary policy, but instead determined by real economic factors alone”.

The standard macro models explain the relationship between interest rates and inflation through aggregate demand and supply frameworks. The demand side of the economy is determined by equilibrium conditions in the money and goods markets. According to Gul and
Ekinci (2006), a rise in the rate of interest increases the opportunity cost of holding cash balances. This reduces the demand for money. The reduction in money demand creates excess supply of credit and stimulates aggregate demand. Consequently, prices must rise (inflation) so that individuals can be satisfied to hold the existing stock of money rather than spending it on commodities or interest-bearing assets.

On the other hand, a change in the interest rate is likely to affect equilibrium in the goods market and hence, prices. For example, a rise in interest rate reduces the borrowers’ disposable income (but increases disposable income for lenders). If marginal propensity to consume (MPC) for borrowers is higher relative to that for lenders, then such an increase will reduce consumption demand. Moreover, a change in the rate of interest rate affects the desire to consume out of income (MPC); for both borrowers and lenders. Higher interest rate makes consumption cheaper tomorrow than today. Rational economic agents will tend to defer consumption and save more (higher marginal propensity to save). Ultimately, consumption spending declines through this channel.

In terms of investment spending, a higher rate of interest reduces the net present value on the expected return on investment and increases the cost of credit which deters investment spending. This channel further reduces aggregate demand and, in turn, prices. The interaction between interest rate and the demand side of the economy does not give a clear prediction of the effect of interest rate on the price level (Kandil, 2005).

On the supply side of the economy indicates that an increase in the rate of interest means higher production costs and, therefore, a rise in prices (inflation). However, Ball (1990) suggests that an increase in the interest rate has an “intertemporal substitution effect on labor supply”. That is, workers prefer to work more today to benefit from the high interest rate through savings. This increased labor supply increases output and, thus, depresses prices. In summary, the “combined effect of the demand and supply channels suggests an ambiguous impact of the interest rate on price” (Ekinci and Gul, 2006).

There has been a lot of empirical literature on the relationship between the two variables. Fisher (1930) seems to be the pioneer study that investigates the relationship between interest rate and inflation. Examining the relationship between nominal interest rates and inflation for the U.S and the UK, annual data for the period 1890-1972 (U.S) and 1820-1924(UK) were used. Fisher found high coefficients of correlation “when the effects of price changes upon interest rates are distributed over several years”, thereby concluding that “interest rates follow price changes closely in degree, though rather distantly in time”. That is, inflation leads interest rates.
Fama (1975) attempted to test the relationship between nominal interest rates on USA’s default-free bonds and price level changes (inflation) for the period: 1953-1971 and concluded that inflation is predicted by nominal interest rates. However, Lee and Bubnys (1984) indicate that such claim was rejected by Carlson (1977) and many others. Fama (1977), however, countered all those challenges and repeated that nominal interest rates predict inflation. In their attempt to clear up these contradictions, Lee and Bubnys (1984) set out to test the basic Fama equation to see if Fama’s hypotheses hold for economies other than the USA. Using data published by the OECD, for the period 1965: 1 to 1983:1, a comparison between USA, West Germany, Japan, Netherlands, France, Canada and the UK was done. A conclusion was reached that Fama’s assertion that nominal interest rates predict inflation seems to hold only for isolated cases. The analysis of USA’s and Japan’s data, for example, appeared to behave in accordance with Fama’s equation. This observation was attributed to similarities in the structure of those economies. However, the same could not be said about the other countries. Netherlands, for example, exhibited an inverse relationship between nominal rates and inflation.

Paleologos and Georgantelis (1996) using cointegration techniques to test if the Fisher effect holds for the Greek economy, during the period 1980: 1 to 1996: 2, found it does not. That is, nominal interest rate and inflation rate do not move together over the long run.

More recently, applying the Johansen cointegration test to South Africa’s data on nominal interest rates and inflation for the period April 2000 to July 2005, Innes(2006) found a weak cointegrating long-run relationship between the two variables, hence proving a weak Fisherian relationship.

Gul and Ekinci (2006) used high frequency data of Turkish nominal interest rates and inflation, to empirically test the relationship between them. The results obtained seem to conform to Fama’s 1975 and 1977 findings. That is, causal relationship occurs only in one direction; from nominal interest rates to inflation. Mahdi and Masood (2011) analyzed the long-run relationship between interest rates and inflation. Applying the Johansen cointegration approach and the error correction model approach (VECM) to Iran’s quarterly data spanning from 1989 to 2007, the results showed a long-run relationship between the two variables, but causality was found to be from interest rates to inflation only. However, applying similar econometric techniques to Nigeria’s data on nominal interest rates and expected inflation, over the period: 1970-2009, Awomose and Alimi (2012) found a partial, but very strong Fisherian relationship between the two variables. Causality was found to be from inflation to interest rates and no “reverse causation” was proven. This seems to concur with Fisher (1930).
There is no general consensus regarding the direction of effect between the two variables; evidenced by the contradictory empirical findings. Moreover, existing literature contains few case studies of developing countries and particularly no study on Namibia, hence this paper. Based on the afore-mentioned literature, one can safely say the following: there are mixed findings with regard to the causality between interest rate and inflation ranging from those who refuting, agreeing and no relationship at all. There are also different methodological approaches whether it is cross-country or individual country’s studies. There is variation in terms of data frequency used ranging from monthly, quarterly and annually. There seem also to be no study on causality between interest rate and inflation. It is against this background this study intends to fill the gap and add to empirical literature for Namibia.

3. Methodology

3.1 Econometric Framework

The study adopted the cross-correlation function approach used by Voznyuk (2010). The cross-correlation is a lagged correlation of two time series. Suppose that $X_t$ and $Y_t$ are time series. Furthermore, let $Y_{t-\beta}$ be time series shifted by time $\beta$. Then employing these notations, the cross-correlation is a function of the lag $\beta$, defined as follows:

$$
CCorr(\beta) = \text{Corr}(X_t, Y_{t-\beta}) \quad \text{where:} \quad \beta = 0, \pm 1, \pm 2, \ldots, \pm \ell \quad \text{...............(3)}
$$

Cross-correlation is also called lead-lag correlation. The cross-correlation function of interest rates and inflation is studied in order to determine whether there is a causal relation between them. This approach was chosen for its simplicity and power to reveal causality between any two variables without requiring data spanning long periods. This is especially appropriate for an analysis focusing on Namibia where the data available does not cover sufficiently long periods.

Asymmetry of the cross-correlation function around the zero lag suggests that one time series predicts or leads the other time series.

If, $CCorr(\beta) > CCorr(-\beta)$ .................................................................(4)

the first series ($X_t$) leads the second series ($Y_t$).

If, however, $CCorr(\beta) < CCorr(-\beta)$ .................................................................(5)

the second series ($Y_t$) leads the first series ($X_t$).

Where $X_t =$ Inflation; and, $Y_t =$ Interest rates.

3.2 Data and Data Sources

This study used monthly time-series data covering the period 2005:01-2012:12. The variables included are consumer price index and interest rate. Inflation in this study is
represented by the percentage change in the consumer price index (CPI) from one month to
another. Average lending rates were used to represent interest rates. It is generally known and
agreed to, that all interest rates tend to move in the same direction over time. This is
consistent with the fact that the cross-correlation function does not hold for periods longer
than 20 years (Voznyuk, 2010). To clearly reveal overall trends, the data were transformed to
logarithmic forms. The data series for consumer price level for Namibia and average lending
rate were obtained from various issues of Bank of Namibia’s Quarterly Bulletins and Annual
Reports.

4. Empirical Analysis And Results

4.1 Trends in Interest Rates and Inflation in Namibia: 2005-2012

Interest rates averaged, logarithmically, at nearly 2.4% throughout 2005, but began to
pick up by the end of 2006; reaching an all-time high of above 2.6% during the period 2007 to
2009. Ever since 2009 interest rates have been on a downward trajectory, closing at a record
low of just a little over 2.1% last year 2012. So, overall interest rates increased steadily
between 2005 and 2009, but have since then been on a downward path. Inflation, on the other
side, began on a downward path of below 1.0%, reaching nearly negative levels by the end of
2005. Thereafter, it rose steadily to record levels of about 2.5% in 2008. By the end of 2008,
however, it began to fall again until the beginning of 2011 when it started to rise; reaching
about 2.0% by the end of last year. As with interest rates, inflation rose in general terms,
between 2005 and 2009, but has remained fairly low since then. The high levels of both
interest rates and inflation recorded during 2007 to 2009 could probably be attributed to the
global recession that prevailed at that time. Figures 1 and 2, below, illustrate the afore-
mentioned trends.

Figure 1: Interest Rates in Namibia: 2005-2012

Figure 2: Inflation in Namibia: 2005-2012

Source: Author’s compilation using Eviews
4.2 Unit Root Test

In order to determine whether interest and inflation rates series contain unit roots, the Augmented Dickey-Fuller (ADF) and the Philips-Perron (PP) tests for stationarity were used. The results of the unit root test in levels are presented in Table 1.

Table 1: Unit root tests: ADF and PP in levels and first differences

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model Specification</th>
<th>ADF Levels</th>
<th>PP Levels</th>
<th>ADF First Difference</th>
<th>PP First Difference</th>
<th>Order of integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>lninfl</td>
<td>Intercept and trend</td>
<td>-2.79</td>
<td>-1.66</td>
<td>-4.87**</td>
<td>-9.20**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
<td>-3.12**</td>
<td>-1.85</td>
<td>-4.73**</td>
<td>-9.30**</td>
<td>1</td>
</tr>
<tr>
<td>lnint</td>
<td>Intercept and trend</td>
<td>-1.88</td>
<td>-1.64</td>
<td>-12.64**</td>
<td>-12.24**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
<td>-0.86</td>
<td>-0.66</td>
<td>-3.98**</td>
<td>-12.09**</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: author’s compilation and values obtained from Eviews

Table 1 shows that the series were found to be non-stationary in level form with the exception of inflation whose results are conflicting. After differencing data the unit root test show that the series became stationary.

4.3 Cross-Correlation Analysis

To check whether causality exists between interest rates and inflation in Namibia, a cross correlation function was obtained and the results are presented in figure 3, below.

Figure 3: Cross Correlations
Sample: 2005M01 2012M12
Included observations: 96
The results above are in line with condition 5, that is, $C\text{Corr}(\beta) < C\text{Corr}(-\beta)$; across all lag-lead values of the function. This, according to Voznyuk (2010), suggests that interest rates leads inflation in Namibia. There seems, therefore, to be causality running from interest rates to inflation. This causality, however, appears to be very weak as evidenced by very low cross correlation values of the function.

A rational explanation for the slight causality from interest rates to inflation is that every increase in interest rates increases the cost of investment (borrowing become costly) for producers, which in turn leads to cost-recovery pricing by producers; reflected through high prices (Mahdi & Masood, 2011).

5. Conclusion

This study empirically investigated causality between interest rates and inflation in Namibia for the period 2005 to 2012. Techniques such as unit root tests and cross-correlations were employed. Graphical analysis shows that relatively high levels of interest rates and inflation were recorded between 2007 and 2009 but not so major. These upswings in the variables could be attributed to the global recession that prevailed during that time. However, the data analysed did not show The cross correlation analysis of interest rates and inflation indicated a very weak causality; in the direction of interest rates to inflation. Emphasis should be made here that causality between interest rates and inflation remains vague and an open question in economics. It should also be stressed that the consumer price index (CPI), while

Source: Author’s compilation using Eviews
being the closest information economists have about changes in the general level of prices, is not a market proxy for inflation but a statistical measure which cannot provide the consistency of results across all the periods of time.

As far as policy is concerned, the causality detected between interest rates and inflation in this paper is safely insignificant. However, this does not mean monetary authorities should not continue to closely monitor the level of interest rates in the economy. Once allowed to veer too high, interest rates can deter both investment and consumption spending. An overview of the general trends seems to indicate that these two variables tend to move together over time. Stability in the level of interest rates should, therefore, to some extent, translate to stability in the general level of prices in the economy.

References


