Short Term Nominal Interest Rate as a Predictor of Expected Inflation: Evidence from South Asian Countries

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Abstract

This research paper investigates the relationship between inflation and short-term interest rates for South Asian region and individual countries in South Asia. The study uses annual data for all South Asian countries from the period 2005 – 2015. A balanced panel data analysis is done to examine the relationship in South Asia. Major macroeconomic variables that have been selected through literature analysis are inflation rate, interest rate, money supply, real GDP, exchange rate, employment rate and imports where the inflation rate is the dependent variable. According to the results, treasury bill rate which represents the nominal interest rate is significant at 1% level of significance in South Asia with a negative relationship. With special focus to country level analysis, Bangladesh, Bhutan and Sri Lanka's interest rates positively correlate to respective countries' inflation rates while India, Nepal and Pakistan's interest rates negatively correlate to inflation rates in respective countries. Hence, we can conclude that there are country wise differences in predicting inflation for South Asian countries.

Keywords: South Asia, Sri Lanka, Interest Rate, Inflation, Treasury Bill Rate

1. Introduction

Inflation and interest rates are linked, and frequently referenced in macroeconomics. Inflation refers to the rate at which prices for goods and services rise. The relationship between these two macro-economic variables can be interpreted in many ways. To majority of people inflation implies an insidious, cancerous swelling of prices and the erosion of the purchasing power of their incomes and savings. Economic growth and social progress require some increase in the level of prices though. To the individual, inflation is a money problem. He relates it to higher cost of living. He may see the remedy as acquiring more money, even if his purchasing power falls. He may fail to realise that purchasing power must ultimately be limited by the production and supply

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of goods and services and the demand for them. His remedy for inflation, which is increasing the availability of money by one method or another, may cheapen his money by forcing prices upward.

Economists have related inflation, with its rise in the cost of living, to periods of full employment of labor and other resources. It is thus a phenomenon of booms and prosperity. Inflation may be temporary, as during the boom period of a business cycle, or it may run over a period of years. If the creeping inflation gives way to wild uncontrolled inflation, the monetary system may collapse, government and other debts may be repudiated, and public and private insolvency may result. One may find many examples in modern history of runaway inflation. Inflation has long been thought of as a condition resulting from abundance of currency in relation to the available supply of goods and services. With a strong demand, a limited supply of goods and services, and a great inflow of purchasing power in the markets, the pressures on prices in-crease and tend to force them upward. Too much money is said to be chasing too few goods. The so-called "demand- pull" factors compel prices to rise.

This is common for all the countries around the world. Inflation has been high pre and post war across countries and many researches have been done to investigate that. Inflation can be predicted beforehand by using interest rates in the country. This is simply what is called Fisher Effect. The relationship between interest rates and inflation, was first put forward by Fisher (1930) who postulates that the nominal interest rate in any period is equal to the sum of the real interest rate and the expected rate of inflation. This is termed as the Fisher Effect. Fisher (1930) hypothesised that the nominal interest rate could be decomposed into two components, a real rate plus an expected inflation rate. He claimed a one-to one relationship between inflation and interest rates in a world of perfect foresight, with real interest rates being unrelated to the expected rate of inflation and determined entirely by the real factors in an economy, such as the productivity of capital and investor time preference. This is an important prediction of the Fisher Hypothesis for, if real interest rates are related to the expected rate of inflation, changes in the real rate will not lead to full adjustment in nominal rates in response to expected inflation. Cooray's (2002) predicting inflation using interest rates has yielded mixed results across countries and across time periods. This research will examine how fisher effect can be applied to the South Asian countries.

South Asia is termed as the collection of countries namely Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, India, Pakistan, and Sri Lanka. The South Asian Association for Regional Cooperation (SAARC), a contiguous block of countries, started in 1985 with seven countries – Bangladesh, Bhutan, India,

the Maldives, Nepal, Pakistan and Sri Lanka – and added Afghanistan as an eighth member in 2007. The South Asia Free Trade Agreement (SAFTA) incorporated Afghanistan in 2011 and the World Bank too added Afghanistan to South Asian Region as well as United Nations Children's Fund (UNICEF) did the same. South Asia remains the world's fastest-growing region although capital inflows declined, inflation has been on the rise, and remittances from oil-exporting countries started to weaken (World Development Indictors, 2017).

South Asian countries have similar inflation, exchange and interest rates. Sustained unrest in Sri Lanka pushed up its inflation rates, but in the other countries inflation only rarely reached double digits. Exchange rates also varied compensating for the inflation; most countries had some sort of flexible exchange rate regimes in the later years. Interest rates tended to move downwards in the reform period. But since foreign exchange markets were thin, and currencies were not fully convertible, the exchange rates were not fully market determined; intervention remained considerable IMF (2017).

Mixed results have been yielded about predictability power of inflation rate depend on the time periods selected and countries interested. Studies such as those of Fama (1975), Atkins (1989), Mishkin (1992), and Crowder and Hoffman (1996) have supported the Fisher hypothesis, while other famous studies such as those of Mishkin (1981, 1982), Barthold and Dougan (1986), and Rose (1988), have shown contradictory evidence. Still other studies, such as those of MacDonald and Murphy (1989), Wallace and Warner (1993), and Engsted (1996), find that the empirical validity of the Fisher hypothesis varied when it was analysed in different time periods or countries. Therefore, it is clear that predictability power of inflation rate is not universal; instead it depends on time zone and countries selected. Hence this piece of research will examine the extent that nominal interest cate can be used as a predictor of expected inflation in South Asian context.

The main objective of this study is to examine the predictability power of interest rates to future inflation of each South Asian country based on its specific factors. Further the sub objectives are to investigate the relationship between interest rates and inflation and to identify disparities between interest rates and inflation rates across South Asian countries.

Fisher hypothesis is one of the most studied topics in economics and finance and the use of nominal interest rates as indicators of inflation expectations have recently gained wide popularity. A stable relation between nominal interest rates and inflation as hypothesized by Fisher (1930) has proven difficult to establish empirically. Dwyer (1984) has shown that the Gibson Paradox, which is a correlation between interest

rates and price levels, is peculiar to circumstances of time and place rather than a universal phenomenon. Nominal interest rates are increasingly used as indicators of inflation expectations, probably because they are easily and quickly available for many different forecasting horizons. But still the topic is interesting since these tests yield mixed results based on the considered time period and markets. Most of the empirical studies on Fisher hypothesis are based on US and European economies, with a few studies focused on Japanese economy and Pacific-Basin Countries, G7 countries and some developed Asian countries. It has been suggested that inflation forecasts derived from short-term interest rates are as accurate as time-series forecasts. Previous analyses of this notion have focused on developing, developed, industrial country data and have provided mixed results. No published work relating the Fisher hypothesis in the South Asian countries was found in the course of study. Therefore, this piece of research is designed to test that predictability of expected inflation using short term interest rate and the prevailing inflation in South Asian context. Therefore, this will be special in that way and in another way, which is the usage of controlled variables.

2. Literature Review

Both theoretical and empirical literature have contributed for the development of the Fisher Effect. Literature provides mixed results on Fisher Effect hypothesis.

2.1. Theoretical Review

Fisher Effect was originally introduced by Irvin Fisher in 1930. The idea relating to nominal interest rate and expected inflation was known as Fisher hypothesis. This theory stated that nominal interest rate could be defined as the sum of two major variables, namely the expected real interest rate and the expected inflation. This relationship implies that there is a one-to-one relationship between nominal interest rate and expected inflation Fisher (1930), where the foresight is thought to be imperfect. The nominal rate can be thought of as the total of equilibrium of the expected real rate and market assessment of expected inflation. Irving Fisher pointed out that with perfect foresight and a well-functioning capital market, the one-period nominal rate of interest is the equilibrium real return plus the fully anticipated rate of inflation. In a world of uncertainty where foresight is imperfect, the nominal rate of interest can be thought of as the equilibrium expected real return plus the market's assessment of the expected rate of inflation (Fama, 1975).

Furthermore, it can be stated in below equation.

Nominal Interest Rate (n) = Real Interest Rate (r) + Inflation Rate (i)

Nominal interest rate refers to the interest rate before taking inflation into account. In other words, it is the sum of real interest rate and expected inflation. Nominal can also refer to the advertised or stated interest rate on a loan, without taking into account any fees or compounding of interest (European Central Bank, 2016). Central banks set short-term nominal interest rates, which form the basis for other interest rates charged by banks and financial institutions. Nominal interest rates may be held at low levels artificially after a major recession to stimulate economic activity through low real interest rates, which encourages consumers to take out loans and spend money. However, a necessary condition for such stimulus measures is that inflation should not be a present or a near-term threat.

Conversely, during inflationary times, central banks tend to set nominal rates high. Unfortunately, they may overestimate the inflation level and keep nominal interest rates high as well. The resulting elevated level of interest rates may have serious economic repercussions, as they tend to stall when spending.

As to World Bank a real interest rate is an interest rate that has been adjusted to remove the effects of inflation to reflect the real cost of funds to the borrower and the real yield to the lender or to an investor. Simply it is the final interest rate when the expected inflation is deducted from nominal interest rate (European Central Bank, 2016). While the nominal interest rate is the interest rate officially assigned to the product or investment, the real interest rate is a reflection of the change in purchasing power derived from an investment based on shifts in the rate of inflation.

According to World bank definition, expected inflation is investors and public expectations of current or future inflation. These expectations may be or may not be rational, but they may affect how the market reacts to changes in target interest rates.

2.2. Empirical Review

The standard view referred to as the Fisher effect involves examining movements in short term interest rates, expected inflation so as to predict the future inflation using the former. Many authors present a range of ideas through their empirical work throughout history and therefore the review of literature related to these subjects yields mixed results.

According to (DePamphilis, 1975) study, Irving Fisher in 1930 has hypothesised that nominal interest rates could be decomposed into a real and a price component. The long-run equilibrium real rate of interest equates real saving and investment in the long-run. The price factor consists of investors' expectations relating to the future rate of inflation. These expectations are historically determined by a distributed lag on

previous price changes. The influence of the weights associated with this distributed lag decays geometrically into the past. He concludes that a one percent sustained increase in the inflation rate will, with the passage of time, increase the nominal rate of interest by the same amount.

Nominal interest rate is defined as the sum of expected inflation and real interest rate in (Söderlind, 1998) study while (Friedman, 1997) has defined it as relative prices set on loan agreements struck between borrowers and lenders. Further it says these rates are determined in markets where loans are extended and received; and to influence the interest rate either supply of funds by lenders or demand for funds by borrowers should be influenced. (Podkaminer, 1998) in his study has said that a sufficiently high, constant, nominal interest rate is alone capable of generating steady inflation.

"Real interest rates are among the most important economic variables and have been studied extensively. They are a central element in savings, consumption decisions and in debates about how to encourage savings and are also a critical explanatory variable for investment decisions since they represent the real cost of borrowing " (Mishkin, 1988). Further Barro and Martin (1990) conclude that high real interest rates reflect positive shocks to investment demand (such as improvements in the expected profitability of investment) or negative shocks to desired saving.

The way in which money is viewed to affect real economic activity in almost every theory of the macro-economy is by altering the real interest rate or the terms of trade Mark (1985). Empirically, in the United States the hypothesis of a constant ex-ante real interest rate is generally rejected for most periods, except perhaps the 1953- 71 period chosen by Fama (1975) to test the efficiency of the Treasury bill market. Rose (1988) questioned whether the ex-ante real interest rate is stable or it was characterized by a univariate process with a unit root. For many periods and countries, he failed to reject the presence of an integrated component in the ex-post real interest rate, as did Walsh (1987) for various sample periods in the United States. Potential non stationarities of the ex-ante real interest rate have important implications not only for determining the effects of monetary policy or fiscal policy, but also for some issues that are central to financial theory of Garcia and Perron (1996).

Inflation is a primary concern of Fisher Effect. The maintenance of price stability is important because fluctuating prices distort economy's price signals and can result in the misallocation of resources. The objective price stability translates into maintaining low and stable price, which is considered to conducive for economic growth and employment generation. The barometer for measuring price stability is inflation DAS et al. (2009). According to Schmidt (1957) inflation is a disproportionate and relatively sharp and sudden increase in the quantity of money or

credit, or both, relative to the amount of exchange business. In simple terms it is the continuous increasing in general price level. Further it says that inflation always produces a rise in the price level and is related primarily monetary and fiscal policy forcing prices upward. Economists have related inflation, with its rise in the cost of living, to periods of full employment of labor and other resources. It is thus a phenomenon of booms and prosperity.

Many researchers have been done in identifying determinants of inflation across many time periods and countries. According to those empirical studies, inflation may occur due to many reasons namely money supply (monetary expansion), remittance, GDP, imports and exports, exchange rates, employment and interest rates (Mitchell 1981, Narayan et al. 2011 and Moser 1995).

2.3. Relationship between Interest rates and inflation

According to Fama (1975) during the 1953-71 periods, there are definite relationships between nominal interest rates and rates of inflation that are subsequently observed. As per his studies interest rate remains the best single predictor of the inflation rate; and nobody has uncovered variables that make substantial contributions to the prediction of inflation beyond that provided by the interest rate alone. Moreover, one of the more interesting propositions of the model, that the largest part of the variation in nominal interest rates reflects variation in expected inflation rates, seems intact.

Moreover, during this period the bill market seems to be efficient in the sense that nominal interest rates summarise all the information about future inflation rates that is in time-series of past inflation rates. Finally, another interesting result is that the substantial variation in nominal bill rates during the 1953-1971 period seems to be entirely due to variation in expected inflation rates; in other words, expected real returns on bills seem to be constant during the period In U.S market. Fama further says studies conducted using pre world data, that means before 1953 does not perform efficiently in predicting inflation. In contrast depending on the time period and the country selected through his study concludes that nominal interest rate is a good predictor of expected future inflation rate.

Based on a univariate time-series modeling of the real interest rate, Fama (1977) find that the interest-rate model yields inflation forecasts with a lower error variance than a univariate model, and that the interest rate model's forecasts dominate those calculated from the Livingston survey. Although a flurry of articles appeared after Fama's (1975) the original article focused on Fama's assumption of a constant real rate of interest and only a few studies have examined the forecasting approach detailed in Fama and Gibbons (1984). For example, using quarterly U.S. data, (Hafer & S. E., 1985) the relative forecasting accuracies of the interest-rate model, a

univariate time-series model of inflation, and forecasts taken from the American Statistical Association-National Bureau of Economic Research (ASA-NBER) were compared. Based on ex ante forecasts for the 1970-84 period, they find that the survey forecasts generally have the greater relative accuracy.

Based on the data quarterly 3 months T-bill rates from 1952 -1971 for USA Crowder (1996) says that their empirical support for the Fisher relation is obtained without specifically modeling any changes that may have taken place in the dynamics of inflation over the sample period and accordingly 1 percent increase in inflation yields a 1.34 percent increase in the nominal interest rate. Accordingly, it is clear that there is a positive relationship between these two variables.

Friedman (1980) through the single equation level, the results provide evidence that, with all other things equal, five of the six major categories of lenders in the U.S. long-term fixed-interest loan market reduce their demands for loans in response to an increase in expected inflation. Even life insurance companies, whose liabilities are almost entirely in nominal form, respond to price expectations in this way. Secondly, at the multi-equation partial-equilibrium level, the results indicate that, with all other things equal, this response by lenders will raise the equilibrium nominal loan yield by 0.65 percent in response to a 1 percent increase in expected inflation. The results also indicate that this 0.65 percent adjustment requires approximately four years for completion. The empirical results presented in his paper indicate that lenders' portfolio behaviour does play an important role in the expected price inflation/nominal interest rate relationship.

Further, Khumalo et al. (2017) in his study of the relationship between inflation and interest rates in Swaziland revisited, found that the monetary authority of a country enables to bring the inflation to a manageable level by controlling the interest rate as it changes the money demand of individuals.

Rachel and Smith (2015) attempted to identify which secular trends could have driven a fall in long term interest rates. The quantitative analysis highlighted slowing global growth as one force that may have pushed down on real rates recently but shifts in saving and investment preferences appear more important in explaining the long-term decline. Meanwhile, desired levels of investment have fallen as a result of the falling relative price of capital, lower public investment, and due to an increase in the spread between risk-free and actual interest rates. Moreover, most of these forces look set to persist and some may even build further. This suggests that the global neutral rate may remain low and perhaps settle at 1% from the medium to long run.

Kilci (2018) in the study of analysis of the relationship between inflation and central bank interest rates in turkey: Fourier approach, empirically proved that the existence

of causality relationship between interest rate (repo rate) and CPI for Turkey within the period from 2005 to 2017.

According to studies conducted by Hafer and Hein (1990) the important result they were able to derived is that, based on data from several countries, inflation forecasts generated from observed nominal interest rates do not dominate those from a univariate time-series model. This conclusion contrasts with that of Fama and Gibbons (1984), who focused solely on U.S. data. Based on the evidence from Belgium, Canada, England, France, and Germany, he has found that time-series forecasts of inflation have equal or lower forecast error and produce unbiased forecasts more often than the interest-rate model. The interest-rate model, it should be noted, generally over predicted inflation for the 1978-86 period for all countries studied. The other important finding from this study is that the interest-rate model forecasts may provide marginally useful information that allows one to improve on the time-series inflation forecasts. This is true for France, Germany, and the United States. This result suggests that the best inflation forecast is one that combines the information inherent in both the time-series and interest-rate models.

Söderlind (1998) conducted his study for two countries namely USA and UK for 1953 – 1995. His data shows that the simple forecasting rule would have worked fairly well in predicting the level of inflation expectations for most of the postwar period. According to Choi (2002) and his studies conducted using US three months T bill rates for a period of 1947 – 1997 Inflation tends to be positively related to short-term inflation forecast ability and is highly plausible that long-term uncertainty outweighs short-term uncertainty during high-inflation periods and, hence, that inflation is positively related to inflation forecast ability.

Kasman, et al. (2006) The study conducted for two types of countries developed, developing for a period of 1957 – 2004 shows a positive relationship between inflation rate and nominal interest rate. Barthold and Dougan (1986) suggested that the predictability power of inflation prior to Second World War is negative while predictability power after war period is positive when considering USA and Australia and under all monetary regimes. Further it says that the early 1980s are a notable exception, since the very volatile real interest rates during this period weaken the link between nominal interest rates and inflation expectations. The results from ex post data are, on average, less favourable to the simple rule than the survey data. They are also less reliable because they vary considerably between subsamples. The idea behind the ex-post regression is that, under rational expectations, the difference between expected and actual inflation should be uncorrelated with the interest rates. However, this may easily fail in a small sample if, for instance, the economy is hit by a series of unprecedented inflation shocks (as in the 1970s). The difference between

the results for the ex-post data and the survey data suggests that this is an important factor behind many of the traditional results regarding the Fisher effect. Nominal interest rates seem to be able to predict much of the variation in the level of inflation expectations, perhaps as much as three quarters. This fraction may even be somewhat larger if we consider average inflation over a few years, but it is clearly smaller for changes in inflation. The reason seems to be that real interest rates and risk premium have relatively more short-run movements than inflation expectations.

Costas and Smith (1998) suggested a threshold effect in the relation between inflation and returns. Since real balances and bank deposits are substitutes in households' portfolios, the zero-nominal return on real balances anchors the rate of return on bank deposits. In a low-inflation economy in which credit is not rationed, an increase in inflation leads to lower real rates (and a higher capital-output ratio) conversely, in a high-inflation economy in which credit must be rationed, an increase in inflation leads to a smaller capital stock. Thus, whether or not the economy has credit rationing is crucial for the link of the inflation level to the inflation effect on returns. Also, its assumption of a constant implicit real rate of return on real balances anchors the nominal rate. Using cross-country data, Michelle et al. (1999) find that inflation and nominal rates are only weakly positively correlated for low-to-moderate-inflation economies, whereas inflation has a positive effect on nominal rates for high-inflation economies. This line of research reconciles framework, in that asset substitutability is emphasized. Their framework, however, emphasizes the link between the inflation process and asset substitutions, assuming that the implicit real returns to real balances rise with inflation if inflation is persistent.

Many reasons have been given for the apparent absence of a short-run Fisher effect in the U.S. before World War I. Friedman and Schwartz (1982) speculated that inflationary expectations adjusted with a very long lag as agents only gradually "learned their Fisher," while (Summers, 1983) argued that money illusion in financial markets was perhaps responsible for the lack of empirical support. Barsky (1987) argued that inflation was essentially a white noise and an unpredictable process before World War I. As a result, Barsky (1987) concluded that "there was probably little variation in expected inflation prior to 1913." If expected inflation was constant, then no correlation would exist between expected inflation rates and nominal interest rates. Barsky and DeLong (1991) also emphasized the inability of investors to forecast inflation but focused explicitly on the failure of investors to understand the quantity theory.

According to the preliminary work done, evidence of negative correlation between inflation and interest rates where the two variables are treated as stationary processes which are subject to temporary disturbances (Mishkin, 1981), (Gibson, 1972)

(Mishkin, 1978). The analysis done by Evans and Lewis (1995) identifies the different types of negative correlations that can be explained theoretically. First, Tobin (1969) and Mundell (1976) present that higher inflation results in a portfolio shift out of nominal assets and into real assets that decreases the return on assets. Second, Fama (1981) and Gibbons (1982) discuss that higher real rates reflect higher productivity in the economy and real rates are correlated with output disturbances.

The paper by Leiderman (1979) presented empirical evidence on the relationship between expected inflation and interest rates for the case of Argentina (1964-76) and arrived at two major conclusions from the analysis. They yielded mixed results. "First, in setting the quarterly nominal interest rate the market appears to use all the information about the subsequent inflation rate that is in time-series of past inflation rates. Thus, Fama's findings on this issue for the United States hold also in the different setting of a high- inflation, semi-industrialized country. Second, the sample information indicates that, at variance with a strict version of Fisher's theory, an increase in expected inflation is not fully transmitted to the nominal interest rate, so that it implies a reduction in the contemporaneous real interest rate."

Klein (1975) stated that "clearly, any period in which the Gibson Paradox is observed will not yield a good fit of the Fisher equation" and he verified this by finding no significant relation between interest and inflation in the United States until about 1960. Summers (1983) has analyzed a long time series of U.S. interest and inflation rates with similar results. Studies using postwar U.S. data have found a significant effect of expected inflation on nominal interest rates, although in no case has that effect been so large as to keep after-tax real rates of return unaffected by expected inflation (see, for example, Fama, 1975; Tanzi, 1980 Peek, 1982; Makin, 1983). There is, then, a clear difference between the pre- and postwar eras either in the way in which bond market participants forecasted inflation or in the way in which expectations of inflation affected nominal yields.

Koch and Hein (1988) compared inflation forecasts derived from tax-exempt yields to those from taxable Treasury bills. Comparing monthly out-of-sample forecasts for the period 1978-86, they did not find any improvement in inflation forecasts by using the tax-exempt yields. Crowder also found in his research that in contrast to Fama (1975), that short-term interest rates may not be good predictors of future inflation. In fact, there are opposite predictive structures that have been identified. But it may take a number of years before the effect of inflation shocks are fully reflected in nominal interest rates as evidenced by the variance de-composition analysis.

Even if the theory suggests that the long-run behavior of the ex-ante real rate is linked directly to the long-run relationship between inflation and nominal interest rates and

the Fisher identity defines the ex-ante real rate as the difference between the nominal interest rate and expected inflation. Evans and Lewis (1995) conclude based on their empirical estimates that inflation does not move one-for-one with the nominal rate in the long run. These results complement the earlier findings of permanent shocks in real rates in the literature.

Levi et al. (1978) has a view that empirical investigators of the effects of anticipated inflation have not been well served by prior beliefs based either on the Fisher hypothesis. The Fisher hypothesis has tended to serve as a criterion for the validity of measures of anticipated inflation for those investigators who search for the measure which results in an estimate of differentiations close to unity. Further it says like the Philips curve, neither the Fisher hypothesis nor the Darby hypothesis represents an isolated phenomenon, but rather should be viewed as a reduced-form relationship derivable from a set of structural equations which compose a reasonably comprehensive macro-economic model.

According to study conducted by Barsky (1987) reexamination and finds that the evidence does not support a short-run relationship between interest rates and future inflation. However, the nonexistence of a short-run Fisher effect does not rule out the possibility that there is a long-run Fisher effect in which inflation and interest rates share a common trend when they exhibit trends. This paper also conducts tests for co-integration along the lines of Engle and Granger (1987) to test for a common trend in interest rates and inflation, and it does find evidence for a long-run Fisher effect in the postwar U. S. data. The above evidence resolves the puzzle of why the Fisher effect appears to be strong in some periods but not in others. The existence of a long-run Fisher effect implies that when inflation and interest rates exhibit trends, these two series will trend together and thus there will be a strong correlation between inflation and interest rates. Just as this analysis predicts, the Fisher effect appears to be strong in the periods when interest rates and inflation exhibit trends. On the other hand, when these variables do not exhibit trends, a strong correlation between interest rates and inflation will not appear if there is no short-run Fisher effect. Thus, the presence of a long-run but not a short-run Fisher effect predicts that a Fisher effect will not be detectable (Sims, 1980) for an excellent review of this topic. There are periods when interest rates and inflation do not have trends. It is exactly in these periods that we are unable to detect any evidence for a Fisher effect. (Mishkin, 1988)

Literature does suggest about methodology. Crowder (1996) recognized that valid tests of the Fisher relation may require consideration of the time series properties of the data. These include papers by Rose (1988), Mishkin (1992), and Evans and Lewis (1995). Rose analyzes the time series properties of the variables that constitute the Fisher paradigm and concludes that interest rates possess a unit root in their

autoregressive representation, but inflation does not. If these properties do characterize the data, a regression of interest rates on inflation is necessarily spurious (Newbold and Davies 1978) because it attempts to link variables that maintain different orders of integration. In this case the real interest rate is a non-stationary series and the textbook representation of the Fisher relation may be rejected out of hand. Rose's conclusions must be viewed carefully since the statistical inference drawn from his tests does not account for the small sample distributions of standard unit root tests in the presence of moving average errors that may characterise U.S. inflation. Moreover, it is widely recognised that conventional univariate unit root tests have a difficult time distinguishing unit and near unit root processes and may not be able to provide a definitive test of the proposition. Mishkin (1992) takes the non-stationarity of inflation and nominal interest rates as a maintained hypothesis and applies the Engle and Granger (1987) methodology to test for common stochastic trends. The simple Fisher relation predicts that two series share a common stochastic trend and a long-run unitary (ignoring tax considerations) response of nominal interest rates to movements in the expected inflation rate. While noteworthy, Mishkin's analysis does not provide particularly sharp statistical inference because his estimate of the relation between inflation and nominal interest rates is very imprecise. However, Mishkin's analysis serves as an important first step, but it would be useful to obtain better measures for the long-run relation.

3. Methodology

The main objective of this study is to investigate the predictability power of inflation rate using nominal interest rate in South Asian countries while other variables stay as control variables. Further, the sub-objective of this study is to illustrate disparity between interest rate and inflation rates across South Asian countries. This study uses annual data for South Asian countries from the period 2005 – 2015. Major macroeconomic variables that have been selected through literature analysis are inflation rate, interest rate, money supply, real GDP, exchange rate, employment rate and imports. Annual Treasury bill rate, Real GDP, exchange rates, imports of goods and services and Broad Money Supply (M2) data were obtained from World Development Indicators database of the World Bank 2017. A balanced panel data regression is done to examine above mentioned main objective. A balanced panel is a multi-dimensional data set observed over multiple time periods. And the specialty in this research is it uses all the countries in South Asian Region. Therefore, this is a population study.

Dependent variable of the study is inflation rate of South Asian countries. Through previous literature both inflation and CPI index's first difference have taken as inflation rate in different analysis. CPI has been used by many scholars in their studies (Engsted, 1995). Change in the consumer price index is a widely perceived and recognized measure of inflation. It may not be conceptually ideal, but it does have its own cyclical pattern, and has less statistical irregularities than some other measures of the inflation rate. The first difference of natural logs of consumer price index has been taken as the inflation of related countries. But in this research inflation rate directly will be used instead.

This study focused on testing the movement of inflation rate in relation to the selected independent variables. Annual Treasury bill rate has been selected as the main indicator to measure the impact of interest rate on inflation rate in South Asian context. Treasury bill rate is identified as a risk-free financial instrument since it is government guaranteed security. This study uses control variables in estimating predictability power of inflation using interest rate. Here in this piece of research four such control variables are used, and they are real GDP, imports, exchange rate and broad money supply (M2), employment rate.

Regression Model

$$IR = \beta_0 + \beta_1 TB + \beta_3 Ex + \beta_5 GDP + \beta_4 Im + \beta_6 M2 + \beta_6 Emp$$

Where,

IR	- Inflation Rate
TB	- Annual Treasury bill rate
Ex	- US dollar exchange rate
GDP	- Real GDP
Im	- Imports of goods and services (US$)
M2	- Money supply (m2)
Emp	- Employment Rate

Two models will be run to test predictability power of inflation rate using nominal interest rate. One model will be used to test for South Asia as a whole while second model will be run for each individual country separately to examine how those macro-economic variables behave in country context.

4. Analysis and Findings

Independent variables are in different forms. Some variables like TB rate, employment rate are in percentages. Some variables like imports of goods and

services, real GDP are in Rupee millions. Therefore, to bring all variables to one basis the log forms of independent variables were used.

Therefore, the model which was used for estimation is as follow.

$$IR = \beta_0 + \beta_1 logTB + \beta_3 logEx + \beta_5 logGDP + \beta_4 logIm + \beta_6 logM2 + \beta_6 logEmp$$

4.1. Model 01: South Asia

The overall analysis of relationship between Inflation rate and other macro-economic variables determines inflation in South Asia. Empirical analysis uses all 8 countries of South Asian region from 2005 to 2015. Panel data analysis used for the analysis.

Accordingly, variables were included to the model based on correlation values, i.e. from the highest correlation to the lowest, by giving careful attention to the sign of the variable coefficient in model, in order to overcome multicollinearity problem. Further, VIF test confirmed that the model is free from the errors of multicollinearity. Hausman test recommended the suitability of random effect model over fixed effect model. The model was adjusted to overcome the errors of heteroskedasticity. The results are given in Table 01.

Table 01: Results of South Asia

Statistic	T. Bill rate	Exchange rate	Real GDP	Imports	Money supply	Employment rate
Co-efficient	-93.23	26.42	-4.38	27.47	-9.36	122.74
P -value	0.00	0.043	0.00	0.00	0.00	0.00

Source: Compiled by author

Overall model and significant variables are significant at 1% level of significance. R^2 of the model is 41% which indicates 41% of dependent variable explained by selected independent variables. Treasury bill rate which represents the nominal interest rate is negatively significant at 1% level of significance.

4.2. Model 02: Country Analysis

A time series multiple regression model for individual countries were run to test the sub objectives of research as mentioned above. To investigate the relationship between inflation rates and interest rates along with identifying disparity between interest rates and inflation rates across South Asian countries. Afghanistan and Maldives were dropped due to lack of data in testing individual models. Models were

run for other six countries only. Results of models are interpreted below. Variables were tested for stationary levels and tested for multicollinearity and heteroskedasticity. Multiple regression model results of each country is given below.

Table 02: Regression output results of country analysis

	Bangladesh	Bhutan	India	Nepal	Pakistan	Sri Lanka
T. Bill rate	**13.09*** **	**51.19** **	**-8.32*** **	**-7.77*** **	**-22.98*** **	**21.16*** **
Exchange rate	-22.87***	244.99**	24.12**	-15.99**	-30.54**	35.23***
Real GDP	-0.71***	132.99**	-1.27***	-1.28***	-0.92***	-0.73***
Imports	14.48***	-0.96***	-0.89***	-16.44***	-5.99***	8.29***
Money Supply	-200.8***	-7.66***	2.76***	29.32***	32.17***	-13.84***
Employment rate	-16.02***	-49.74***	-354.62***	-278.72***	-33.14***	-27.76***
Observations	32	32	32	32	32	32
F statistic	0.03	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	23%	30%	33%	29%	27%	17%

Source: Compiled by author

4.3. Findings

The model 01 for South Asian Region is significant under 5% level of significance and therefore it can be concluded that the inflation rate of South Asian countries can be predicted through nominal interest rate. There is a negative relationship between interest rate and inflation rate in South Asian region, which means, when interest rate changes, the inflation rate will change to the opposite direction.

All the independent variables are also significant under 5% level of significance. Even in individual country contexts except for Afghanistan and Maldives (Estimation of models were unable due to lack of data) inflation rate can be predicted through interest rate. The F statistics of individual models are less than 0.05. Each country's

model namely; Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka is significant under 5% level of significance.

The individual p values of respective independent variables in each model are less than 0.05 which leads not to accept null hypothesis. Therefore, independent variables allocated for each model in each country is also significant under 5% level of significance. There is a disparity between inflation rate and interest rate across South Asian countries. Models for individual countries estimated different co-efficient for each country which means the degree of changing inflation rate is due to the change of interest rate. Bangladesh, Bhutan and Sri Lanka's interest rates positively correlate to respective country's inflation rates while India, Nepal and Pakistan's interest rates negatively correlates to inflation rates in respective countries.

5. Conclusion

This study was carried out to identify the predictability power of inflation rate using nominal interest rate for South Asian region. That was the main objective of the study and sub objectives were aimed to find country wise predictability power and disparity between inflation rate and interest rate across South Asian countries. Thus, to meet with objectives a panel model regression and 6 time series regression models were estimated. And it was found that inflation rate can be predicted through short term nominal interest rate. Also, there is a disparity between inflation rate and interest rate across countries in the region.

As explained in previous chapter it is concluded that the predictability power of inflation rate can be done using short term interest rate. As per the thesis it is by using TB rates. Further it was revealed that this scenario is common for all the South Asian countries considered and there is a disparity between interest rate and inflation rate across countries. According to (Fama, 1975), (Hafer & Hein, 1990), (Söderlind, 1998) it has been concluded and founded that interest rate is the best predictor of inflation rate. There is a disparity for countries like India, Nepal and Pakistan for there is a negative relationship between interest rate and inflation rate. Scholars like Mishkin (1981), (Fama 1975), (Gibson, 1972), (Friedman, 1980) have found that there is a one to one negative relationship between interest rate and expected inflation. Bangladesh, Bhutan and Sri Lanka are having a positive relationship between inflation and interest rate (Crowder, 1996) (Choi, 2002) (Kasman, et al., 2006), (Michelle, et al., 1999) through their researches, they have proved that there is a positive relationship between interest rate and inflation rate even if the interest rate is a predictor of expected inflation. So, it can be concluded that even if the interest rate is a predictor of inflation there can be positive and negative relationships between

interest rate and inflation rate depending upon the country and the time period which was tested. Therefore, the results of this research can be used by central bank of any country in implementing monetary policy and deciding on actions on interest rate as an instrument.

References

Barro, R. J. & Sala-i-Martin, X 1990, 'World real interest rates', *NBER Working Papers from National Bureau of Economic Research Inc*, no 3317.

Barsky, R. B 1987, 'The fisher hypothesis and the forecastability and persistence of inflation', *Journal of Monetary Economics*, vol. 19, no. 1, pp. 3-24.

Barsky, R. B. & DeLong, B. J 1991, 'Forecasting pre-world war i inflation: the fisher effect and the gold standard', *The Quarterly Journal of Economics*, vol. 106, no. 3, pp.815-836.

Barthold, T., & Dougan, W 1986, 'The fisher hypothesis under different monetary regimes', *The Review of Economics and Statistics*, vol. *68, no.* 4, pp. 674-679.

Woon Gyu Choi 2002, 'the inverted fisher hypothesis: inflation forecastability and asset substitution', IMF Staff Papers, Palgrave Macmillan, vol. 49, no. 2, pp 1-4.

Cooray, A., 2002, 'The fisher effect: a review of the literature', *Research papers from Macquarie University, Department of Economics*, no. 206
Costas, A. & Smith, B. D 1998, 'Financial intermediation and regime switching in business cycle', *American Economic Review*, vol. 88, no. 3, pp. 516-36.

Crowder, W. H 1996, 'The long run relationship between nominal interest rates and inflation: the fisher equation revisited', *Journal of Money, Credit and Banking*, vol. 28, pp. 102-18.

Das, A., John, J., & Singh, S 2009, 'Measuring core inflation in India', *Indian Economic Review*, vol. *44, no.* 2, pp. 247-273.

DePamphilis, D. M 1975, 'Long term interest rates and the anticipated rate of inflation', *Journal Business Economic, pp.* 11-18 Pages

Dwyer, G 1984, 'The Gibson paradox: a cross-country analysis', *Economica*, vol. 51, no. 202, pp. 109-127.

Engsted, T 1995, 'Does the long-term interest rate predict future inflation? A Multi-Country Analysis', *The Review of Economics and Statistics*, pp. 42-54.

European Central Bank 2016, 'What is the difference between nominal and real interest rates?' accessed by:https://www.ecb.europa.eu/explainers/tell-me/html/nominal_and_real_interest_rates.en.html.

Evans, M. D. D. & Lewis, K. K 1995, 'Do expected shifts in inflation affect estimates of the long-run fisher relation?', *The Journal of Finance*, vol. 50, no. 1, pp. 225-253.

Esra N. Kilci (2018), Analysis of the relationship between inflation and central bank interest rates in turkey: fourier approach, International Journal of Economic and Administrative Studies, 2019 (22): pp.135-146.

Fama, E 1975, '*Short-term interest rates as predictors of inflation*', The American Economic Review, vol. 65, no. 3, pp. 269-282.

Fama, E 1977, Interest rates and inflation: the message in the entrails', *The American Economic Review*, vol. *67, no.* 3, pp. 487-496.

Fisher, I 1930, '*The Theory of Interest'*, Macmillan Company, United Nations of America.
Friedman, B 1980, 'Price inflation, portfolio choice, and nominal interest rates', *The American Economic Review*, vol. 70, no. 1, pp. 32-48.

Friedman, B. M 1997, 'Who puts the inflation premium into nominal interest rates?', *The Journal of Finance*, vol. 33, no, 3.

Friedman, M. & Schwartz, A. J 1982, '*Monetary trends in the United States and the United Kingdom, their relation to income, prices, and inflation*',
National Bureau of Economic Research, University of Chicago Press.

Garcia, Rene & Perron, Pierre 1996, 'an analysis of the real interest rate under regime shifts', *The Review of Economics and Statistics*, vol. 78, no. 1, pp. 111-125.

Gibson, William E 1972, 'interest rates and inflationary expectations: new evidence', *American Economic Review*, vol. 62, no. 5, pp. 854-865.

Hafer, R W & Hein, Scott E 1985, 'on the accuracy of time-series, interest rate, and survey forecasts of inflation', *The Journal of Business*, vol. 58, no. 4, pp 377-398.

Hein, S. E. & Hafer, R. W 1990, 'Forecasting inflation using interest-rate and time-series models: some international evidence. *The Journal of Business,* pp. 1-17.

South Asian Regional Update, 2017, International Monetary Fund.

Kasman, S., Kasman, A. & Turgutlu, E 2006, 'Fisher hypothesis revisited: a fractional cointegration analysis', *Emerging Markets Finance and Trade*, vol. 42, no. 6, pp.59-76.

Klein, B 1975. 'Our new monetary standard: the measurement and effects of price uncertainty, 1880-1973', *Wiley Online Library*, vol. 13, no. 4, pp. 461-484.

Koch, T. W. & Hein, S. E 1988, 'Interest rates, taxes and short-term inflation forecasts'.

Leiderman, L 1979, Interest rates as predictors of inflation in a high-inflation semi-industrialized economy', *The Journal of Finance,* vol. *34, no.* 4, pp. 1019-1025.

Levi, M., & Makin, J 1978, 'Anticipated inflation and interest rates: further interpretation of findings on the fisher equation', *The American Economic Review,* vol. *68, no.* 5, pp.801-812.
Lindiwe Catherine Khumalo, Emmanuel Mutambara and Akwesi Assensoh- Kodua (2017). Relationship between inflation and interest rates in Swaziland revisited. *Banks and Bank Systems (open-access),* 12(4), 218- 226.

Mark, N 1985, 'A note on international real interest rate differentials', *The Review of Economics and Statistics*, vol. *67, no.* 4, pp.681-684.

Michelle, B., Boyd, J. H. & Smith, B. D 1999, 'Inflation and asset return', *European Economic Review,* vol. 43, pp. 737-754.

Mishkin, F. S 1981, 'The real interest rate: an empirical investigation', *Carnegie-Rochester Conference Series on Public Policy*, Vol. 15, pp. 151-200.

Mishkin, F 1988, 'Understanding real interest rates', *American Journal of Agricultural Economics,* vol. *70, no.* 5, pp. 1064-1072.

Frederic S. Mishkin 1978, 'Efficient-markets theory: implications for monetary policy', *Brookings Papers on Economic Activity, Economic Studies Program*, vol. 9, no. 3, pp. 707-752.

Mitchell, D 1981, 'Determinants of inflation uncertainty', *Eastern Economic Journal*, vol. *7, no.*2, pp. 111-117.

Morck, R. & Yeung, B 1991, Why investors value multinationality. *Journal of Business*, 64(2), pp. 165-87.

Moser, G. G 1995, 'The main determinants of inflation in Nigeria'.

Narayan, P. K., Narayan, S. & Mishra, S 2011, 'Do remittances induce inflation? fresh evidence from developing countries'.

Podkaminer, L 1998. Inflationary Effects of High Nominal Interest Rates.

Rachel, L. and Smith, T. D. 'Secular drivers of the global real interest rate', *Staff Working Paper No. 571*, Bank of England.

Rose, A. K 1988, 'Is the real interest rate stable?', *The Journal of Finance*, Vol. 43, no. 5, pp. 1095-1112.

Schmidt, E 1957, 'Full employment as a cause of inflation', *Proceedings of the Academy of Political Science*, vol. *26, no.* 3, pp. 9-26.

Sims, C 1980, 'Macroeconomics and reality', *Econometrica, vol. 48, no.* 1, pp. 1-48.

Söderlind, P 1998, 'Nominal interest rates as indicators of inflation expectations', *Scandinavian Journal of Economics, vol. 100, no. 2, pp. 457-472*.

Summers, L. H 1983, 'The nonadjustment of nominal interest rates: a study of the fisher effect', *NBER Working Paper*, no. 836.