# ALTERNATIVE SPECIFICATIONS OF FISHER HYPOTHESIS AND EMPIRICAL INVESTIGATION

**Researcher:**
**Ms. Surayya**
**115-FE/Ph.D/F-08**

**Supervisor:**
**Dr. Asad Zaman**
**Co-Supervisor:**
**Dr. Abdul Qayyum (Late)**

**International Institute of Islamic Economics,**
**International Islamic University Islamabad.**

# ALTERNATIVE SPECIFICATIONS OF FISHER HYPOTHESIS AND EMPIRICAL INVESTIGATION

**Ms. Surayya**
**115-FE/Ph.D/F-08**

**Submitted in partial fulfillment of the requirement of the Doctor of Philosophy in Economics at International Institute of Islamic Economics, International Islamic University Islamabad.**

**Supervisor: Dr. Asad Zaman**
**Co- Supervisor: Dr. AbdulQayyum (Late)**

## APPROVAL SHEET

# ALTERNATIVES SPECIFICATIONS OF FISHER HYPOTHESIS AND EMPIRICAL INVESTUGATIONS

By

**Surayya**
**Reg. # 115-FE/Ph.D. (Eco)/F2008**

Accepted by International Institute of Islamic Economics, International Islamic University, Islamabad, as partial fulfillment of the requirements for the award of Ph.D degree in Economics.

**Supervisor:** ____________________
Professor Dr. Asad Zaman
Ex-V.C, PIDE, University Islamabad

**Co-supervisor:** ____________________
Professor Dr. Abdul Qayyum (Late)
Professor, PIDE, University Islamabad

**Internal Examiner:** ____________________
Associate Professor, Dr. Abdul Rashid
IIIE, International Islamic University, Islamabad

**External Examiner I:** ____________________
Associate Professor, Dr. Tariq Majeed,
Quaid-e-Azam University, Islamabad

**External Examiner II:** ____________________
Associate Professor, Dr. Tahir Mukhtar,
Fatima Jinnah Women University, Rawalpindi

HOD
School of Economics,
International Islamic University, Islamabad

Director General
International Institute of Islamic Economics
International Islamic University, Islamabad

Date of Viva Voce: 21-07-2020

**DEDICATED**

**To**

*My Grand Parents*
*For silent prayers, sacrifices, patience and immortal love*

*My Parents*
*For being my first teachers; Who taught me to trust Allah*

*My Mother in Law*
*For her love and care for me and my children*

# ACKNOWLEDGEMENTS

First of all I would like to pay my profound thanks to Almighty Allah, who has provided me with the opportunity, ability and determination to complete this dissertation.

I offer my cordial respect and heartfelt thanks to the Holy Prophet Hazrat Muhammad (S.A.W) who exhorted us to seek knowledge from cradle to grave.

I utter my fervent gratitude to my supervisor Prof. Dr. Asad Zaman and my co-supervisor Prof. Dr. Abdul Qayyum (Late). I whole heartedly acknowledge their valuable guidance and cooperation during the entire period of my Ph. D. I learned a lot from my teachers and I am particularly obliged to Dr. Razzaque Hamza Bhatti, Dr. Pervez Zamurrad Janjua, Dr. Hafiz Muhammad Yasin and Dr. Abdul Jabbar.

My sincere regards to Dr. Atiq uz Zaffar and Dr. Abdul Rashid, who remain extremely supportive. I am also thankful to Dr. Hajra Ihsan, Dr. Hamid Hassan and Dr. Atiq ur Rehman for their support and encouragement.

I am extremely thankful to Ali Raafie, Syed Niaz Ali Shah, Tauqir Ahmed and Muhammad Nawaz Malik for their co-operation and timely processing of my thesis.

I might not have been able to complete the long arduous journey without the help of my parents and parents in law. I lost them during this journey but I have always felt that their prayers are with me. I am especially thankful to my husband Mukhtar Ahmed, brothers Zia-ur- Rehman and Saif-ur-Rehman and my children Muneeba Mukhtar, Maryam Mukhtar, Muhammad Bin Mukhtar and Musaab Bin Mukhtar, who are radiant of energy and inspiration for me.

I am also thankful to my dear friends Siffat Mushtaq, Sadia Noureen, Mahnaz Aslam and Sabeen Almas for their unyielding support. At the end, I would like to extend my gratitude to those, whom I could not mention in this brief space. May Almighty Allah reward them all.

# TABLE OF CONTENTS

## 4. Empirical Results

# LIST OF TABLES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| ADF | Augmented Dickey- Fuller |
| APEC | Asia Pacific Economic Co-operation |
| ARDL | Auto Regressive Distributed Lag |
| ARFIMA | Auto Regressive Fractionally Integrated Moving Average |
| BRICS | Brail, Russia, India, China, South Africa |
| BSE | Busharest Stock |
| CADF | Covariate Augmented Dickey Fuller |
| CIP | Covered Interest Parity |
| CPI | Consumer Price Index |
| DF-GLS | Dickey-Fuller Generalized Least Square |
| DOLS | Dynamic Ordinary Least Square |
| ECM | Error Correction Model |
| EMS | European Monetary Systems |
| EU | European Union |
| FH | Fisher Hypothesis |
| FM-OLS | Fully- Modified Ordinary Least Square |
| FPE | Financial Market Price Index |
| G7 | Canada, France, Germany, Italy, Japan, UK, US |
| GARCH | Generalized Auto Regressive Conditional Heteroskedasticity Model |

| | |
|---|---|
| GDP | Gross domestic Product |
| GMM | Generalized Method of Moment |
| GNP | Gross National Product |
| IFS | International Financial Statistics |
| IMF | International Monetary Fund |
| IPS | Im, Pesaran and Shin |
| KPSS | Kwiatkowski-Phillips-Schonidt-Shin |
| OECD | Organization of Economic Cooperation for Development |
| OLS | Ordinary Least Squares |
| PP | Phillips-Perron |
| PPI | Producer Price Index |
| PPP | Purchasing Power Parity |
| Q Data | Quarterly Data |
| RIP | Real Interest Parity |
| SPS | Sequential Panel Selection |
| SURM | Seemingly Unrelated Regression Model |
| UIP | Uncovered Interest Parity |
| VECM | Vector Error Correction Model |
| WS | Weighted Symmetric |
| Y Data | Yearly Data |

# Abstract

Fisher hypothesis provides theoretical framework for the study of relationship between nominal interest rate and inflation. It assumes one to one direct relationship between nominal interest rate and anticipated inflation rate. Modifications to this model are explained by Mundell effect, Phillips curve and Friedman effect, Levi and Makin effect, Darby effect and Carmichael and Stebbing effect (Inverted Fisher Hypothesis). Fisher hypothesis in the stock market specifies that the stock returns should be directly linked to the inflation rate. Fisher hypothesis in open economy suggests that when economic agents are rational and there are fully integrated global markets, a long run convergence among markets and the country specific rate of interest is evident and the difference in nominal rate of interest is completely modified to future expected rate of inflation. The objective of our study is to explore the Fisher hypothesis and its alternative specifications using quarterly and yearly IFS Panel data sets from 1948-2018 and applying General to Specific Methodology. Fisher hypothesis, Fisher hypothesis in the stock market and Fisher hypothesis in the open economy is tested for the whole sample and for above average money supply/GDP countries and below average money supply/GDP countries. Our findings show that Fisher hypothesis in its strong form does not hold. Our analysis in the stock market indicates that stock market returns are not only determined by the inflation but are also determined by the real returns in the last year and inflation in the last year as well. Fisher hypothesis holds in most of the world economies but it holds in its weak form. Fisher hypothesis in open economy holds in its strong form.

**Key Words:** Fisher hypothesis, Inflation Rate, Interest Rate, Uncertainty, Monetary policy

**JEL Classification:** E40, E43, E52

CHAPTER

1

# INTRODUCTION

This chapter deals with the introduction of the study. Its Section 1.1 discusses the back ground of the study. Section 1.2 discusses the theoretical and policy significance of the study. However, Section 1.3 discusses the study objectives and motivations and Section 1.4 discusses the study plan.

## 1.1 Back Ground

The Fisher hypothesis offers a theoretical framework for the study of the association amid inflation and nominal interest rate. However, it is originally associated with Fisher (1930). Fisher hypothesis asserts that when economic agents are rational and they are able to perceive fully the changes in future, then the equilibrium nominal interest rate has been composed of real interest rate and fully anticipated future inflation rate. But in uncertainty, when economic agents are not able to perceive changes fully, the nominal of interest rate should be the combination of both expected inflation and real interest rate.

Fisher hypothesis is used to find the competence of the markets. In stock market it indicates that the Stock returns should be directly linked to the expected future inflation rate. Equities are thought to be "hedges" for unanticipated inflation. They represent ownership on real assets. The nominal expected return on an asset has been the totality of real interest rate, real risk premium and expected future inflation.

Fisher hypothesis in the open economy is also known as the hypothesis of perfect asset substitutability. It is explained by Real Interest Parity (RIP) condition. RIP suggests that when economic agents make their decisions rationally and there are fully integrated global markets (capital, foreign exchange and goods). Then the investors are able to select their portfolio freely and their ability to earn profits due to differences in the prices of the goods and assets and the par values of currencies are reduced. In this situation a long run convergence has been evident among markets and the country specific rate of interest due to increase in dependency (Singh and Banerjee, 2006). In this case the difference in nominal interest rate is completely modified to the future expected inflation rate. So the domestic and foreign ex ante rate of interest become equal for all countries.

Fisher hypothesis forms basis for the theoretical models which explain that the role of money is neutral in determining the real variables of the economy in the long run. It is also crucial for understanding the fluctuations in nominal interest rate. However, the government uses rate of interest mechanism to control inflation. The costs of inflation are enormous and dreadful. High inflation is the main cause of loss in welfare. During inflation the demand for real balances falls as the real purchasing power of the public falls. In inflation the efficiency of price mechanism is decreased and the resources are wasted in gathering information. The performance of the interest rate as a hedge and a forecaster against inflation becomes suspicious in such situations. Consequently, the uncertainty about expected inflation also reduces both consumption and investment. It further impairs economic performance. Inflationary expectations influence nominal interest rate. In fact, it plays dynamic role in today's world economies. The Fisher hypothesis has far-reaching effects not only for debtors and creditors but it has also significant impact on the effectiveness of fiscal and monetary policies.

Fisher hypothesis is used to find the level of assimilation among different markets within the country as well as at the international level. The strength of Fisher hypothesis shows that if market forces are set free, they allocate resources optimally throughout the world and they provide an increased protection to the national economies from foreign shocks. Moreover, in internationally integrated financial markets, the markets in which capital is perfectly mobile, capital flows eradicate the difference between real and nominal rate of return on same assets and saving difference across the country has been unlikely to badly affect investment by increasing the real cost of borrowing. At the same time, funds can be borrowed by the country at the world rate. Consequently, the inequality of real interest rates among countries would be equivalent to indicating that domestic investment is held in check by domestic savings. It implies that domestic savings and investments are correlated.

Models of Fisher hypothesis and its alternative specifications, *i.e;* Phillips curve, Friedman Effect, Inverted Fisher hypothesis, Tailor effect, Fisher hypothesis in the stock market and Fisher hypothesis in the open economy have been tested by many researchers separately using different techniques but they have found conflicting results. Some studies accept, *e.g.* Baharumshah *et, al.* (2009), Holmes *et, al.* (2009), while others reject or have found mixed results, *e.g.* Rose (1988), Hakan *e, al.* (2007), and Ling *et, al.* (2007). The objective of our study is to use the panel data estimation and General to Specific Modeling to study the alternative specifications of Fisher hypothesis to resolve these issues.

## 1.2 Theoretical and Policy Significance

Fisher hypothesis forms the basis of the theoretical models which explain that the role of money is neutral in determining the real variables of the economy. It is also crucial for understanding the changes in nominal interest rate. The quantity theory of money demonstrates that the money growth rate regulates inflation rate in an economy. Moreover, the Fisher hypothesis clarifies that the nominal interest rate has been embellished by the expected inflation rate. In presence of Fisher hypothesis, the real interest rate is constant over time. Real interest rate affects all savings and investment decisions in the economy. The real interest rate performs major role in determining the prices of different assets and capital flows through its exchange rate upshot. So comprehending the association among interest rates and other variables is a crucial topic in the study of financial markets.

Fisher hypothesis undertakes that to maintain equilibrium real interest rate, inflation rate must match with nominal rate of interest. The most important role of the interest rate is represented by the portfolio effect. It takes place as money and other financial assets are alternative forms of holding wealth. Whenever there has been a change in growth rate of money stock, it causes contrast among desired and actual money balance. This difference in both further affects the demand for other financial assets and is eliminated through a change in the rate of return.

Cost of capital has a significant effect on decisions to invest. The cost of capital is important in business cycles as well. The interest rate is a main element in the capital cost which affects investment decisions and expenditures. Moreover, the inventory investment and the trade credit is also affected by the short –run interest rate, while long-term interest rates affect long term plan of investment and residential housing. In this regard, an efficient and well-functioning stock market assists the economic growth and development procedure in an economy through the escalation of household savings, efficient distribution of investment resources, and attracting the foreign portfolio investment. Furthermore, a well-organized pricing process recompenses well-managed and profitable firms by enhancing the market value of their shares. It also lowers the costs of capital for firms. A reduction in the cost of capital leads to an efficient resource allocation and channelization of firms to profitable and well organized firms in an economy.

The costs of inflation are enormous and dreadful. One implication of high inflation is the loss in welfare. This loss in welfare is caused by falling demand for real balances as the real purchasing power of the public falls during periods of high inflation.

The interest rate mechanism is the most extensively used policy instrument by the governments in controlling the inflation. The costs of inflation are enormous and dreadful. An elevated inflation rate is the source of decrease in welfare. This decrease in welfare is caused by falling demand for real balances. In inflation the efficiency of price mechanism is decreased and the resources are wasted in gathering information. The role of interest rate as a hedge and predictor of inflation becomes uncertain in these situations. Consequently, the uncertainty about expected inflation reduces both consumption and investment. It also impairs the economic performance. Moreover, the effectiveness of monetary and fiscal policies is also affected by inflationary expectations. The expectations about inflation affect nominal interest rate. Hence, the Fisher hypothesis has important effects not only for debtors and creditors but also for the effectiveness of monetary and fiscal policies.

A monetary policy planned to achieve output and price level steadiness generally works through its effects on the economy's aggregate demand schedule. Central bank conducts its policies in financial markets, (the markets for government bonds, for interbank loans and for central bank credit). Central bank chooses an intermediate target that it can effectively control. Interest rates are mostly used as intermediate targets because they can be observed regularly by the central bank. Average data of interest rates on financial instruments are available on daily basis and central bank can quickly track interest rates. An extensively agreed suggestion in modern economics is that policy rules are better than discretion in enhancing the economic performance of a country. Monetary policy instrument rules provide achievable options to the developing countries. These countries are missing the pre-requisite for more refined targeting rules. In economic theory two rules have been supported to control the interest rates; Friedman's deflation rule (1969) and Tailor's rule (1993). Fisher effect forms the basis of these two rules.

Friedman (1969) built his deflation rule on Pareto optimality condition. According to this condition, the efficient level of production of a commodity requires that marginal cost of the commodity shall be equal to the marginal benefits usually measured by the commodity price. However; the marginal cost of money is near to zero. Moreover the social cost /opportunity cost of money has been the nominal interest rate. This rate is also the opportunity cost of holding money .Thus the nominal interest rate should not be greater than zero to minimize this social cost or opportunity cost of money holding. So the inflation in the economy must be equal to the interest rate.

Taylor (1993) offered a monetary policy instrument rule to pursue monetary policy operations. In this instrument rule he recommends that federal fund rate target (discount/interest rate) should be set in such a way that it should be the same or equal to the "equilibrium" fund rate with the collaboration of current inflation plus the weighted average of monetary authority's response to its deviations from the targeted inflation and percentage deviation of the real GDP from its potential level. The recommended rule by Taylor is as follow:

$$\mathrm{I}_t = R + \Pi_t + a_1 Y_t + a_2(\Pi_t - \Pi^*)$$

where:

$\mathrm{I}_t$ is the nominal interest rate,

R is the long run equilibrium real interest rate,

$\Pi_t$ is the current inflation rate,

$\Pi^*$ is the target inflation rate and

$Y_t$ is the deviation of output in period t from its long run trend.

Taylor says that $a_1$ and $a_2$ should be greater than zero for the stability of an economy.

These rules have not been followed by the central banks. Interest rate targeting is the popular policy in the USA, UK and Japan. These countries have adopted the zero interest rate policies. The State Bank of Pakistan also uses interest rate targeting policy in response to high inflation expectations. Our present study will be useful in exploring the policies effects on relationship between inflation and real interest rate.

On the theoretical side, numerous clarifications exist for failure of one to one relationship between nominal interest rate and expected inflation rate. However, short –run situation has been generally considered by theoretical models and the marginal product of capital has been set free to differ on financial assets real return. However, the macroeconomic simple model containing vertical aggregate supply curve equation and IS, LM creates the Fisher hypothesis and $dR/d\Pi$ (expected inflation effect $\Pi$ on real interest rate R), equals unity. On the other hand there have been numerous considerable variations of the above model that show a different value of $dR/d\Pi$.

First, Mundell effect suggests that the existence of real balance effect on consumption dampens $dR/d\Pi$.

Second, the Phillips effect says that when aggregate supply curve is not vertical, this situation dampens $dR/d\Pi$.

Third, Makin and Levi show inflation uncertainty is affected by expected level of future inflation however the inflation uncertainty affect the parameters of behavioral function .Thus this underlying channel changes the value of $dR/d\Pi$.

Fourth, the Darby suggests when a tax on nominal interest income is present then $dR/d\Pi$ rises.

Fifth, Carmichael and Stebbing (1983) argue that the bonds have been more close substitutes for money, thus expected inflation and nominal interest rate has no influence on the bond.

And finally, Mitchell (1985) argues that when there are numerous financial assets. They can cause a different value of the size of nominal interest and inflation rate effect.

Since the early 1980s, financial markets and institutions have experienced foremost changes. Essential organizational transformations in the financial services across markets have taken place. Enhanced production, communication, and technological dependence and integration among national and international financial economic system has promoted an atmosphere which is helpful for global investment and trade activities. In recent times, this shift has been even more enhanced by movement headed for money market deregulation and liberalization both in developed and developing countries. Financial liberalization has been fostered to increase the domestic financial system proficiency by relaxing rate of interest, decreasing credit control, flourishing healthy competitive financial institutions and developing capital and money markets (Moosa and Bhatti, 1997).

When financial markets are integrated, events in one country will have their impact on the financial markets in other countries. How quickly and to what extent this impact is transmitted to other markets depends on the degree of integration amongst the world markets. The magnitude of integrated world markets has significantly shaken up the interest and exchange rate behaviors across countries. However, such behavior in rates has decisive repercussions in determining the level that domestic monetary authorities can use to build independent monetary policies. However there is a universal agreement on the suggestion that more integrated international markets promise the more restricted scope of utilizing independent monetary policies. Therefore the power of the stabilization policies is reduced. Feldstein (1982) explains that unless the real rate of interest has been different among countries, policies used by the government to increase the domestic savings cannot be successful. Hence, it is a must for policy makers to consider the possible consequences of international market integration while pursuing the domestic monetary and fiscal policies.

If the world markets are not fully integrated and stock prices do not change according to the changes in goods prices. The nominal stock returns also do not change with expected inflation. In such situations the common stocks do not play the role of a good hedge against inflation. It has following implications:

First, the fluctuations in price of stocks have been a sign of firm's future and present efficiency. Lesser stock prices show that firm's performance is poor. Second, price of stock has been expected to decrease the household consumption demand. Third, investment spending will fall with decrease in stock price .A decrease in stock price is viewed as an indication that the value of firms' capital is low in the market. As a result mergers are encouraged instead of new capital investment. Fourth, when an adverse relationship runs from price of stocks to goods, hampers capital stock growth. The capital stock growth then in turn exerts an opposite effect on productivity and output.

The empirical validity of the Fisher hypothesis has several important implications:-

First, the strength of the Fisher hypothesis is vital for the understanding of relationships among different markets *i.e*; the foreign exchange, capital and goods. It is also important to understand the movements of exchange rates and the behavior of the interest rates (both nominal and the real) within the country as well as at the international level. It has important implications for pursuing independent domestic stabilization policies. For example, the validity of these conditions point out the presence of integration amongst the world markets.

More integrated the world markets more difficult it is for the national governments to run independent monetary policies. This is also true when real exchange rates and interest rates among countries are mean-reverting over time.

Secondly, the validity of the Fisher hypothesis shows that when the market forces are free, they allocate resources around the world optimally. In this way they will provide an increased separation of the national economies from foreign shocks. For example, the Fisher hypothesis displays that if the markets for goods and assets operate efficiently and market agents are risk neutral, then investors around the world become insensitive while choosing portfolios among domestic and foreign securities. Moreover, in internationally integrated financial markets, in which capital is perfectly mobile, possibility of infinite capital flows remove the return (nominal and real) differentials on the similar assets. Shortage of savings in one country does not crowd out investment with an increase in the real borrowing cost and the country borrows funds at world interest rate. Consequently, unequal international interest rate would be equivalent to indicating that domestic investment is held in check by the domestic savings. It implies that domestic savings and investment are related.

The world economies are facing high rates of inflation; the study of fisher hypothesis has far reaching consequences for investors and policy makers. Fisher himself used the lag distributed structure to measure the inflationary expectations. The early studies of the Fisher hypothesis mostly used a proxy of inflationary expectation *e.g.*, Cagan (1956), and Gibson (1970). Muth in 1961 pioneered the theory of rational expectations and in 1970 Fama advanced the theory of efficient markets. Such method is evident by Lahiri and Lee (1979) Levi and Makin (1979) etc. suggesting the inclusion of Fisher hypothesis theories and instigating the properties of variables through time series analysis that involved the methodological advances of the Fisher hypothesis e.g., Mishkin (1992) and Wallace and Warner (1993). In any case, the prices are continuously changing and the pricing decisions are not based only on current information. We have followed Mishkin(2003).

## 1.3 Motivation and Objectives of the Study

There is a lot of research work on different aspects of Fisher hypothesis for different countries but a single, unique study covering almost all specifications of Fisher hypothesis is lacking. The present study is an effort in the same direction.

Another motivation for this empirical exercise comes from the fact that the process of international liberalization of capital markets started in early 1980s. Liberalization of the capital market is conventionally assumed to result in higher degree of capital mobility and financial integration across different countries. The extraordinary expansion of capital flows across border is believed to have dissolved the barriers separating national financial markets by eliminating the differential among both return (real and nominal) on similar assets denominated in different currencies.

The major study objective has been to analyze empirically the Fisher Hypothesis validity and its alternative specifications. If the Fisher Hypothesis holds then inflation has no effect on financial markets through changes in the real rate of interest and the monetary and fiscal policies become ineffective.

The second objective is to extend the empirical evidence on Fisher Hypothesis and its alternative specifications.

## 1.4 Research Questions

Research questions of our study include:

Does Fisher hypothesis hold in the world economies?

Does inverted Fisher hypothesis hold in world economies?

Does Fisher hypothesis hold in the Stock market of the world economies?

Does Fisher hypothesis hold in the Open economies of the world?

## 1.5 Significance of the Study

This study incorporates almost all specifications of Fisher hypothesis. The findings of the study are also important for the decision makers in today's world *i.e*; the individuals, the firms and the policy makers.

Our results indicate that Fisher hypothesis either does not hold or holds in its weak form in most of the world economies so countries can pursue their independent monetary and fiscal policies. Interest rate last year has positive and significant effect on nominal interest rate. Inflation last year and expected inflation has positive and significant effect in most of the cases and money supply has significant effect in determining the nominal interest rate. The countries can pursue their independent monetary and fiscal policies. They must also take care of inflation. Fisher hypothesis hold in stock market but it holds in its weak form. Real returns last year has positive and significant effect. Stocks do not provide a complete hedge against inflation, so investors must seek other forms of investment. Fisher hypothesis holds in the open economies in all the cases.

## 1.6 Plan of the Study

Organization of the present research is as:

2nd Chapter depicts a brief literature review. 3rd Chapter discusses the theoretical aspects of the Fisher hypothesis, Methodology and data. 4th Chapter presents empirical results and 5th Chapter presents conclusions.

CHAPTER

2

# LITERATURE REVIEW

This chapter deals with the literature review of Fisher hypothesis and its alternative specifications. Section 2.1 explains the literature review of Fisher hypothesis. Section 2.2 explains the literature review related to the alternative specifications of the Fisher hypothesis. Section 2.3 explains the literature review related to Fisher Hypothesis in the Stock Market. Section 2.4 explains the literature review related to the Fisher Hypothesis in the open economy and conclusion of the chapter is given at the end.

## 2.1 Literature Review of Fisher Hypothesis

Early studies support the Fisher hypothesis includes Gibson (1972), Pyle (1972), Cargill (1976), Lahiri (1976) and Tanzi (1980). Gibson (1972) and Pyle (1972) use U.S Treasury bills data of different maturities. They use Livingstone survey data of future price expectations from 1947-.70 and 1954-69 respectively. They apply Ordinary Least Square (OLS) method. They find that the nominal interest rate completely changes according to the changes in future inflationary expectations and the real interest rate is not changed or influenced by future price expectations. Cargill (1976) uses Carlson's (1975) revised data of two periods (1950:6-1975:12) and (1952:6-1975:12). He employs Cochrane-Orcutt GLS procedure. His results confirm the hypothesis during the former period (1950:6-1975:12) only. Lahiri (1976) and Tanzi (1980) test the Fisher hypothesis using alternative proxies for expected future inflation *i.e*; distributed lags, adaptive expectations, extrapolative expectations and Frenkel's (1975) mechanism. Lahiri (1976) uses data from 1953 through 1970 and Tanzi (1980) uses the data from June 1959 to December 1975. Their results confirm the Fisher hypothesis.

Later on Mishkin (1992), Phylaktis and Blake (1993), Evans and Lewis (1995) and Crowder and Hoffman, (1996), study the long run Fisher effect for US. They find a direct and one- to one relationship between nominal interest rates and expected future inflation rate. Mishkin (1992), Phylaktis and Blake, (1993) and Evans and Lewis (1995) employ Engle Granger technique using the data set from 1971:1 to 1987:2 and 1955 to 1990 respectively, while Crowder and Hoffman, (1996) apply Johansen (1988) technique using quarterly data from 1952:1 to 1991:4.

Studies of Nelson and Schwert (1977), Huizinga and Mishkin (1984), and Kinal and Lahiri (1988) use the US data and produce mix results. Nelson and Schwert (1977) use the data from January 1953 to July 1971. They employ a Box-Jenkins approach to form a time series forecaster of inflation rate. This forecaster of inflation is built on past rates of inflation. The regression of the inflation rate on the interest rate and the estimated inflation rate yield a non-zero coefficient of estimated inflation. It indicates that the forecaster contains information about the rate of inflation which is not incorporated by the rate of interest. Huizinga and Mishkin (1984), Kinal and Lahiri (1988) and Rose (1988) focus on the assumption which forms the basis of Fisher hypothesis that the ex ante real interest rate is fixed or constant. They use the data from 1959 to 1981 related to seven securities of different maturities and four different price indices. They apply Monte Carlo Simulation technique. They find that all seven assets have performed poorly as a hedge against expected future inflation, and that the longer-maturity assets performance as hedge against inflation is even poorer. They also find that ex ante real interest rates are statistically significant for shorter periods of time. Kinal and Lahiri (1988) use quarterly data for 1953:1-1985:2. They estimate their model by two-step two-stage least squares. They have used the interest-rate model to formulate investors' ex ante forecasts of inflation. They find that the investors' ex ante forecasts of inflation are unbiased while the Livingston survey forecasts are biased. They have also found that mean squared prediction error of their inflation forecasts increases when price expectations are included in the model as a determinant of ex ante real interest rates.

Studies that reject the Fisher hypothesis include, Rose (1988), and Fahmy and Kandil (2003). Fahmy and Kandil (2003) use monthly data from1980:1 to 1997:12. They apply ADF and Johansen and Julius (1990) techniques. They find no cointegration between the short term and long term interest rates. They conclude that short term interest rates have very little significance to forecast future inflation rates. They also assert that the inflation rate and interest rates change together in the long run.

Fama (1975), Garbade and Watchel (1978) and Dawyer (1981) test both of the hypothesis jointly that Treasury bill market is efficient and real interest rate is fixed over time. Fama (1975) uses US data set from 1953 to 1971. He finds that the nominal interest rate is an unbiased predictor of expected future inflation rate. Fama’s results support the joint hypothesis that the market is efficient. Garbade and Watchel (1978) use the US data from 1953 to 1971 and employ time-varying parametric regression analysis to test the joint hypothesis. They find no evidence in favour of hypothesis. Their results also reject the assumption that the real interest rate is fixed or constant during the sample period. They use interest-rate model to construct investors' ex ante forecasts of inflation. They have shown that they are unbiased. Dawyer (1981) uses US quarterly data from 1954 through 1973. His results are consistent with Fama (1975). He uses the information about past interest rates and inflation rates, past growth rates of the base, the money supply, and real *GNP*. His tests also allow for a positive marginal tax rate which changes the results a little. The hypothesis is generally consistent with the data, which provides support for the suggestion that predictable changes of the money supply do not affect expected real interest rates.

Fisher hypothesis has also been tested in Pakistan and India by Hasan, (1999) and Sathye, *et, al.* (2008). Hasan, (1999), tests the Fisher Hypothesis in Pakistan. He tries to estimate the long-run relationship between interest rate and inflation rate. He uses quarterly data of International Monetary Fund (IMF), International Financial Statistics data base from 1957Q1 to 1991 Q2. He applies cointegration analysis. He develops inflationary expectations model using adaptive and rational expectation approaches. Hasan's study finds the long-run association between nominal interest rate and inflation rate. In his study the partial Fisher Hypothesis is accepted. Sathye, *et, al.* (2008), tests the link between short-term nominal interest rate and inflation rate for financial market of India. They use monthly data of inflation and nominal short term interest rates. Their data set ranges from April 1996 to August 2004. The data is gathered from the Hand book on Indian Statistics published by the Reserve Bank of India. They perform Augmented Dickey- Fuller (ADF) and the Phillips- Perron (PP) unit root tests to check stationarity of the variables in their model. To test the co-integration, they have used the Engle-Granger and Johansen-Juselius methods. Their results explain that short-term nominal interest rates are useful in predicting expected future inflation.

Panel data study that support Fisher Hypothesis is done by Westerlund (2006). He uses monthly data set of Economic Outlook and Main Economic Indicators. He includes twenty OECD countries from 1980:1 to 2004:4. He applies ADF and Durbin-Hausman techniques.

Panel data studies that reject the Fisher Hypothesis include Zisimos and Apostolos (1999), Coppock and Poitras (2000), Crowder (2003) and Herwartz (2011). Zisimos and Apostolos (1999), use post war quarterly data set from 1957:1 to 1972:1 for Belgium, Canada, Denmark, France, Germany, Greece, Ireland , Japan, Netherlands, U.S, U.K. They apply ADF and Engle and Granger (1987), Non Structural Bivariate Autoregressive Methodology (King and Watson 1997), Augmented Weighted Symmetric (WS) methods. They conclude that fully anticipated inflation has less than a unit effect on nominal interest rates, and it also decreases the real interest rates even in the long run. Coppock and Poitras (2000) test the Fisher hypothesis for 40 countries using the data from 1976-1988. They apply OLS, Bounded influence estimation (Two Step and Iterated) methodology. Crowder (2003) uses monthly data from 1960:1 to 2000:12 of nine industrialized countries; US, UK, Germany, Japan, Italy, Belgium, France, Netherlands and Canada. He applies DOLS, FM-OLS Johansen (1991) Dickey –Fuller (ADF 1984), Phillips-Perron (PP 1988), Levin and Lin (1992), Im, Pesaran and Shin (IPS 1997) and Covariate Augmented Dickey Fuller (CADF) tests. He finds that the nominal interest rates and inflation rates are I (1) processes. He finds monetary super neutrality in 80% of the empirical specifications. He concludes that Fisher effect estimates depend on the deterministic specification and normalization of the regression. Herwartz (2011) uses unbalanced cross section data of 114 countries. He applies panel data methods and Functional coefficient models (Cai, Fan and Yao 2000). His empirical analysis consists of country specific regressions. He uses Panel data methods to complement his study. He finds less than one

Fisher coefficient from a worldwide perspective. He concludes that when there is large positive change in inflation or high inflation risk or high interest rates, a long run equilibrium association or link between expected future inflation and interest rate as assumed by Fisher (1930), does not prevail in the economies of the world.

Panel data studies of Engsted (1995), Hakan *et.al.* (2007), Ling *et, al*. (2007) and Ghazali and Ramlee, (2003) find mix results. Engsted (1995) uses the monthly data set of thirteen OECD countries from 1962:2 to 1993:1. He applies Dicky Fuller test and Multivariate Maximum Likelihood method. He finds that for most countries interest rates and inflation are non stationary I (1) processes. Fisher hypothesis is rejected for Canada, USA, Belgium, France, Italy, Sweden, Switzerland, Denmark and Ireland. In Japan and UK the hypothesis is accepted. Hakan *et, al.* (2007) use the International Financial Statistics (IFS) data set of G7 countries and 45 developing countries. He applies Garch technique. He finds that Fisher hypothesis holds in G7 countries, while it holds in only twenty three developing countries. There is positive and significant link between interest rates and inflation uncertainty for six G7 countries. Same positive and significant link between interest rates and inflation uncertainty exists in 18 developing countries. This relationship is negative for seven developing countries. Fisher hypothesis holds in his study but it holds in its weak form. Ling *et, al*. (2007) use the monthly data of nine East Asian economies from 2001:1 to 2006:3. They apply unit root tests (ADF, DF-GLS). Their results of the short run data show that Fisher hypothesis holds in Malaysia, Taiwan and Philippines. The results of long run data show that Fisher hypothesis holds in China, Hong Kong, Indonesia, Singapore and South Korea as well. Ghazali and Ramlee, (2003), examine the presence of Fisher effect in the G7 countries *i.e;* Canada, France, Germany, Italy, Japan, UK and USA. They use monthly data from1974:1 –

1996:6. The data set is used from the CD-Rom version of International Financial Statistics of the International Monetary Fund. They have used the Consumer Price Index (CPI) as a proxy of the inflation rate in each country. He applies ordinary least squares regression. The inflation rate is the dependent variable and short-term interest rates are the independent variable in his study. His study provides significant support for the Fisher effect. In determining the stochastic process of short-term interest rates and inflation rates. He also uses ARFIMA model. To find the possibility of a long-run relationship between interest rates and inflation he uses Engle–Granger two-step cointegration procedure.  He finds that the long-run equilibrium link between interest rates and expected future inflation as supposed by Fisher does not hold in G7 countries.

Satake (2011) concludes that few studies support the Fisher hypothesis 'strong form'. Empirical evidence is mixed and changes over time and space. Mostly it is in favour of partial Fisher effect. He says that time series analysis gives mixed results.

## 2.2 Literature Review of Alternative Specifications of Fisher Hypothesis

In this section the literature review of alternative specifications of Fisher hypothesis is explained. Section 2.2.1 deals with the literature review of the Fisher hypothesis with Phillips curve and Friedman effect. Section 2.2.2 deals with the literature review on Darby Effect and Section 2.2.3 deals with the literature review on Inverted Fisher hypothesis.

### 2.2.1 Literature Review of Fisher Hypothesis with Phillips curve and Friedman Effect

Taylor (1981) re-estimates the equations used by Levi and Makin (1979) using the Cochraneorcutt technique. He finds that the coefficients of expected future inflation rate are considerably decreased. The strong systematic link between interest rates and output does not hold. He also finds that the inflation uncertainty becomes an insignificant variable. His results show that the Phillips curve effect is responsible for the failure of Fisher hypothesis. He doesn't find the presence of Mundell effect and the inflation uncertainty effects.

### 2.2.2 Literature Review of Darby Effect

The studies that confirm the presence of Darby effect is Feldstein (1976) and Crowder and Hoffman (1996). Feldstein (1976) uses neo classical growth model.  He studies personal income tax, corporate tax and lump sum tax. He says that the link of the interest rate and the rate of inflation is highly affected by the presence of the corporation and personal income taxes. The force of the Fisher effect lies in the factors like equality of the real interest rates, cost of the capital to the firm, and the real returns to the savers. All of these factors will be equal in the absence of taxes. In an economy with personal and corporate income taxes this is not true. Crowder and Hoffman, (1996), use quarterly data from 1952:1 to 1991:4. They test the long run Fisher relation and the Darby effect. They apply Johansen (1988) and VECM techniques. They find that the nominal interest rates change according to the changes in inflation rate even after allowing for the changes in marginal tax rates. These changes in the marginal tax rates have occurred over the sample period. They also find that inflation can predict the future of interest rates.

The studies that have inconclusive results are Carr *et, al.* (1976) and Cargill (1977). Carr *et, al.* (1976) examine the Darby hypothesis. They use rational expectations hypothesis to create a synthetic price expectations series. Then they apply it to four models of interest rate determination. They have used quarterly Canadian data from 1959:1 to 1971:2. They also use a distributed lag proxy for price expectations using Almon variables. The Almon variables are created on past rates of inflation. They find inconclusive results about the Darby hypothesis. Cargill (1977) tests Darby hypothesis for US using Livingston data for the decade of 1960's. He re-estimated his model by including real GNP and real money supply.

The study that rejects the Darby effect is Tanzi (1980). Tanzi (1980) reestimates equations used by Gibson, Lahiri, and Gordon to study the inflationary expectations. He uses the monthly data from June 1959 to December 1975. He tests the hypothesis that when there are income taxes, the increase in nominal interest rates must exceed inflationary expectations. He finds this coefficient significantly less than 1 in all the equations. He concludes that individuals do not suffer from the money illusion but they suffer from the fiscal illusion.

Ezrati (1982) theoretically analyses that market participants face a vector of alternative uses of funds. These alternatives pay returns. These returns can be compared with interest returns. Some of these returns are taxed. Markets are in equilibrium when the after-tax, after-inflation returns are equal on all these alternatives. If the market is in equilibrium before the development of inflation expectations, such a development will shift the funds towards those options which are expected to compensate investors in real terms. The returns on fixed-income securities increase until they compensate for the anticipated inflation. When two investment options are taxed differently, that difference also figures into the premiums provided for expected inflation. Tanzi's model is a special case where the alternative tax rate equals zero. This expanded model cannot explain the Tanzi's results. His simple calculation of the expected coefficient on the inflation expectations proxy overstates the impact of taxes because it ignores the effect on alternative returns and tax exempt market participants. Ezrati says that his model requires further broadening to account for the difference like Mundell's work. The Mundell's work suggests that inflation expectations reduce the demand for real money balances and offset other forces which push the interest rates upward.

### 2.2.3 Literature Review of Inverted Fisher Hypothesis

Studies which find support of inverted Fisher hypothesis include Amsler (1986), Gupta (1991) and Choudhry (1997). Amsler (1986) studies both Fisher effect and inverted Fisher effect. He uses US data for 1963: II to 1979: IV. He applies Hsiao and OLS techniques. He says that the Fisher effect implies $\partial r / \partial \pi^e = 0$ and the inverted Fisher effect hypothesis implies that $\partial i / \partial \pi^e = 0$ and $\partial r / \partial \pi^e = -1$. The nominal return on capital is measured by the rate of return series for single family homes. The nominal financial return is measured by consol. He uses three measures of inflationary expectations *i.e;* perfect foresight, inflationary expectations as a function of past inflation rates and inflationary expectations as a function of past values of inflation. His results support both the Fisher effect as well as Inverted Fisher effect. Gupta (1991) uses quarterly US data from 1968: IV to 1985: IV. He applies OLS technique. He estimates his model using both levels and the first differences of the variables. He makes correction for serial correlation using Beach-Mckinnon procedure. Choudhry (1997) examines the inverted Fisher effect in Belgium, France and Germany. He uses the data from 1955 to 1994. He applies the cointegration method. He uses both short –term and long-term interest rates. He applies the ADF and the KPSS unit root tests. He uses Engle- Granger and Harris - Inder tests. He finds evidence of partial inverted Fisher effect.

Studies which find no relation between nominal interest rates and inflation include Viren (1986) and Gallagher (1986), Barth and Bradley (1988) and Choi (2002). Viren (1986) uses prewar period monthly data (1926-1938) from eight countries. He tests both the Fisher hypothesis and the inverted Fisher hypothesis. He applies univariate AR (6) model. He uses the Granger model. His results show no causality between nominal interest rate and the inflation rate. He finds that nominal interest rate causes inflation rate in case of UK only. He concludes that inflation and interest rates follow time paths with very little covariance.

Gallagher (1986) uses the quarterly U.S data for the period 1953:I – 1978:IV. He performs the Granger causality analysis of the link between net of tax nominal interest rate and the inflation rate. He finds that inflation and nominal interest rates are contemporaneously uncorrelated. Barth and Bradley (1988) use US data for the period 1953-1984. They use Tanzi’s and Fair’s tax series. They find that Fair’s tax series is not useful as it is not built on taxes on interest income. They also find that Fair’s tax series does not measure the marginal tax rate. Choi (2002) uses the monthly data of US, Germany, Brazil and Argentina from 1947:1 to 1997:12. He applies OLS, WALD and LM tests. Full sample results show that IFS is rejected. Sub sample results show that IFS is rejected in high forecastibilty regions and accepted in low forecastibilty regions.

## 2.3 Literature Review of Fisher Hypothesis in the Stock Market

Early studies of Fisher hypothesis in stock market find that the performance of common stocks as hedges against inflation is very poor in the United States. These studies show that expected stock returns are negatively linked with expected inflation in the United States. These studies include Reilly *et, al.* (1970), Oudet (1973), Nelson (1976), Jaffe and Madelker (1976), Bodie (1976), Fama and Schwert (1977) and Gultekin (1983). Reilly *et, al.* (1970) uses the data from 1937 to 1968. He finds that almost all net returns during the periods are negative. Oudet (1973) uses quarterly data from 1953 to 1970. He uses a simultaneous two equations model and Pearson correlation coefficient which is negative and significant at .001 levels. Nelson (1976) in a theoretical paper argues that there is negative link between inflation and stock returns. Jaffe and Madelker (1976) employ Lawrence Fisher Index to measure the stock market returns. They regress real and nominal stock market index on ex post inflation and proxies of expected and unexpected inflation. They have incorporated both inflationary and non-inflationary periods. They have found that the Short-term returns are inversely related to coexistent, anticipated and unanticipated inflation. It implies that real and nominal stock market returns are poor hedge for inflation. While the long-term returns are positively associated with anticipated and unanticipated inflation.

Bodie (1976) applies Markowitz-Tobin mean–variance model of portfolio choice. He finds that in the short run the real return on equity is inversely related to both anticipated and unanticipated inflation. If someone wants to use them as a hedge for inflation he must sell them in the short run. Fama and Schwert (1977) use stocks, bonds, T-Bills, residential real estate and labor income in their study to check whether these are good hedge against inflation. They find that residential real estate is the only complete hedge for both the expected and unexpected inflation. Government debt instruments (bonds and bills) are a complete hedge for expected future inflation only. While labor income is a partial hedge for expected and unexpected future inflation and common stock market returns are inversely linked to both expected and unexpected future inflation. Gultekin (1983) uses monthly data from January 1947 to December 1979 of 26 countries. In his study he uses International Financial Statistics (IFS) data set issued by International Monetary Fund (IMF) and Capital International Perspective (12/1958-12/1979) data on stock market indices. He applies ARIMA model and Cochrane –Orcutt techniques. For regression analysis he uses Zellner's seemingly unrelated regression model (SURM). He does not find a consistent positive link between nominal stock market returns and inflation rates. He also finds that there are differences among countries and this link is not established over time.

Bhatti and Oglo (2013) find mix result. They use monthly data on stock market prices and goods prices for the period 2001M1-2012M10. They employ Cochrane-Orcutt, error-correction and cointegration techniques. They find that the Fisher hypothesis holds only in Kazakhstan. Their results from cointegration tests do not show the presence of a long run link between stock market prices and goods prices and a significant error correction representation exists for Russia. It shows that it takes less than two years to reestablish the equilibrium between stock market prices and goods prices.

Studies which confirm the Fisher hypothesis in stock market include Cagan (1974), Firth (1979) and Gultekin (1983). Firth (1979) tests the Fisher hypothesis for stock market returns and inflation using British data from 1955 to 1976. He obtains the percentage monthly stock market returns from the London Business School's share price databank. He measures the inflation with the help of monthly Index of Retail Prices. He extends back his monthly and annual data from 1935 and 1919 respectively. He studies the link between stock market returns and stock market prices for a longer time period. He calculates the monthly stock market returns from June 1935 from the Financial Times Ordinary Share Index. He finds that the Fisher hypothesis holds. Cagan (1974) discusses the history of common stock market values and inflation for many countries. He calculates percentage changes in the real value of stocks from 1939 to 1969. He finds that a wide-ranging group of stocks will protect against inflation only in peace times. It will not protect against inflation during the hyperinflation or wartime destruction. He also concludes that as compared to bonds or other fixed-value assets, stock market prices when broadly selected pass the test as a hedge for inflation for long-term holdings only. Gultekin (1983) uses US annual and semiannual data for the period 1952:6-1979:12. He applies OLS technique. He finds a direct positive one to one link between expected stock market returns and expected future inflation. He says that the expected real return on stock market prices is directly and positively linked to expected future inflation and this relation is not fixed over time.

Solnik and Solnik (1997) use monthly data of eight countries *i.e*; US, Germany, France, Netherlands, UK, Switzerland, Japan and Canada from 1958:12 to 1996:1. They apply Instrumental variable approach for one to twelve months holding periods and GMM (Hansen, 1982) technique. The Fisher hypothesis is not rejected in their study. Cross-sectional regression between the mean stock market return and their mean inflation rate of all countries included in the study sample shows strong support of Fisher model during the whole period. GMM results accept the Fisher hypothesis in the long time period.

## 2.4 Literature Review of Fisher Hypothesis in the Open Economy

Levi and Makin (1978) and Hansson and Charles (1986) has theoretically discussed the Fisher hypothesis in the open economy. Levi and Makin (1978) investigate the impact of an increase in anticipated inflation on nominal and real interest rates in an open economy model with freely flexible exchange rate. His results show that the effect of change in anticipated inflation on nominal interest rate is expected to vary over time and space. Such variations can arise due to differences in structural features such as the degree of openness of an economy or from changes in the structural parameters *i.e*; such as elasticity of money wage demanded with respect to prices, the elasticity of expected exchange rates with respect to changes in spot rates and the rate of adjustment of traded goods prices towards purchasing power parity.

Hansson and Charles (1986), say that the classical and the tax-modified Fisher hypotheses of Darby, Feldstein, and Tanzi represent equilibrium conditions in a closed economy. So they frame the similar situations in an open economy. Their theoretical predictions are close to actual observations. Hansson and Charles conclude that the nominal interest rates change unevenly in a one to one relation with the rate of inflation. Differences from such a one to one link can occur if different types of incomes are taxed differently or the purchasing power parity does not hold. They prove that real net interest rates, the interest rates after tax deductions, are affected by anticipated future inflation. So the saver's real net return after tax payment is decreased by inflation. So an increase in anticipated inflation rate coupled with nominal interest rate in the domestic economy decreases the borrower's real interest rate after tax payments.

Studies that support Fisher open hypothesis include Cumby and Obstfeld (1981), Moosa and Bhatti (1996), Wu and Chen (1998), Macdonald and Nagayasu (2000), Holmes *et, al.* (2009), Holmes (2002), Baharumshah *et al.*(2005), Baharumshah *et, al.*(2009), Camarero *et, al*. (2008) and Hatemi, (2009). Cumby and Obstfeld (1981) use data of U.S, Canada, and France, Dutch, Netherlands, Switzerland, and U.K from 5 July 1974 to 27 June 1980. They use Q-statistic and Maximum likelihood test. Their results show that Fisher hypothesis does not hold. They interpreted their results as signal in favour of existence of a foreign exchange risk premium for most major currencies of the world. These findings support the modern theories which suggest that the foreign exchange market efficiency is in line with the presence of risk premium at equilibrium.

Moosa and Bhatti (1996) test RIP within European Monetary System (EMS) countries: Belgium, Italy, Netherland, Germany, UK and Switzerland. They use quarterly data from 1979:1 to1993:2. They apply DF, Phillips Ouliaris (1990), DW, LM, FF, HS, SUR, TVP, Kalman Filter techniques. They find more integration and convergence between Germany and Switzerland than between Germany and other countries. They conclude that this convergence is due to the similarity of monetary policies pursued by the respective central banks. Wu and Chen (1998) use monthly data of Canada, Japan, France, Germany, Italy, Netherlands, Switzerland, and US from 1979:1 to 1996:9. They use Levin and Lin (1992), Im, Pesaran, and Shin (1995), Maddala and Wu (1996), ADF, WS (Weighted Symmetric) techniques. Their findings are not sensitive to base country. Macdonald and Nagayasu, (2000), use International Financial Statistics issued by International Monetary Fund (IFS) from 1976 to 1997 for fourteen industrialized countries. For individual countries they used ADF, MA, and Johansen (1988) techniques. For panel cointegration they use Pedroni (1997) test. They apply these techniques on Real Exchange Rate Real Interest Rate Differential (PERI) model. Their single country analyses with fixed equilibrium exchange rate show a very weak link between real exchange rate and real interest rate differential in the long run. Panel cointegration test results show the signs of the presence of a long run statistically significant link as assumed by PERI model. Holmes *et, al.* (2009) use quarterly data of Australia and New Zealand from 1974Q1 to 2006Q4. They use Markov-switching framework and ADF techniques. Their results show the presence of RIP in the long run. They conclude that volatility is regime dependent rather than constant across different periods.

Holmes (2002) uses IFS data of three months Treasury bill data of nine countries Belgium, Canada, France, Germany, Italy, Japan, Netherlands, U.K and USA from March 1979 to December 1998. He defines three sub groups *i.e*; first group includes the countries which have strong record of ERM membership. Belgium, France, and Netherlands are included in this first group. Second group includes the countries which were ejected in September1992. This group includes group one plus Italy and UK. Group three includes non-European Union countries *i.e*; Canada, USA and Germany. He employs ADF, Im Pesaran, and Shin (1997) tests. He tests the hypothesis, whether real interest rates follow random walk or not. He also checks the presence of long run *ex post* RIP among European Union countries. He finds the presence of RIP with respect to Germany. He also finds a long-run link during second half of the 1980s for the main European members. He finds the same long run link for Belgium, France and the Netherlands during the mid to late 1990s. Baharumshah *et, al.* (2005) use quarterly data from 1977:Q1 to 2001:Q4 of Asian economies. Their data set includes the countries from Asia Pacific Economic Cooperation (APEC) *i.e;* Hong Kong SAR, Singapore, South Korea and Taiwan Province of China, the non- APEC members are India and Sri

Lanka. From developing countries Indonesia, Malaysia, Philippines and Thailand are included in their study. They have used Japan as the base country. They divide data into three sub-periods: the pre-liberalization era include the time period from 1977:Q1 to 1984:Q4 and the post-liberalization era with the Asian crisis does not include the time period from 1985:Q1 to 2001:Q4 or excluding the time period from 1985:Q1 to 1997:Q2. They have applied IPS, Harris & Tzavalis (1999, HT) and LM techniques. In their study RIP hypothesis is accepted between Japan and Asian emerging economies. Deviations from RIP are only approximately 6–7 months long. RIP holds even during the Asian crisis in their study. Baharumshah *et, al.* (2007) use quarterly IMF data from 1977:Q1 to 2002:Q1. They include USA, Japan, Germany, France, Italy, Canada, UK, South Korea, Hong Kong, Phillipines, Thailand, Taiwan, Singapore, Malaysia, Indonesia, Sri Lanka and India in their study. They apply nonlinear unit root tests using Kapetanios *et, al.* (2003, KSS) and ADF. They conclude that hypothesis of equality of real interest rates is rejected only in Hong Kong and Taiwan. They find no support in favour of the hypothesis that Asian countries capital markets are more integrated with Japan than USA. They also do not find any support in favour of the preposition that the earlier studies use low testing power classical unit root tests and have not accounted for the non-linearity in the adjustment to the long –run equilibrium, that's why their results show convergence of interest rates.

Holmes (2009) Tests for nonlinearity or threshold effects and non-stationarity or unit roots in real interest rate differentials. He uses data set of ten countries *i.e;* Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. These countries joined EU in 2004. He uses ADF, Perron (1997) structural break tests, Caner and Hansen (2001), structural break with asymmetric adjustment methods. He finds evidence of nonlinear behaviour in the real interest rate differentials of these countries. Their results reflect the transition process and economic integration alive in these economies. He concludes that there are differences in the magnitude of convergence across the new EU members: some of these countries show switching between two stationary time periods with different speeds of adjustment towards RIP, while other countries shift between stationary and non-stationary time periods. His results show lesser support in favour of RIP among the countries which joined EU in 2004 than the other emerging economies of the world.

The study of Shrestha and Tan (2005) finds no support of RIP. They use monthly data of G7 countries from 1978:7 to 2001:12. They apply ECM, Wavelets, Dynamic Simultaneous Equations Models of Pesaran (1997) and Hsiao (1997). They say that RIP in its strictest sense does not hold due to the fact that UIP does not hold.

## 2.5 Conclusion

The literature review of the fisher hypothesis and its alternative specifications show that the models of Fisher hypothesis provide only partial explanation. Only few studies accept the Fisher hypothesis and its alternative specifications while others reject it or have mixed results. So it is essential to develop a general model. This model may help us in pointing out the true determinants of interest rates. Our study will enhance and widen our comprehension and vision about the working of interest rates in the world economies. We will use general to specific approach for model specification. Many studies have been conducted to study the Fisher hypothesis but a general presentation is not used by any of the previous studies.

CHAPTER

3

# THEORETICAL BACKGROUND AND METHODOLOGY

This chapter deals with theoretical issues of Fisher hypothesis and its alternative specifications and methodology of our study. Section 3.1 discusses the Fisher hypothesis. Section 3.2 discusses the alternative specifications of Fisher hypothesis. Section 3.3 discusses the Fisher hypothesis in the stock market and Section 3.4 discusses the Fisher hypothesis in the open economy. Panel data and its types are discussed in Section 3.5, followed by panel data model and its types in Section 3.6. Section 3.7 discusses the estimation methodology and Section 3.8 discusses the data and the variables of the model and a conclusion is given at the end.

## 3.1 The Fisher Hypothesis

In a precise form, the Fisher hypothesis is given by

$$(1+i)=(1+r^{e})(1+\pi^{e}) \tag{3.1}$$

Supposing that the term $r^{e}\pi^{e}$ is very minute, this equation reduces to

$$i_t = r^{e}_{t+1} + \Delta p^{e}_{t+1} \tag{3.2}$$

According to the Fisher hypothesis the spread between the financial assets return $(i_t)$ and the assets real rate of return $(r_t)$ adjusts to the expected future inflation rate. Fisher hypothesis forecasts that nominal and real interest rate completely adjusts according to the fluctuations with the expected inflation and interest rate remains constant over period during which the economic agents hold these financial assets. However the real interest rate $r_{t+1}^{e}$ has been supposed fixed at, $\bar{r}$ .moreover, such reliability of real interest rate is due to a stochastic term, $u_t$ $u_t$ is not related to expected future rate of inflation (Sargent, 1972). The stochastic form can be written as:

$$r_{t+1}^{e} = \bar{r} + u_t \tag{3.3}$$

$$i_t = \bar{r} + \Delta p_{t+1}^{e} + u_t \tag{3.4}$$

Now to deal with expected future inflation, the mechanism upon which these expectations about future inflation are formed is as follows:

$$\Delta p_{t+1}^{e} = E(\Delta p_{t+1} | \Omega_t) \tag{3.5}$$

where

E is the expected value operator and

$\Omega_t$ is the information set available at time when the expectation is made. It is supposed that market is efficient and the information set $\Omega_t$ contains all the available information required to forecast the inflation rate in future. The inflation rate realized from time *t* to *t+1* will differ from the expected future inflation rate by a random term which is orthogonal to the past information. Formally, this is given by

$$\Delta p_{t+1} = \Delta p_{t+1}^{e} + \upsilon_{t+1} \tag{3.6}$$

Such that $E(\Delta p_{t+1} | \Omega_t) = 0$ and $E(\upsilon_{t+1}\upsilon_{t+1-i}) = 0 \forall_i \neq 0$. Replacing Equation (2.6) into Equation (2.3) and modifying the subsequent one in a stochastic regression form:

$$i_t = \alpha + \beta \Delta P_{t+1}^{e} + w_{t+1} \tag{3.7}$$

where

$\alpha$ is the 'constant' long-run equilibrium real interest rate and

$w_{t+1} = u_t - \upsilon_{t+1}$ is an error term including all the random variables which are not influenced by the anticipated future inflation rate.

Equation (2.7) suggests that when the real interest rate $i_t - \Delta p^e_{t+1}$ is unchanged, the nominal interest rate also changes when the anticipated inflation rate changes. For a strong-form Fisher hypothesis to hold the twin restriction that $(\alpha, \beta) = (0,1)$ and the error term $w_t$ is stationary should not be rejected.

## 3.2 Alternative Specifications of the Fisher Hypothesis

This section deals with the alternative specifications of the Fisher hypothesis. Section 3.2.1 discusses the Fisher hypothesis. Section 3.2.2 discusses the Mundell effect. Section 3.2.3 discusses the Fisher hypothesis with Phillips curve and Friedman effect. Section 3.2.4 discusses the Darby effect.

### 3.2.1 Mundell Effect

Mundell (1963) by introducing the real balance effect into the Hicksian IS-LM framework, reaches the conclusion that nominal interest rate increases less than unity in response to anticipated future inflation and so the real interest rate decreases during periods of high inflation. The specific channel through which this mechanism works is that, the reduction in real balances, under inflationary environment, puts downward pressure on consumption, raising real savings and lowering the investment demand, and ultimately reduces the real interest rate. Under real balance effect real interest rate falls in response to higher expected inflation.

Tobin 1965 says that the inflation decreases the demand for money balances. It also increases the capital intensity and in this way it lowers the real return and so becomes a major causes for the nominal interest rate to increase by less than the inflation rate (Tobin, 1965).

In another hypothesis (Fried and Howitt, 1983) propose that inflation decreases the real return on money. The real return on money is measured by the negative of the inflation rate. So it is sound to assume that inflation also decreases the real return on financial assets which are close substitute to money.

### 3.2.2 Fisher Hypothesis with Phillips curve and Friedman Effect

Levi and Makin (1978, 1979) using general equilibrium model derived the reduced form link between anticipated inflation and the nominal interest rate. New dimension to the relationship is given by incorporating the Phillips curve and inflation rate on uncertainty into the model to find the determinants of nominal interest rate. When changes in the real interest rate are controlled by adding more variables in the Fisher equation, then the Fisher hypothesis cannot be rejected.

Levi and Makin (1979) discuss that if the short run Phillip curve holds then $\Delta P_{t+1}^{e}$ and $w_{t+1}$ in equation (3.7) can be correlated. Hence, to take into account the bias, $\Delta Y_{t+1}$ growth in real output (for the Phillips curve effect) is introduced in the Equation (3.7). The modified equation is:

$$i_t = \alpha + \beta \Delta P_{t+1}^e + \gamma \Delta Y_{t+1} + w_{t+1} \quad (3.8)$$

where

$\Delta Y_{t+1}$ is the real income growth rate.

Friedman (1968) findings show that for several countries in the 1960's, the real output changes in response to the increase in price level suggesting the existence of upward sloping Phillips curve. The model specification is completed by adding the inflation uncertainty term to study the new avenues through which anticipated inflation can affect nominal interest rate. After including the Friedman and Phillips effects, Equation (3.8) becomes

$$i_t = \alpha + \beta \Delta P_{t+1}^e + \gamma \Delta Y_{t+1} + \delta \sigma_t + w_{t+1} \quad (3.9)$$

The new determinants $\Delta Y_{t+1}$, the growth in real income and $\sigma_t$, the degree of uncertainty about expected future inflation allow to test jointly the presence of Phillips and Friedman effects. Equation (3.9) implies the restriction $\beta = 1$ and $\gamma, \delta < 0$.

Taylor (1981), tests the Fisher hypothesis using the following equation:

$$i_t = \alpha + \beta_0 \Delta p_{t+1}^e + \beta_1 m_t + u_t \quad (3.10)$$

Where $m_t$ is the nominal money supply.

### 3.2.3 Darby Effect

Darby (1975) notes that when taxes on interest or investment income are present, nominal interest rates should rise by more than expected future inflation only if the after tax real return is to be unaffected. Thereby suggesting the exact link between the nominal and real interest rate is:

$$i_t = (r_t + \dot{P}_t^*)/(1-t) \tag{3.11}$$

Fisher's conclusion that there is direct link between nominal return and anticipated inflation is relevant to the special case in which taxes are not levied on interest income and the demand for real money balances is interest insensitive. However if the moneylender pays income tax on the nominal interest return receipts, the after –tax return is $(1-\tau)\left(1+i\right)$ times the amount of money being lent and the debtor deducts tax payment from gross income, the net amount the debtor pays is $(1-\tau)\left(1+i\right)$ times the amount of money being lent. By taking into account these tax considerations, the strong form fisher hypothesis as given Equation (3.1) can be written as (3.12):

$$i_t = \frac{1}{1-\tau} r^e + \frac{1}{1-\tau} \pi^e + \frac{1}{1-\tau} r^e \pi^e \tag{3.12}$$

Substituting Equation (3.2) into the above expression and then the resulting expression into equation (3.4) and (3.6) we may obtain Equation (3.7)

Where

$$\alpha = \frac{1}{1-\tau} a, \beta = \frac{1}{1-\tau} \text{ and } w_{t+1} = \frac{u_t - \upsilon_{t+1}}{1-\tau}$$

### 3.2.4 Inverted Fisher Hypothesis

Extending the Mundell (1963) and Tobin (1965) models, Carmichael and Stebbing (1983) offer another hypothesis. They question the validity of the assumption that the real interest rate is constant or fixed in the Fisher hypothesis. Under Fisher hypothesis the real interest rate is assumed to be an exogenous variable. It is further assumed that the real return on capital is influenced by technology and the rate of time preference. In such a situation, it is justified that the nominal interest rate is completely modified according to the changes in the expected inflation rate. However in empirical literature the interest rate is used to check the Fisher hypothesis. It is the return on financial assets (the return on the substitutes for money) rather than the return on capital. The opportunity cost of money is not the real interest rate rather it is the nominal return which is relatively constant due to financial regulations. When money and financial assets are close substitutes for each other then expected real interest rate fluctuates in opposite directions in one-to-one correspondence with the expected future inflation rate. Hence a phenomenon termed as inverted Fisher hypothesis prevails. Similarly real interest rate after tax will adjust in opposite direction to the changing inflation rate, with the unaffected after-tax nominal interest rate. This is given by:

$$r_{t+1}^{e} = \gamma_0 + \gamma_1 P_{t+1}^{e} + \upsilon_{t+1} \qquad (3.13)$$

Equation (3.13) implies the restriction $\gamma_0 = 0$ and $\gamma_1 = -1$.

The inverted Fisher hypothesis is less expected to hold in situations when the degree of substitutability between money and other financial assets is low *i.e*; under deregulated financial markets and hyperinflation.

## 3.3 Fisher Hypothesis in the Stock Market

When Fisher hypothesis is applied to the stock market returns, it implies that the one-period expected nominal return on a portfolio of common stocks must reveal fully expected future inflation such that the *ex ante* real return of the portfolio remains constant over the holding period (Nelson 1976).

$$\alpha_t = E(R_t / I_t) - E(\rho_t / I_t) \tag{3.14}$$

where

$\alpha_t$ is the *ex ante* real interest rate,

$R_t$ is the actual realized rate of return on portfolio during period $t$,

$I_t$ is the information set available to the market at the beginning of period $t$, $E$ is the mathematical expectations operator, and

$\rho_t$ is the rate of inflation realized over period $t$.

Testing of Fisher hypothesis must be based on actual realized rates of return $R_t$ and actual rates of inflation $(\rho_t)$ which are associated to their *ex ante* counterparts by the relations

$$R_t = E(R_t / I_t) + u_t \tag{3.15}$$

$$\rho_t = E(\rho_t / I_t) + \varepsilon_t \tag{3.16}$$

$u_t$ is prediction error and

$\varepsilon_t$ is prediction error

Both $u_t$ and $\varepsilon_t$ are not related with the predicted values. Splitting the *ex ante* real interest rate $\alpha_t$ into average and variable parts $\alpha$ and $\tilde{\alpha}_t$ respectively and using (3.14), (3.15) and (3.16), it can be shown that the link between observed stock returns and rates of inflation is as follows:

$$R_t = \alpha + \beta\rho_t + (\tilde{\alpha}_t + u_t - \beta\varepsilon_t) \tag{3.17}$$

$\beta$ is unity under Fisher hypothesis.

## 3.4 Fisher Hypothesis in the Open Economy

Fisher open condition or international Fisher effect is explained by the real interest parity (RIP) hypothesis. The real interest parity (RIP) hypothesis assumes that the capital and foreign exchange markets function efficiently, the real interest rate on financial assets having comparable risks tends to be equalized across countries. The interest rates across countries are equal mainly due to commodity and financial arbitrage. The hypothesis assumes that while the investment decisions the investors (either domestic or foreign) are more anxious about the expected purchasing power of the return on their investments instead of only the nominal return. This hypothesis requires three conditions simultaneously:

(i) Fisher hypothesis in closed economy which requires efficiency in the domestic capital market,

(ii) Ex ante PPP which requires efficiency in commodity and financial markets, and

(iii) Uncovered Interest Parity (UIP) which requires efficiency in domestic and foreign capital markets.

The above mentioned three conditions are explained by following equations:

$$r_{t+1}^{e} = i_t - \Delta P_{t+1}^{e} \quad (3.18)$$

$$r_{t+1}^{*e} = i_t^{*} - \Delta P_{t+1}^{*e} \quad (3.19)$$

$$s_{t+1}^{e} - s_t = \Delta P_{t+1}^{e} - \Delta P_{t+1}^{*e} \quad (3.20)$$

$$s_{t+1}^{e} - s_t = i_t - i_t^{*} \quad (3.21)$$

where $r_{t+1}^{e}$ is the expected future real interest rate over the holding period which is extended between t and t+1,

$\Delta P_{t+1}^{e}$ is the expected change in the inflation rate between *t* and *t+1*, *s* is the logarithm of the nominal exchange rate,

*i* is the nominal interest rate,

and an asterisk implies the corresponding foreign variables.

Solving for the domestic real interest rate (3.18), (3.19) and (3.21) yield:

$$r_{t+1}^{e} = r_{t+1}^{*e} + \Delta s_{t+1}^{e} + \Delta P_{t+1}^{*e} - \Delta P_{t+1}^{e} \qquad (3.22)$$

Equation (3.22) shows that the difference between domestic real interest rate and the foreign real interest rate reflects the expected change in the real exchange rate. If the domestic real interest rate is above the foreign real interest rate furthermore the real exchange rate is expected to depreciate, then commodity and financial arbitrage takes place. This situation raises the domestic investment and arbitrageurs in anticipation to make riskless profit purchase the domestic goods to be sold in the foreign markets. Under perfect commodity and financial arbitrage, the equality of real interest rates is again maintained by upward pressure of high demand for domestic goods and securities on real exchange rate. A rise in the real exchange rate hinders the domestic competitiveness by raising nominal interest rate and expected future inflation, and finally reducing the domestic real interest rate. Similar course of actions (in opposite direction) take place in the foreign country to equalize the real interest rates among countries.

If ex ante PPP holds across countries, substituting (3.20) into (3.22) we get the RIP condition,

$$r_{t+1}^{e} = r_{t+1}^{*e} \qquad (3.23)$$

An alternative way to arrive at the RIP condition as represented by Equation (3.23) is to assume Covered Interest Parity (CIP), *ex ante* PPP and the unbiasedness of the forward rate as a forecaster of the market's expectations of the future spot rate. Where CIP and the unbiasedness hypothesis are given by:

$$f_t - s_t = i_t - i_t^* \quad (3.24)$$

$$s_{t+1}^e = f_t \quad (3.25)$$

Where $f_t$ is the one-period forward exchange rate which is defined as the domestic currency price of a unit of the foreign currency.

Combining Equations (3.24) and (3.25) yield the Fisher open condition.[1]

$$i_t - \Delta P_{t+1}^e = i_t^* - \Delta P_{t+1}^{*e} \quad (3.26)$$

Equation (3.26) explains that if the Fisher hypothesis holds in closed economy as well as in the foreign economy. Hence the equality and constancy of *exante* real interest rate across countries are maintained, then the nominal interest rate differential adjusts fully to the expected future inflation rate.

Real interest parity condition:

$$rid_{i,t} = \alpha + \beta \, rid_{i,t-1} + \varepsilon_{i,t}$$

$rid_{i,t}$ is real interest rate differential of $ith$ country against the foreign country at spot.

$r_{i,t}$ is the real interest rate of $ith$ country at spot *t*, and

$r_{us,t}^*$ is the real interest rate of the foreign country (US).

$$rid_{i,t} = r_{i,t} - r_{us,t}^*$$

In our present study, if $rid_{i,t}$ is mean reverting in the long run. So the RIP hypothesis holds in the long-run equilibrium.

---

Economists generally refer to Equation (3.21) , not Equation (3.26) , as the 'Fisher open' condition. However since Fisher (1930)defined real interest rates as actual interest rates minus the expected inflation rate, Equation (3.26) is more appropriately called the 'Fisher open' condition while Equation (3.21) can be called the 'interest open' condition (Levi, 1990, p. 159).

The real interest parity condition is given as:

$$r_{i,t} = \alpha + \beta \, r^{*}_{i,t} + \varepsilon_{i,t} \qquad (3.27)$$

Fisher Open Condition or RIP holds if:

$\alpha = 0$ and $\beta = 1$

## 3.5 Panel Data

In econometrics, the term panel data or longitudinal data means a multi-dimensional data set. This data set frequently involves measurements over time. Panel data contain observations of multiple phenomena obtained over multiple time periods for the same subject or cluster of a panel. A subject or cluster establishes a panel member. Countries, firms or individuals can be members of a panel data set. There are two types of panel data sets:

1. Balanced Panel Data
2. Unbalanced Panel Data

### 3.5.1 Balanced Panel Data

In a balanced panel, the number of time periods T (years, quarters of the year, months, days of the week etc.) is the same for all countries, firms or individuals *i*.

### 3.5.2 Unbalanced Panel Data

In an unbalanced panel, the number of time periods T (years, quarters of the year, months, days of the week etc.) is not the same for all countries, firms or individuals *i*.

### 3.6 Panel Data Models

Panel Data models are those in which we have data about a set of countries, firms or individuals over a set of time periods. We say that the panel is balanced if there is data about the same group of countries, firms or individuals for each time period (years, quarters of the year, months, days of the week etc.) in the sample.

The general framework for our panel data models as explained by Johnston 1997 is:

$$Y_{it} = \alpha + \beta_2 X_{2it} + \beta_3 X_{3it} + \ldots\ldots\ldots\ldots + \beta_k X_{kit} + u_{it} \qquad (3.28)$$

$Y_{it}$ = value of the dependent variable for unit *i* in period *t*.

$X_{jit}$ = value of the *j*th explanatory variable for unit *i* in period *t*.

$i = 1,\ldots\ldots\ldots, p$

$t = 1,\ldots\ldots\ldots, m$

$j = 2,\ldots\ldots\ldots, k$

The most common way to organize the data in Equation (4.1) is by decision units. Thus let

$$Y_i = \begin{bmatrix} Y_{i1} \\ . \\ . \\ . \\ Y_{im} \end{bmatrix} \qquad X_i = \begin{bmatrix} X_{2i1} \ldots\ldots X_{3i1} \ldots\ldots X_{ki1} \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ X_{2im} \ldots\ldots X_{3im} \ldots\ldots X_{kim} \end{bmatrix} \qquad u_i = \begin{bmatrix} u_{i1} \\ . \\ . \\ . \\ u_{im} \end{bmatrix}$$

Denote the data and the disturbances relevant to the *i*th unit. The data may be “stacked” to form

$$y = \begin{bmatrix} y_1 \\ . \\ . \\ . \\ y_p \end{bmatrix} \qquad X = \begin{bmatrix} X_1 \\ . \\ . \\ . \\ X_p \end{bmatrix} \qquad u = \begin{bmatrix} u_1 \\ . \\ . \\ . \\ u_p \end{bmatrix} \qquad (3.29)$$

where $y$ is $n \times 1$, X is $n \times (k-1)$ and $u$ is $n \times 1$. The model in equation (4.1) may be expressed as

$$y = [i \quad X] \begin{bmatrix} \alpha \\ \beta \end{bmatrix} + u \qquad (3.30)$$

where $i$ is an $n \times 1$ vector of units, $\alpha$ is a scalar, and $\beta = (\beta_2, \beta_3, ......\beta_k)$.

A variety of models have been derived from equation (3.30) by varying the assumptions made about the systematic part of the equation and /or the assumptions made about the disturbance vector.

### 3.6.1 Fixed Effects Models vs. Random Effects Models

**Table (3.6.1) Taxonomy of Time –Series, Cross-Section Models**

| | **Assumptions About** | **Assumptions About** | **Assumptions About** |
|---|---|---|---|
| **Model** | **Intercept** $\alpha$ | **Vector of slope coefficients** $\beta$ | **Disturbance term** $u_{it}$ |
| I(a) | Common for all *i,t* | Common for all *i,t* | $E(uu') = \sigma_u^2 I_n$ |
| I(b) | Common for all *i,t* | Common for all *i,t* | $E(uu') = V$ |
| II(a) | Common for all *i,t* | Common for all *i,t* | Fixed effects model |
| II(b) | Varying over *i* | Common for all *i,t* | Rand om effects model |
| III(a) | Varying over *i,t* | Common for all *i,t* | Fixed effects model |
| III(b) | Varying over *i,t* | Common for all *i,t* | Rand om effects model |
| IV | Varying over *i* | Varying over *i* | $E(uu') = \sigma_u^2 I_n$ or $E(uu') = V$ |

Panel data models are divided into two groups *i.e;* fixed effects models and random effects models. These models are based on the assumptions about the values of intercept $\alpha$, vector of slope coefficients $\beta$ and disturbance term $u_{it}$. A possible taxonomy of models is given in Table (3.6.1).

## 3.7 Estimation Methodology

Estimation methodology of our study deals with the analysis of the variables of the model. Panel unit root analysis is done using Im, Pesaran and Shin (IPS) Test 1997. A short analysis of panel unit root tests is explained in section 3.7.1. For the estimation of the model, a general to specific methodology is used as explained in the section 3.7.2. The data is analyzed in following strands for both yearly data and quarterly data sets of IFS (International Financial Statistics):

i) Fisher hypothesis, Fisher hypothesis in the stock market and Fisher hypothesis in the open economy is tested for all countries in sample.

ii) The data is divided into two groups according to the Money Supply/GDP ratio *i.e*; above average Money Supply/GDP countries and below average Money Supply/GDP countries and (i) is repeated for both samples. Above average Money Supply/GDP countries are expected to be more inflationary.

### 3.7.1 General to Specific Model

The literature review shows that the existing models of Fisher hypothesis provide only partial explanation. There is an essential need to develop a general model. This model will help us in finding out the true determinants of interest rates. These determinants will enhance and widen our understanding and vision about the behavior of interest rates. In this study we shall employ general to specific approach for model specification. Many studies have been done to study the Fisher hypothesis and its alternative specification but a general presentation has never been used in these studies. Our research is an attempt towards this end.

One of the crucial aspects of the Hendry methodology is an effort to deal with multiple models. When there are huge number of models and all the models are built on diverse theoretical considerations, and all of them are empirically valid. Then encompassing methodology can be used to form a single model, which can represent best among a class of models. There is not any literature available for the statistical assessment of the working of these models. So it is necessary to formulate a model which may explain the existing models and it should be able to combine the existing theories.

Models of Fisher hypothesis show that the equation (3.33) or Fisher hypothesis with Phillips curve and Friedman Effect encompasses the earlier models.

$$i_t = \alpha + \beta_0 \Delta p^e_{t+1} + \beta_1 \Delta Y_{t+1} + \beta_2 \sigma_t + w_{t+1} \tag{3.33}$$

The remaining models can be deduced by putting suitable restrictions:

$\beta_1 = 0$ and $\beta_2 = 0$ Fisher Hypothesis

$\beta_1 = 0$, Fisher hypothesis with Friedman effect

$\beta_2 = 0$, Fisher hypothesis with Phillips curve

The model in equation (3.34) is an exception to the (3.33)

$$i_t = \alpha + \beta_0 \Delta p^e_{t+1} + \beta_1 m_t + u_t \tag{3.34}$$

The Inverted Fisher Hypothesis

$$r_{t+1}^{e} = \gamma_0 + \gamma_1 p_{t+1}^{e} + \upsilon_{t+1} \qquad (3.13)$$

Here according to the Fisher effect

$$i_t = r_{t+1}^{e} + \Delta p_{t+1}^{e}$$

$r_{t+1}^{e}$ is the ex-ante real interest rate

So the general form of Fisher hypothesis becomes:

**3.7.1a A General Model for Fisher Hypothesis**

$$\begin{aligned} i_{i,t} &= a + b_0 i_{i,t-1} + b_1 \Delta p_{i,t} + b_2 \Delta p_{i,t}^{e} + b_3 \Delta p_{i,t+1}^{e} + b_4 \Delta Y_{i,t} + b_5 \Delta Y_{i,t+1} \\ &+ b_6 \sigma_{i,t} + b_7 \sigma_{i,t-1} + b_8 m_{i,t} + b_9 m_{i,t-1} + w_{t+1} \end{aligned} \qquad (3.14)$$

$$i = 1,\ldots\ldots,N;\ t = 1,\ldots\ldots,T,$$

$i_{i,t}$ is the observation on *ith* country for the *t*th time period.

**3.7.1b A General Model for Fisher Hypothesis in the Stock Market**

A general model is:

$$R_{i,t} = a + b_0 R_{i,t-1} + b_1 \rho_{i,t} + b_2 \rho_{i,t-1} + \left(\tilde{a}_t + u_t - b\varepsilon_t\right) \qquad (3.15)$$

**3.7.1c Fisher Hypothesis in the Open Economy**

$$r_{i,t} = a + b r_{i,t}^{*} + \varepsilon_{i,t} \qquad (3.16)$$

## 3.8 DATA

In this study we have used both yearly and quarterly data set of International Financial Statistics (IFS) from 1948 to 2018. These are unbalanced panel data sets. Nominal interest rates ($i$) is measured through discount rate, lending rate, bank rate or money market rate.

Inflation is measured by Consumer Price Index (CPI). Real income (**$Y$**) is measured by data on Gross Domestic Product (GDP). Nominal money supply ( $m$ ) measured by $M_1$ and $M_2$. Uncertainty about anticipated inflation(**$\sigma$**) is measured by 3-5 years standard deviation of CPI. Data of taxes on interest income is not available so the Darby effect can not be calculated. Financial Price Index data is used to calculate the stock market returns. US interest rate data is used to calculate the foreign interest rate.

**Table (3.8) Variables of the Model**

| Variable | Description |
|---|---|
| $i_{i,t}$ | discount rate, lending rate, bank rate or money market rate |
| $P_{i,t}$ | $\frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} \times 100$ |
| $Y_{i,t}$ | Ln GDP |
| $(\sigma)$ | 3-5 years standard deviation of CPI. |
| $m_{i,t}$ | Ln $M_1$ and Ln $M_2$ |
| $R_{i,t}$ | $\frac{FPI_t - FPI_{t-1}}{FPI_{t-1}} \times 100$ |

In absence of a direct measure of inflationary expectations, it is assumed that individuals are rational and they correctly anticipate future inflation. According to the Fisher equation the nominal interest rate in time $t(R_t)$ is composed of the ex-ante real interest rate $(E_{t-1}[r_t])$ and the expected inflation rate $(E_{t-1}[\pi_t])$ (Mishkin 2003), i.e. $R_t = E_{t-1}[r_t] + E_{t-1}[\pi_t] + \upsilon_t$, where $E_t[\bullet]$ denotes the conditional expectations operator. Following Rose (1988) it is assumed that under rational expectations the expected and the actual inflation rate differ by a stationary, $\upsilon_{1t}$ zero mean forecast error v1t obtaining $\pi_t = E_{t-1}[\pi_t] + \upsilon_{1t}$.

## 3.9 Conclusion

In this study unbalanced panel data set of International Financial Statistics (IFS) from 1948 to 2018 is used. To analyze the variables of the model *i.e;* Nominal interest rate ($i$), Consumer Price Index (CPI), real income ($Y$) and nominal money supply ($m$), and financial price index, panel unit root analysis is done using Im, Pesaran and Shin (1997) technique and a general to specific methodology is used to estimate the Fisher hypothesis and alternative specifications of the Fisher hypothesis in the stock market and in the open economy.

CHAPTER

# 4 EMPIRICAL RESULTS

In this chapter the empirical findings of the study are explained. Section 4.1 deals with the results of annual data. Section 4.1.1 (A) deals with the empirical findings of the models of the Fisher hypothesis. Section 4.1.2 (A) deals with the empirical findings of the models of the Fisher hypothesis in the stock market and Section 4.1.3 (A) deals with the empirical findings of the models of the Fisher hypothesis in the open economy. Section 4.1.1 (B) deals with the empirical findings of the models of the Fisher hypothesis for above average money supply/ GDP countries. Section 4.1.2 (B) deals with the empirical findings of the models of the Fisher hypothesis in the stock market for above average money supply/GDP countries and Section 4.1.3 (B) deals with the empirical findings of the models of the Fisher hypothesis in the open economy for above average money supply/GDP countries.

Section 4.1.1 (C) deals with the empirical findings of the models of the Fisher hypothesis for below average money supply/GDP countries. Section 4.1.2 (C) deals with the empirical findings of the models of the Fisher hypothesis in the stock market for below average money supply/GDP countries and Section 4.1.3 (C) deals with the empirical findings of the models of the Fisher hypothesis in the open economy for below average money supply/ GDP countries. Section 4.2 deals with the results of quarterly data. Section 4.2.1 (A) deals with the empirical findings of models of the Fisher hypothesis. Section 4.2.2 (A) deals with the empirical findings of the models of the Fisher hypothesis in the stock market and Section 4.2.3 (A) deals with the empirical findings of the models of the Fisher hypothesis in the open economy. Section 4.2.1 (B) deals with the empirical findings of the models of the Fisher hypothesis for above average money supply⁄GDP countries. Section 4.2.2 (B) deals with the empirical findings of the models of the Fisher hypothesis in the stock market for above average money supply⁄GDP countries and Section 4.2.3 (B) deals with the empirical findings of the model Fisher hypothesis in the open economy for above average money supply⁄GDP countries. Section 4.2.1(C) deals with the empirical findings of the model of the Fisher hypothesis for below average money supply⁄GDP countries. Section 4.2.2 (C) deals with the empirical findings of the random effects models of the Fisher hypothesis in the stock market for below average money supply⁄ GDP countries and Section 4.2.3 (C) deals with the empirical findings of the model of the Fisher hypothesis in the open economy for below average money supply⁄GDP countries.

## 4.1 Empirical Results of Yearly Data

### 4.1.1 (A) Empirical Results of Random Effects Model of Fisher Hypothesis (Y Data)

The results of Hausman test show that the general model of Fisher hypothesis is a random effects model. Constant is negative and significant. A full Fisher effect and Phillips curve effect does not hold here. Rather inverted fisher hypothesis holds here but it holds in its weak form. Friedman effect and Taylor effect also holds here.

Wald test results show that we can remove expected inflation and uncertainity last year from our model. Other significant (at 1%) variables of the model are nominal interest rate last year, inflation, growth in real income and money supply last year. Nominal interest rate last year and inflation are positively affecting the nominal interest rate while growth in real income and money supply last year are negatively affecting the interest rate.

**Table 4.1.1(A) Empirical Results of Effects Models of Fisher hypothesis (Y Data)**

| | General Model | | Specific Model 1 | | Specific Model 2 | |
|---|---|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | -17.20 | (-2.22)* | -17.59 | (-2.28)* | -17.33 | (-2.24)* |
| $i_{i,t-1}$ | 0.31 | (18.78) ** | 0.31 | (18.81)** | 0.31 | (18.90)** |
| $\Delta P_{i,t}$ | 0.04 | (19.80) ** | 0.04 | (22.52)** | 0.04 | (22.72)** |
| $\Delta P^e_{i,t}$ | 0.00 | (0.59) | - | - | - | - |
| $\Delta P^e_{i,t+1}$ | -0.03 | (-10.03)** | -0.03 | (-10.49)** | - 0.03 | (10.52)** |
| $\Delta Y_{i,t}$ | -87.67 | (-3.80)** | -94.02 | (-4.60)** | -94.68 | (-4.64)** |
| $\Delta Y_{i,t+1}$ | 86.18 | (3.72)** | 92.58 | (4.51)** | 93.26 | (4.54)** |
| $\sigma_{i,t}$ | -2.31 | (-3.11) ** | -2.34 | (-3.16)** | -2.08 | (-3.25)** |
| $\sigma_{i,t-1}$ | 0.24 | (0.70) | 0.24 | (0.70) | - | - |
| $m_{i,t}$ | 123.72 | (9.58)** | 123.44 | (9.57)** | 123.67 | (9.59)** |
| $m_{i,t-1}$ | -122.56 | ( -9.48) ** | -122.33 | (-9.46) ** | -122.62 | (-9.49)** |
| $R^2$ | 0.63 | | 0.63 | | 0.63 | |
| $\overline{R}^2$ | 0.62 | | 0.63 | | 0.63 | |
| Durbin Watson | 1.99 | | 1.98 | | 1.98 | |
| Wald Test Prob. | 0.55 | | 0.49 | | - | |
| F-Statistic | 281.46 | | 312.83 | | 351.99 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | | 0.00 | |
| Hausman Test Statistics | 239.19 | | | | | |
| Hausman Test Prob. | 0.00 | | | | | |

**indicates significance at 1%.
*indicates significance at 5%.

## 4.1.2(A) Empirical Results of Fisher Hypothesis in the Stock Market

To estimate Fisher hypothesis in the stock market or equation (3.15) IFS unbalanced panel data of 68 countries, 1948 – 2018, is used. Our model is a cross section random effects model. Results reveal that the constant term and the variables of the model real returns on assets last year, inflation and inflation in last year are directly related to real returns. All variables of our model except inflation last year are significant at 1%. Wald test is used to test the effects of inflation last year in determining the real returns. The results indicate that the null hypothesis is rejected at 5% and we can safely remove this variable from our model.

**Table 4.1.2 (A) Empirical Results of Models of Fisher Hypothesis in the Stock Market (Y Data)**

| | General Model | | Specific Model | |
|---|---|---|---|---|
| **Regressors** | **Co-efficient** | **t-Statistic** | **Co-efficient** | **t-Statistic** |
| Constant | 4.66 | (5.74)** | 4.97 | (6.21) ** |
| $R_{i,t-1}$ | 0.11 | (4.56) ** | 0.12 | (5.07) ** |
| $\rho_{i,t}$ | 0.47 | (-7.57) ** | 0.43 | (-9.5) ** |
| $\rho_{i,t-1}$ | 0.04 | (0.61) | - | - |
| $R^2$ | 0.07 | | 0.06 | |
| $\overline{R}^2$ | 0.07 | | 0.06 | |
| Durbin Watson | 1.99 | | 2 | |
| Wald Test Prob. | 0.55 | | - | |
| F-Statistic | 38.75 | | 53.14 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | |

**significant at 1%.

Estimation results of the specific model of the Fisher hypothesis show that the constant term and the variables of the model real returns on assets last year and inflation are statistically significant at 1%. Constant is 4.97. Real returns on assets last year and inflation has a direct significant effect on real returns. 1% increase in returns last year increases real returns to 0.12% whereas a 1% increase in inflation increases real returns to 0.43%. So we can say that the Fisher hypothesis is prevalent in the world economies but in its weak form.

### 4.1.3 (A) Empirical Results of Fisher Hypothesis in the Open Economy

Equation (3.16) is estimated using data from 164 countries, 1948 – 2018, is used. The results show that the numerical value of constant is 6.30 but it is statistically insignificant. The co-efficient of foreign real interest rate (US real interest rate) is approximately equal to 1 and it is statistically significant as well at 1% level of significance. Real interest differentials of the world economies are also calculated and unit root test is performed to see the long run link. The results show that the null hypothesis of no unit roots is accepted at 5% level of significance and a long run link exists among the world interest rates.

**Table 4.1.3 (A) Empirical Results of Fisher Hypothesis in the Open Economy (Y Data)**

| General Model | | |
|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** |
| Constant | 6.30 | (1.61) |
| $r_{i,t}^{*}$ | 0.97 | (3.43)** |
| $R^2$ | | 0.003 |
| $\overline{R}^2$ | | 0.002 |
| Durbin Watson | | 2.21 |
| F-Statistic | | 11.75 |
| Prob.(F-Statistic) | | 0.00 |
| Prob. (Im, Pesaran and Shin) | | 0.00 |

**indicates significance at 1%.

Study results have been align with the results of Cumby and Obstfeld (1981), Moosa and Bhatti (1996), Wu and Chen (1998), Macdonald and Nagayasu, (2000), Holmes *et, al.*(2009), Holmes (2002), Baharumshah *et, al.*(2005), Baharumshah *et, al.*(2009), Camarero *et.al*.(2008) and Hatemi (2009). Cumby and Obstfeld (1981), Moosa and Bhatti (1996), Wu and Chen (1998), Macdonald and Nagayasu, (2000), Holmes *et, al.*(2009), Holmes (2002), Baharumshah *et, al.*(2005), Baharumshah *et, al.*(2009), Camarero *et, al.*(2008) and Hatemi (2009).

### 4.1.1 (B) Empirical Results of FH for Above Average Money Supply/GDP Countries

**Table 4.1.1.1(B) Empirical Results of Random Effects Models of Fisher hypothesis for Above Average Money Supply/GDP Countries (Y Data)**

| | General Model | | Specific Model 1 | |
|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 1.94 | (0.32) | 1.22 | (0.21) |
| $i_{i,t-1}$ | 1.06 | (45.19) ** | 1.07 | (45.48)** |
| $\Delta P_{i,t}$ | -0.54 | (-6.09) ** | -0.54 | (-6.31)** |
| $\Delta P^e_{i,t}$ | 0.29 | (3.01) ** | 0.30 | (3.22) ** |
| $\Delta P^e_{i,t+1}$ | -0.23 | (-3.35) ** | -0.24 | (-3.43)** |
| $\Delta Y_{i,t}$ | -52.46 | (-4.26) ** | -55.04 | (-4.63)** |
| $\Delta Y_{i,t+1}$ | 53.40 | (4.33) ** | 56.04 | (4.73)** |
| $\sigma_{i,t}$ | 0.37 | (0.77) | - | - |
| $\sigma_{i,t-1}$ | -1.72 | (-2.88)** | -1.34 | (-4.01)** |
| $m_{i,t}$ | -12.04 | (-1.11) | -12.04 | (-1.11) |
| $m_{i,t-1}$ | 11.64 | (1.08) | 11.64 | (1.08) |
| $R^2$ | 0.96 | | 0.63 | |
| $\bar{R}^2$ | 0.96 | | 0.63 | |
| Durbin Watson | 2.01 | | 1.98 | |
| Wald Test Prob. | 0.44 | | 0.49 | |
| F-Statistic | 300.20 | | 312.83 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | |

**indicates significance at 1%.
*indicates significance at 5%.

**Table 4.1.1.2(B) Empirical Results of a Random Effects Specific Models of Fisher hypothesis for Above Average Money Supply/GDP Countries (Y Data)**

| | Specific Model 2 | | Specific Model 3 | |
|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 0.66 | (0.11) | -2.03 | (-0.45) |
| $i_{i,t-1}$ | 1.06 | (46.89)** | 1.07 | (49.75)** |
| $\Delta P_{i,t}$ | -0.58 | (-7.06)** | -0.58 | (-7.20)** |
| $\Delta P_{i,t}^{e}$ | 0.32 | (3.38) ** | 0.32 | (3.49) ** |
| $\Delta P_{i,t+1}^{e}$ | -0.25 | (-3.71)** | -0.25 | (-3.72)** |
| $\Delta Y_{i,t}$ | -48.63 | (-4.75)** | -48.63 | (-4.77)** |
| $\Delta Y_{i,t+1}$ | 49.73 | (4.85)** | 49.42 | (4.84)** |
| $\sigma_{i,t}$ | - | - | - | - |
| $\sigma_{i,t-1}$ | -1.46 | (-4.65)** | - | - |
| $m_{i,t}$ | -0.41 | (-0.72) | -1.45 | (-4.65)** |
| $m_{i,t-1}$ | - | - | - | - |
| $R^2$ | 0.96 | | 0.96 | |
| $\overline{R}^2$ | 0.96 | | 0.96 | |
| Durbin Watson | 1.97 | | 1.98 | |
| Wald Test Prob. | 0.47 | | 0.49 | |
| F-Statistic | 376.96 | | 432.76 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | |

**indicates significance at 1%.
*indicates significance at 5%.

To estimate a general model of Fisher hypothesis or equation (3.14), International Financial Statistics (IFS) unbalanced panel data of 14 countries, 1973 – 2018, is used. The results of random effects general model of Fisher hypothesis for above average money supply/GDP show that Fisher hypothesis, Phillips curve and Friedman effect are rejected. Inverted Fisher hypothesis holds in its weak form along with the Taylor effect holds here. Wald test results show that we can safely remove uncertainity. Uncertainity last year and money supply last year from our model. Interest rate last year and expected inflation are positively and significantly affecting the interest rate while inflation and growth in real income are negatively affecting the interest rate.

### 4.1.2 (B) Empirical Results of Fisher Hypothesis in the Stock Market of Above Average Money Supply/GDP

To estimate Fisher hypothesis in the stock market of above average Money Supply/GDP countries or equation (3.15) IFS unbalanced panel data of 68 countries, 1948 – 2018, is used. Our analysis for above-average Money Supply/GDP countries, shows that in general model only inflation in last year is a significant variable in determining the real returns. Wald test results show that we can remove the real returns last year from our model.

Once again our results of a specific model (1) indicate that both inflation and inflation last year has a positive effect on real returns but this effect is statistically not significant. Wald test results show that we can safely remove inflation in the last year from our model as well.

**Table 4.1.2 (B) Empirical Results of Fisher Hypothesis in the Stock Market of Above Average Money Supply/GDP (Y Data)**

| | General Model | | Specific Model 1 | | Specific Model 2 | |
|---|---|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 3.38 | ( 1.13) | 4.20 | (1.42) | 5.54 | (1.97)* |
| $R_{i,t-1}$ | -0.03 | (-0.40) | - | - | - | - |
| $\rho_{i,t}$ | 0.47 | (-1.61) | 0.54 | (-1.48) | 0.95 | (-0.31) |
| $\rho_{i,t-1}$ | 0.79 | (2.15)* | 0.55 | (1.57) | - | - |
| $R^2$ | 0.16 | | 0.14 | | 0.13 | |
| $\bar{R}^2$ | 0.15 | | 0.13 | | 0.13 | |
| Durbin Watson | 2.04 | | 2.11 | | 2.12 | |
| Wald Test Prob. | 0.69 | | 0.12 | | - | |
| F-Statistic | 13.29 | | 17.44 | | 33.12 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | | 0.00 | |

*indicates significance at 5%.

Our results of a specific model (2) of the Fisher Hypothesis for above-average Money Supply/GDP countries show that the value of the constant is 5.54 and it is significant at 5%

level. Inflation is also directly related to real returns. A 1% increase in inflation increases the real returns to 0.95%. This effect is statistically insignificant.

### 4.1.3 (B) Empirical Results of Fisher Hypothesis in the Open Economy of Above Average Money Supply/GDP Countries

Equation (3.16) is estimated using data from 14 countries. Data from set from 1948 to 2018 is used. The results show that numerical value of constant is 24.36 but it is statistically insignificant. The co-efficient of foreign real interest rate (USA real interest rate) is 1.38 and it is statistically significant as well at 1% level of significance. Fisher hypothesis holds here.

**Table 4.1.3 (B) Empirical Results of Fisher Hypothesis in the Open Economy of Above Average Money Supply/GDP Countries (Y Data)**

| General Model | | |
|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** |
| Constant | 24.36 | (0.77) |
| $r_{i,t}^{*}$ | 1.38 | (4.7)** |
| $R^2$ | 0.11 | |
| $\overline{R}^2$ | 0.10 | |
| Durbin Watson | 1.45 | |
| F-Statistic | 21.68 | |
| Prob.(F-Statistic) | 0.00 | |

**indicates significance at 1%.

### 4.1.1 (C) Empirical Results of Fisher Hypothesis for Below Average Money Supply/GDP Countries

To estimate a general model of Fisher hypothesis or equation (3.14), International Financial Statistics (IFS) unbalanced panel data of 111 countries is used. The estimation results of the model shows that inverted fisher hypothesis holds in these economies in its weak form along with Friedman effect and Taylor effect. Phillips curve effect does not hold here. Interest rate last year and inflation are affecting the interest rates positively and significantly while the growth in real income is affecting it negatively. Wald test results show that we can safely remove uncertainity last year from our model.

**Table 4.1.1 (C) Empirical Results of Fisher hypothesis for below Average Money supply/GDP Countries (Y Data)**

| | General Model | | Specific Model | |
|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | -24.62 | (-2.90)** | -24.29 | (-2.87)** |
| $i_{i,t-1}$ | 0.29 | (16.87) ** | 0.29 | (16.96)** |
| $\Delta P_{i,t}$ | 0.04 | (18.84) ** | 0.04 | (18.99)** |
| $\Delta P^{e}_{i,t}$ | -0.00 | (-0.12) | - 0.00 | (-0.14) |
| $\Delta P^{e}_{i,t+1}$ | -0.03 | (-9.50) ** | -0.03 | (-9.52)** |
| $\Delta Y_{i,t}$ | -116.48 | (-4.29) ** | -118.04 | (-4.37)** |
| $\Delta Y_{i,t+1}$ | 116.10 | (4.29) ** | 117.63 | (4.36)** |
| $\sigma_{i,t}$ | - 2.43 | (-2.89)** | -2.15 | (-2.96)** |
| $\sigma_{i,t-1}$ | 0.24 | (0.66) | - | - |
| $m_{i,t}$ | 130.00 | (9.35)** | -130.37 | (9.38)** |
| $m_{i,t-1}$ | -129.78 | (-9.35)** | -130.17 | (1.08) |
| $R^2$ | 0.63 | | 0.63 | |
| $\bar{R}^2$ | 0.63 | | 0.63 | |
| Durbin Watson | 2.02 | | 2.03 | |
| Wald Test Prob. | 0.51 | | - | |
| F-Statistic | 265.46 | | 295.03 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | |

**indicates significance at 1%.
*indicates significance at 5%.

## 4.1.2 (C) Fisher Hypothesis in the Stock Market of Below Average Money Supply/GDP Countries

To estimate Fisher hypothesis in the stock market of below average money supply/GDP countries or equation (3.15) IFS unbalanced panel data of 68 countries, 1948 – 2018, is used.

Our results of general model of the Fisher hypothesis for below-average Money Supply/GDP countries, show that returns in last year and inflation have a positive and significant effect in determining the real returns whereas inflation last year has a negative and insignificant effect on real returns.  Wald test results indicate that we can eliminate inflation last year from our analysis. The result of the specific model shows that constant is 5.96 and it is statistically significant at 1%. The variables of the model, real returns on assets last year and inflation are also statistically significant at 1%. Real returns on assets last year and inflation are directly related to real returns. A 1% increase in real returns last year increases the real returns to 0.14% while a 1% increase in inflation increases the real returns to 0.31%.

**Table 4.1.2 (C) Empirical Results of Fisher Hypothesis in the Stock Market of Below Average Money Supply/GDP Countries (Y Data)**

| | General Model | | Specific Model | |
|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** | **Co-efficient** | **t-Statistic** |
| Constant | 4.67 | (5.66)** | 4.85 | (5.96) ** |
| $R_{i,t-1}$ | 0.14 | (5.25) ** | 0.14 | (5.56) ** |
| $\rho_{i,t}$ | 0.38 | (-7.75) ** | 0.31 | (-11.5) ** |
| $\rho_{i,t-1}$ | -0.01 | (-0.22) | - | - |
| $R^2$ | 0.06 | | 0.05 | |
| $\overline{R}^2$ | 0.05 | | 0.05 | |
| Durbin Watson | 1.97 | | 1.97 | |
| Wald Test Prob. | 0.83 | | - | |
| F-Statistic | 26.52 | | 36.68 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | |

**indicates significance at 1%.

Constant is -0.50 and it is statistically insignificant. The variables of the model, real returns on assets last year, inflation and inflation in the last year are statistically significant at 1% level of significance.  Real returns on assets last year and inflation has positive and significant effect on the real returns. While inflation in the last year has negative and significant effect on real returns on assets. Coefficient of inflation is 1 with standard error 0.04 it supports the Fisher hypothesis in the stock market. Stock market returns act as a good hedge against inflation.

### 4.1.3 (C) Fisher Hypothesis in the Open Economy of Below Average Money Supply/GDP Countries

Equation (3.16) is estimated using data from 115 countries, 1948 – 2018, is used. Estimation results show that the numerical value of constant is -0.67 but it is statistically insignificant. The co-efficient of foreign real interest rate (US real interest rate), is 1.10 and it is statistically significant as well at 1% level of significance. Fisher hypothesis holds here.

**Table 4.1.3 (C) Empirical Results of Fisher Hypothesis in the Open Economy of Below Average Money Supply/GDP (Y Data)**

| General Model | | |
|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** |
| Constant | -16.58 | (-0.67) |
| $r_{i,t}^{*}$ | 1.10 | (6.77)** |
| $R^2$ | 0.02 | |
| $\overline{R}^2$ | 0.02 | |
| Durbin Watson | 0.78 | |
| F-Statistic | 42.28 | |
| Prob.(F-Statistic) | 0.00 | |

**indicates significance at 1%.

## 4.2 Empirical Results of Quarterly Data

### 4.2.1 (A) Empirical Results of Fisher Hypothesis (Q Data)

To estimate general random effects model of Fisher hypothesis data set of 59 countries 1959Q3 through 2018Q1 has been used. The results show that Fisher hypothesis holds in its weak form only. Phillips curve effect and Friedman effects hold but they are insignificant. Taylor effect holds here. Wald test results show that we can remove growth in real income, growth in real income last year, uncertainity, uncertainity last year, money supply and money supply last year.

**Table 4.2.1.1(A) Empirical Results of Fisher Hypothesis (Q Data)**

| | General Model | | Specific Model 1 | |
|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 2.19 | (2.15)* | 2.18 | (2.15)* |
| $i_{i,t-1}$ | 0.85 | (121.06)** | 0.85 | (121.06)** |
| $\Delta P_{i,t}$ | 0.18 | (6.56)** | 0.18 | (6.56)** |
| $\Delta P^e_{i,t}$ | 0.16 | (5.78)** | 0.16 | (5.78)** |
| $\Delta P^e_{i,t+1}$ | 0.19 | (6.64)** | 0.19 | (6.65)** |
| $\Delta Y_{i,t}$ | 0.21 | (0.16) | 0.15 | (1.63) |
| $\Delta Y_{i,t+1}$ | -0.06 | (-0.05) | - | - |
| $\sigma_{i,t}$ | -0.34 | (-1.19) | -0.34 | (-1.19) |
| $\sigma_{i,t-1}$ | 0.30 | (1.05) | 0.30 | (1.05) |
| $m_{i,t}$ | 5.65 | (1.71)* | 5.65 | (1.71)* |
| $m_{i,t-1}$ | -5.88 | ( -1.78)* | -5.88 | ( -1.78)* |
| $R^2$ | 0.86 | | 0.86 | |
| $\overline{R}^2$ | 0.86 | | 0.86 | |
| Durbin Watson | 1.65 | | 1.96 | |
| Wald Test Prob. | 0.96 | | 0.29 | |
| F-Statistic | 1938.72 | | 2154.79 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

The estimation results of the specific model of fisher hypothesis shows that all the variables of the model are now statistically significant at 1% level of significance. The numerical value of coefficient of anticipated inflation $\Delta P^e_{i,t+1}$ is not equal to one so our null hypothesis of strong form fisher hypothesis is rejected. The null hypothesis of fisher hypothesis in weak form is accepted at 1% level of significance. Lagged interest rate, inflation and expected inflation have positive and significant effect on nominal interest rates.

### 4.2.1.2 (A) Empirical Results of Specific Models of FH (Q Data)

| | Specific Model 2 | | Specific Model 3 | |
|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 2.16 | (2.13)* | 2.22 | (2.19)* |
| $i_{i,t-1}$ | 0.85 | (121.23)** | 0.85 | (121.29)** |
| $\Delta P_{i,t}$ | 0.18 | (6.69)** | 0.18 | (6.67)** |
| $\Delta P^e_{i,t}$ | 0.16 | (5.78)** | 0.15 | (5.57)** |
| $\Delta P^e_{i,t+1}$ | 0.19 | (6.60)** | 0.18 | (6.57)** |
| $\Delta Y_{i,t}$ | 0.15 | (1.60) | 0.15 | (1.64)* |
| $\Delta Y_{i,t+1}$ | - | - | - | - |
| $\sigma_{i,t}$ | -0.11 | (-0.60) | - | - |
| $\sigma_{i,t-1}$ | - | - | - | - |
| $m_{i,t}$ | 5.44 | (1.65)* | 5.24 | (1.60) |
| $m_{i,t-1}$ | -5.66 | (-1.72)* | -5.48 | (-1.67)* |
| $R^2$ | 0.86 | | 0.86 | |
| $\bar{R}^2$ | 0.86 | | 0.86 | |
| Durbin Watson | 1.66 | | 1.65 | |
| Wald Test Prob. | 0.55 | | 0.11 | |
| F-Statistic | 2423.93 | | 2770.70 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

**4.2.1.3 (A) Empirical Results of Specific Model of FH (Q Data)**

| | Specific Model 4 | | Specific Model 5 | | Specific Model 6 | |
|---|---|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 2.36 | (2.34) ** | 2.78 | (2.84) ** | 1.25 | (3.97)** |
| $i_{i,t-1}$ | 0.85 | (124.60) ** | 0.85 | (125.33)** | 0.85 | (125.32)** |
| $\Delta P_{i,t}$ | 0.18 | (6.74)** | 0.18 | (6.81)** | 0.18 | (6.79)** |
| $\Delta P^e_{i,t}$ | 0.15 | (5.81)** | 0.16 | (5.87)** | 0.16 | (5.87)** |
| $\Delta P^e_{i,t+1}$ | 0.19 | (6.65)** | 0.19 | (6.74)** | 0.19 | (6.74)** |
| $\Delta Y_{i,t}$ | 0.15 | (1.67)* | - | - | - | - |
| $\Delta Y_{i,t+1}$ | - | - | - | - | - | - |
| $\sigma_{i,t}$ | - | - | - | - | - | - |
| $\sigma_{i,t-1}$ | - | - | - | - | - | - |
| $m_{i,t}$ | - | - | - | - | - | - |
| $m_{i,t-1}$ | -0.24 | ( -2.16)* | -0.17 | (-1.65)* | - | - |
| $R^2$ | 0.86 | | 0.86 | | 0.86 | |
| $\overline{R}^2$ | 0.86 | | 0.86 | | 0.86 | |
| Durbin Watson | 1.65 | | 1.65 | | 1.65 | |
| Wald Test Prob. | 0.09 | | 0.10 | | - | |
| F-Statistic | 2154.79 | | 3873.95 | | 4839.26 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

## 4.2.2 (A) Empirical Results of Fisher Hypothesis in the Stock Market

To estimate Fisher hypothesis in the stock market or equation (3.15) IFS unbalanced panel data of 42 countries, 1958Q3 – 2018Q1, is used. Results of a general model show that constant is -23.73 and statistically insignificant. The variables of the model real returns on assets last year, inflation and inflation in the last year are statistically significant at 1% level of significance. Real returns on assets last year and inflation has positive and significant effect on the real returns. While inflation in the last year has negative and significant effect on real returns on assets. Fisher hypothesis holds in the stock market of these economies but it holds in its weak form.

**Table 4.2.2 (A) Empirical Results of FH in the Stock Market (Q Data)**

| General Model | | |
|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** |
| Constant | -23.73 | (-0.31) |
| $R_{i,t-1}$ | 1.35 | (258.71)** |
| $\rho_{i,t}$ | 0.75 | (7.75)** |
| $\rho_{i,t-1}$ | -1.09 | (-11.08)** |
| $R^2$ | | 0.94 |
| $\bar{R}^2$ | | 0.94 |
| Durbin Watson | | 0.64 |
| Logliklihood | -42828.33 | |

**indicates significance at 1%.

## 4.2.3(A) Empirical Results of Fisher Hypothesis in the Open Economy

Equation (3.16) is estimated using data from 60 countries. Quarterly data from 1959Q2 to 2017Q4 is used here.

**Table 4.2.3 (A) Empirical Results of Model of FH in the Open Economy (Q Data)**

| General Model | | |
|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** |
| Constant | 0.04 | (4.97) ** |
| $r^*_{i,t}$ | 1.00 | (306.47)** |
| $R^2$ | | 0.96 |
| $\bar{R}^2$ | | 0.96 |
| Durbin Watson | | 1.21 |
| Logliklihood | | -641.29 |
| F-Statistic | | 93922.82 |
| Prob.(F-Statistic) | | 0.00 |

**indicates significance at 1%.

The results show that the numerical value of constant is 0.04 and it is statistically significant at 1% level of significance. The co-efficient of foreign real interest rate (US real interest rate), is equal to 1 and it is statistically significant as well at 1% level of significance. Fisher hypothesis holds here.

### 4.2.1(B) Empirical Results of Fisher Hypothesis for Above Average Money Supply/GDP Countries

**Table 4.2.1(B) Empirical Results of FH for Above Average Money Supply/GDP Countries (Q Data)**

| | General Model | | Specific Model 1 | | Specific Model 2 | |
|---|---|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 2.62 | (2.72)** | 2.62 | (2.98)** | 2.62 | (2.99) ** |
| $i_{i,t-1}$ | 0.92 | (71.68)** | 0.92 | (73.12)** | 0.92 | (73.25)** |
| $\Delta P_{i,t}$ | - 0.01 | (-1.23) | - 0.01 | (-1.23) | - 0.01 | (-1.24) |
| $\Delta P^e_{i,t}$ | -0.01 | (-1.40) | -0.01 | (-1.40) | - 0.01 | (-1.42) |
| $\Delta P^e_{i,t+1}$ | 0.00 | (0.71) | 0.00 | (0.71) | 0.00 | (0.71) |
| $\Delta Y_{i,t}$ | - 0.16 | (-0.02) | -0.03 | (-0.32) | -0.03 | (-0.33) |
| $\Delta Y_{i,t+1}$ | 0.13 | (0.02) | - | - | - | - |
| $\sigma_{i,t}$ | -0.01 | (-0.06) | -0.01 | (-0.06) | - | - |
| $\sigma_{i,t-1}$ | 0.20 | (2.02)* | 0.02 | (2.03)* | 0.19 | (3.03)** |
| $m_{i,t}$ | -3.53 | (-1.63) | -3.53 | (-1.64) | -3.54 | (-1.65)* |
| $m_{i,t-1}$ | 3.36 | (1.55) | 3.36 | (1.56) | 3.37 | (1.58) |
| $R^2$ | 0.97 | | 0.97 | | 0.97 | |
| $\bar{R}^2$ | 0.97 | | 0.97 | | 0.97 | |
| Durbin Watson | 1.74 | | 1.74 | | 1.74 | |
| Wald Test Prob. | 0.99 | | 0.95 | | 0.75 | |
| F-Statistic | 906.73 | | 1011.11 | | 1141.57 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

To estimate a general model of Fisher hypothesis or equation (3.14), International Financial Statistics (IFS) unbalanced panel data of 8 countries, 1996Q3 – 2018Q1, is used. The results of the general random effects model of Fisher hypothesis for above average money supply/GDP show that Fisher hypothesis, Phillips curve and Friedman effect are rejected. Only the Taylor effect holds here. Wald test results show that we can safely remove all the variables from our model except interest last year, money supply and money supply last year from our model.

**Table 4.2.1.1(B) Estimation Results of Specific Models of Fisher hypothesis for Above Average Money Supply/GDP Countries (Q Data)**

| | Specific Model 3 | | Specific Model 4 | | Specific Model 5 | |
|---|---|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 2.43 | (3.71)** | 2.40 | (3.79)** | 2.44 | (3.90)** |
| $i_{i,t-1}$ | 0.92 | (83.46)** | 0.93 | (84.94)** | 0.93 | (86.10)** |
| $\Delta P_{i,t}$ | - 0.01 | (1.23) | - 0.01 | (-2.22)** | - 0.01 | (-1.95)* |
| $\Delta P^e_{i,t}$ | -0.01 | (-1.41) | -0.01 | (-1.79)* | - | - |
| $\Delta P^e_{i,t+1}$ | 0.00 | (0.72) | - | - | - | - |
| $\Delta Y_{i,t}$ | - | - | - | - | - | - |
| $\Delta Y_{i,t+1}$ | - | - | - | - | - | - |
| $\sigma_{i,t}$ | - | - | - | - | - | - |
| $\sigma_{i,t-1}$ | 0.20 | (3.06) ** | 0.20 | (3.14)** | 0.03 | (1.08) |
| $m_{i,t}$ | -3.46 | (-1.63) | -4.16 | (-2.04)* | -4.29 | (-2.10)* |
| $m_{i,t-1}$ | 3.29 | (1.55) | 4.00 | (1.96)* | 4.16 | (2.04)* |
| $R^2$ | 0.97 | | 0.97 | | 0.97 | |
| $\bar{R}^2$ | 0.97 | | 0.97 | | 0.97 | |
| Durbin Watson | 1.75 | | 1.75 | | 1.76 | |
| Wald Test Prob. | 0.47 | | 0.07 | | 0.28 | |
| F-Statistic | 1308.82 | | 1564.20 | | 1875.96 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

Fisher hypothesis holds in very weak form and this effect is statistically insignificant. Only Taylor effect holds here. Money supply is affecting the interest rate negatively and significantly. Interest rate last year and money supply last year is positively and significantly affecting the interest rate at 1% and 5% levels respectively.

**Table 4.2.1.1(B) Empirical Results of Fisher hypothesis for Above Average Money Supply/GDP Countries (Q Data)**

| | Specific Model 6 | | Specific Model 7 | |
|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 2.43 | (3.88)** | 2.49 | (4.01)** |
| $i_{i,t-1}$ | 0.93 | (86.16)** | 0.93 | (86.29) ** |
| $\Delta P_{i,t}$ | - 0.01 | (-1.94)* | - | - |
| $\Delta P^{e}_{i,t}$ | - | - | - | - |
| $\Delta P^{e}_{i,t+1}$ | - | - | - | - |
| $\Delta Y_{i,t}$ | - | - | - | - |
| $\Delta Y_{i,t+1}$ | - | - | - | - |
| $\sigma_{i,t}$ | - | - | - | - |
| $\sigma_{i,t-1}$ | - | - | - | - |
| $m_{i,t}$ | -4.41 | (-2.16)* | -4.48 | (-2.25)* |
| $m_{i,t-1}$ | 4.29 | (2.10)* | 4.35 | (2.19)* |
| $R^2$ | 0.97 | | 0.97 | |
| $\overline{R}^2$ | 0.97 | | 0.97 | |
| Durbin Watson | 1.75 | | 1.74 | |
| Wald Test Prob. | 0.05 | | - | |
| F-Statistic | 2343.41 | | 3114.51 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

## 4.2.2(B) Empirical Results of Fisher Hypothesis in the Stock Market of Above Average Money Supply/GDP Countries

To estimate Fisher hypothesis in the stock market of above average Money Supply/GDP countries or equation (3.15) IFS unbalanced panel data of 6 countries, 1958Q3 – 2018Q4, is used. Constant is positive and statistically significant as well. The variables of the model, real returns on assets last year, inflation and inflation in the last year have positive effect on real returns. Real returns last year is also statistically significant. Wald test results show that we can easily remove inflation and inflation last year from our model.

**Table 4.2.2(B) Empirical Results of Fisher Hypothesis in the Stock Market of Above Average Money Supply/GDP (Q Data)**

| | General Model | | Specific Model 1 | | Specific Model 2 | |
|---|---|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** | **Co-efficient** | **t-Statistic** | **Co-efficient** | **t-Statistic** |
| Constant | 1.94 | (2.85)** | 1.97 | (3.14)** | 2.11 | (4.52)** |
| $R_{i,t-1}$ | 0.31 | (8.90)** | 0.31 | (8.91)** | 0.31 | (8.92)** |
| $\rho_{i,t}$ | 0.07 | (0.23) | 0.09 | (0.33) | - | - |
| $\rho_{i,t-1}$ | 0.04 | (0.15) | - | - | - | - |
| $R^2$ | 0.10 | | 0.10 | | 0.10 | |
| $\bar{R}^2$ | 0.09 | | 0.10 | | 0.10 | |
| Durbin Watson | 1.97 | | 1.97 | | 1.97 | |
| Logliklihood | -2885.67 | | -2885.68 | | -2885.73 | |
| Wald Test Prob. | 0.88 | | 0.74 | | - | |

**indicates significance at 1%.

## 4.2.3(B) Empirical Results of Fisher Hypothesis in the Open Economy of Above Average Money Supply/GDP Countries

**Table 4.2.3(B) Empirical Results of Fisher Hypothesis in the Open Economy of Above Average Money Supply/GDP Countries (Q Data)**

| General Model | | |
|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** |
| Constant | 0.06 | (1.83) * |
| $r^*_{i,t}$ | 1.00 | (75.40)** |
| $R^2$ | 0.95 | |
| $\bar{R}^2$ | 0.95 | |
| Durbin Watson | 1.21 | |
| Logliklihood | -110.93 | |
| F-Statistic | 5699.71 | |
| Prob.(F-Statistic) | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

Equation (3.16) is estimated using data from 8 countries, 1996Q2 – 2018Q4, is used.

The results show that the numerical value of constant is 0.06 and it is statistically significant.

The co-efficient of foreign real interest rate (US real interest rate), is 1.00 and it is statistically significant as well at 1% level of significance.

### 4.2.1(C) Empirical Results of Fisher Hypothesis for Below Average Money Supply/GDP Countries

**Table 4.2.1.1(C) Empirical Results of Fisher hypothesis for Below Average Money Supply/GDP Countries (Q Data)**

| | General Model | | Specific Model 1 | | Specific Model 2 | |
|---|---|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 1.23 | (1.12) | 1.23 | (1.12) | 1.22 | (1.12) |
| $i_{i,t-1}$ | 0.82 | (108.68)** | 0.82 | (108.70)** | 0.82 | (73.25)** |
| $\Delta P_{i,t}$ | 0.35 | (5.19)** | 0.34 | (5.45)** | 0.34 | (-1.24) |
| $\Delta P_{i,t}^{e}$ | 0.52 | (7.84)** | 0.52 | (7.84)** | 0.52 | (7.84)** |
| $\Delta P_{i,t+1}^{e}$ | 0.22 | (3.42)** | 0.22 | (3.58)** | 0.22 | (3.58)** |
| $\Delta Y_{i,t}$ | 0.28 | (0.20) | 0.28 | (0.20) | 0.11 | (1.01) |
| $\Delta Y_{i,t+1}$ | - 0.18 | (-0.126)** | -0.18 | (-0.13) | - | - |
| $\sigma_{i,t}$ | -0.44 | (-0.30) | -0.44 | (-2.08)** | -0.44 | (-2.09)** |
| $\sigma_{i,t-1}$ | - 0.00 | (-0.01) | - | - | - | - |
| $m_{i,t}$ | 2.42 | (0.69) | 4.42 | (0.69) | 2.44 | (0.70) |
| $m_{i,t-1}$ | -2.52 | (-0.72) | -2.52 | (-0.72) | -0.55 | (-0.73) |
| $R^2$ | 0.86 | | 0.86 | | 0.86 | |
| $\bar{R}^2$ | 0.86 | | 0.86 | | 0.86 | |
| Durbin Watson | 1.65 | | 1.65 | | 1.65 | |
| Wald Test Prob. | 1.00 | | 0.84 | | 0.48 | |
| F-Statistic | 1827.82 | | 2031.59 | | 2286.27 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

To estimate a general model of Fisher hypothesis or equation (3.14), International Financial Statistics (IFS) unbalanced panel data of 51 countries 1959Q3-2018Q1 is used. The results show that Fisher hypothesis holds in its weak form and Phillips curve effect also present here. Interest rate last year, inflation, expected inflation and real income are positively and significantly affecting the interest rate.

Wald test results show that we can remove growth in real income, growth in real income last year, uncertainity, uncertainity last year, money supply and money supply last year.

**Table 4.2.1.2(C) Estimation Results of Specific Models of Fisher hypothesis for Below Average Money Supply/GDP Countries (Q Data)**

| | Specific Model 3 | | Specific Model 4 | | Specific Model 5 | |
|---|---|---|---|---|---|---|
| **Regressor** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** | **Co-efficient** | **t-Stat.** |
| Constant | 1.28 | (1.18) | 0.70 | (0.93) | 1.17 | (0.93) |
| $i_{i,t-1}$ | 0.82 | (110.59)** | 0.82 | (110.90)** | 0.83 | (111.05)** |
| $\Delta P_{i,t}$ | 0.35 | (5.46)** | 0.34 | (5.44)** | 0.35 | (5.46)** |
| $\Delta P^{e}_{i,t}$ | 0.53 | (7.91)** | 0.53 | (8.02)** | 0.53 | (8.03)** |
| $\Delta P^{e}_{i,t+1}$ | 0.22 | (3.62)** | 0.23 | (3.72)** | 0.23 | (3.73)** |
| $\Delta Y_{i,t}$ | 0.11 | (1.01) | 0.07 | (0.77) | - | - |
| $\Delta Y_{i,t+1}$ | - | - | - | - | - | - |
| $\sigma_{i,t}$ | -0.43 | (-2.03)* | -0.49 | (-2.43)** | -0.46 | (-2.35)** |
| $\sigma_{i,t-1}$ | - | - | - | - | - | - |
| $m_{i,t}$ | - | - | - | - | - | - |
| $m_{i,t-1}$ | -0.11 | (-0.74) | - | - | - | - |
| $R^2$ | 0.86 | | 0.86 | | 0.86 | |
| $\bar{R}^2$ | 0.86 | | 0.86 | | 0.86 | |
| Durbin Watson | 1.65 | | 1.65 | | 1.65 | |
| Wald Test Prob. | 0.46 | | 0.44 | | - | |
| F-Statistic | 2286.27 | | 3049.16 | | 3659.38 | |
| Prob. (F-Statistic) | 0.00 | | 0.00 | | 0.00 | |

*indicates significance at 5%.
**indicates significance at 1%.

The results of the specific model of Fisher hypothesis for below average money supply/ GDP countries show that Fisher hypothesis holds in its weak form and Friedman effect holds here.Interest rate last year, inflation and expected inflation are positively and significantly affecting the interest rate.

### 4.2.2(C) Fisher Hypothesis in the Stock Market of Below Average Money Supply/GDP Countries

To estimate Fisher hypothesis in the stock market of below average money supply/GDP countries or equation (3.15) IFS unbalanced panel data of 36 countries, 1957Q3 – 2018Q4, is used.

**Table 4.2.2(C) Empirical Results Fisher Hypothesis in the Stock Market of Below Average Money Supply/GDP Countries (Q Data)**

| General Model | | |
|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** |
| Constant | -36.98 | (-0.36) |
| $R_{i,t-1}$ | 1.35 | (236.43)** |
| $\rho_{i,t}$ | 0.76 | (7.09)** |
| $\rho_{i,t-1}$ | -1.09 | (-10.12)** |
| $R^2$ | | 0.94 |
| $\overline{R}^2$ | | 0.94 |
| Durbin Watson | | 0.64 |
| Logliklihood | -36155.91 | |

**indicates significance at 1%.

Constant is -36.98 and it is statistically insignificant. The variables of the model, real returns on assets last year, inflation and inflation in the last year are statistically significant at 1% level of significance. Real returns on assets last year and inflation has positive and significant effect on the real returns. While inflation in the last year has negative and significant effect on real returns on assets. Coefficient of inflation is 0.76. It supports the Fisher hypothesis in weak form.

## 4.2.3 (C) Fisher Hypothesis in the Open Economy of Below Average Money Supply/GDP Countries

Equation (3.16) is estimated using data from 52 countries, 1959Q2 – 2018Q4, is used. The results show that the numerical value of constant is 0.03 and it is statistically significant. The co-efficient of foreign real interest rate (US real interest rate), is 1.00 and it is statistically significant as well at 1% level of significance.

**Table 4.2.3 (C) Empirical Results of Fisher Hypothesis in the Open Economy of Below Average Money Supply/GDP (Q Data)**

| General Model | | |
|---|---|---|
| **Regressor** | **Co-efficient** | **t-Statistic** |
| Constant | 0.03 | (4.7) ** |
| $r^*_{i,t}$ | 1.00 | (296.30)** |
| $R^2$ | | 0.97 |
| $\overline{R}^2$ | | 0.97 |
| Durbin Watson | | 1.14 |
| Logliklihood | -516.17 | |
| F-Statistic | 87792.42 | |
| Prob.(F-Statistic) | 0.00 | |

**indicates significance at 1%.

CHAPTER

# 5 CONCLUSIONS AND POLICY IMPLICTIONS

In this dissertation we have estimated alternative specifications of Fisher Hypothesis. Both yearly and quarterly data set of International Financial Statistics (IFS) from 1948-2018 is used. This is an unbalanced panel data set. Panel unit root analysis of the yearly data shows that the interest rate data is stationary at the levels, while the inflation, real income, money supply and share price data is stationary at the first difference. A random effect general model of Fisher hypothesis is estimated by using data of 130 countries, from 1955 to 2018. Our results show that firstly; the Fisher hypothesis and Phillips curve effect does not hold in any case. Secondly inverted Fisher hypothesis holds in its weak form in all the cases. Thirdly; Friedman effect holds in overall data as well as below average money supply/GDP countries. Forthly; Taylor effect holds in all the cases. Fifthly; interest rate last year has positive and significant effect on interest rate. Sixthly; inflation has positive and significant effect in all cases except above average money supply/GDP countries where it is negative. Seventhly; expected inflation has positive and significant effect only in case of above average money supply/GDP countries. Eighthly; growth in real income is negative and significant in all cases. Ninethly; uncertainity last year is insignificant and lastly; Money supply last year has negative effect on interest rate and this effect is significant only for the whole data. Unit root test of the residuals of the model show that there is a long run relationship among the variables of the model. As suggested by Taylor (1981), Graham (1988), Hasan (1999) and Herwartz (2011).

To estimate a random effect Fisher hypothesis model in the stock market unbalanced yearly data set of International Financial Statistics (IFS) from the year 1950 through 2018 is used. IPS panel unit root test shows that the CPI, and financial market price index data is stationary at the first difference. Our results indicate; firstly, the Fisher hypothesis holds in the world economies but it holds in its weak form. So the stocks provide a hedge against inflation but they are not perfect hedge. Secondly, inflation has a positive and significant effect on real returns except above average money supply/GDP countries where this effect is insignificant. Thirdly, inflation last year is directly but insignificantly affecting real returns in all cases under study. It is has negative effect in case of below average money supply/GDP countries. Fourthly, real returns last year has a direct and significant effect in all cases except above-average Money Supply/GDP countries. In above average Money Supply/GDP countries this effect is negative and insignificant.

Panel unit root analysis of the quarterly data shows that all the variables; interest rate inflation, real income, money supply and share price data is stationary at the first difference. A random effect general model of Fisher hypothesis is estimated by using data of 59 countries, 1959Q3 through 2018Q1. Our results show that firstly; the Fisher hypothesis holds in its weak form and this effect is significant as well except above average money supply/GDP countries. Secondly; Phillips curve effect holds but is insignificant except above average money supply/GDP countries where this effect does not hold. Thirdly; Friedman effect holds but this effect is insignificant. Forthly; Taylor effect is insignificant in all the cases except over all data where it is positive and significant as well.  Fifthly; interest rate last year has positive and significant effect on interest rate. Sixthly; inflation has positive and significant effect in all cases except it above average money supply/GDP countries where it is negative. Seventhly; expected inflation has positive and significant effect only in case of above average money supply/GDP countries where it is negative and insignificant. Eighthly; growth in real income is positive and insignificant in all cases except above average money supply/GDP countries where it is negative and insignificant. Ninethly; uncertainity last year is positive and significant in above average money supply/GDP countries only and lastly; Money supply last year has negative effect on interest rate and this effect is significant only for the whole data. Unit root test of the residuals of the model show that there is a long run relationship among the variables of the model.

To estimate a random effect Fisher hypothesis model in the stock market unbalanced yearly data set of International Financial Statistics (IFS) from the year 1950 through 2018 is used. IPS panel unit root test shows that the CPI, and financial market price index data is stationary at the first difference. Our results indicate; firstly, the Fisher hypothesis holds in the world economies but it holds in its weak form. So the stocks provide a hedge against inflation but they are not perfect hedge. Secondly, inflation last year is indirectly and significantly affecting real returns except above average money supply/GDP countries where this effect is positive and insignificant. It is has negative effect in case of below average money supply/GDP countries. Thirdly, real returns last year has a direct and significant effect in all cases except above-average Money Supply/GDP countries. In above average Money Supply/GDP countries this effect is negative and insignificant.

Our analysis of the of Fisher hypothesis in the open economy show that the Fisher hypothesis holds in all the cases for both the yearly data as well as quarterly data.

Overall our results indicate that Fisher hypothesis either does not hold or holds in its weak form in most of the world economies so countries can pursue their independent monetary and fiscal policies. Interest rate last year has positive and significant effect on nominal interest rate. Inflation last year and expected inflation has positive and significant effect in most of the cases and money supply has significant effect in determining the nominal interest rate.

So countries can pursue their independent monetary and fiscal policies. They must also take care of inflation. Fisher hypothesis hold in stock market but it holds in its weak form. Real returns last year has positive and significant effect. Stocks do not provide a complete hedge against inflation, so investors must seek other forms of investment. Fisher hypothesis holds in the open economies in all the cases.

Further research is possible by using more advanced techniques.

# REFERENCES


Akmal M. S., (2007), 'Stock Returns and Inflation: An ARDL Econometric Investigation Utilizing Pakistani Data', *Pakistan Economic and Social Review*, 45:1, 89-105.

Amsler, C. A., (1986), 'The Fisher Effect: Sometimes Inverted, Sometimes Not?', *Southern Economic Journal*, 52:3, 832-35.

Badillo R, Reverte C. and Rubio E. (2011),'The Fisher Effect in the EU Revisited; New Evidence Using Panel Cointegration Estimation with Global Stochastic Trends', *Applied Economics Letters*, 18, 1247-51.

Baharumshah, A. Z., Haw, C.T., and Fountas, S., (2005), 'A Panel Study on Real Interest Rate Parity in East Asian Countries: Pre- and Post-Liberalization Era'. *Global Finance Journal*, 16, 69-85.

Baharumshah, A. Z., Liew, V.K-S, and Haw, C.T., (2009), 'The Real Interest Rate Differential: International Evidence Based on Non-Linear Unit Root Tests', *Bulletin of Economic Research*, 61, 83-94.

Bai, J., and S. Ng (2004), 'A Panic Attack on Unit Roots and Cointegration', *Econometrica*, 72, 1127-77.

Bai Z., (2014), 'Study on the Impact of Inflation on the Stock Market in China', *International Journal of Business and Social Sciences*, 5:7, 261-71.

Baltagi B. H. and C. Kao, (2000 ), 'Non Stationarity Panels, Cointegration in Panels and Dynamic Panels, A Survey in : B. Batagi (ed.), Non Stationarity Panels, Cointegration in Panels and Dynamic Panels, Advances in Econometrics, Amsterdam, 15, *JAI press*, 7-52.

Banerjee , A. (1999), 'Panel Data Unit Roots and Cointegration: An Overview', *Oxford Bulletin of Economics and Statistics*, Special Issue, 0305-909.

Barth, J. R., and Bradley M.D., (1988), 'On Interest Rates, Inflationary Expectations and Tax Rates', *Journal of Banking and Finance*, 12: June, 215-20.

Bhatti R. H. and Pak O. (2013), Stock Returns and inflation in Kazakhstan, Russia, and Ukraine , *International Journal of Economics and Finance Studies*, 5: 1, ISSN: 1309-8055 (Online)

Bodie, Z., (1976 ), 'Common Stocks as a Hedge Against Inflation', *The Journal of Finance*, 31: 2, Papers and Proceedings of the Thirty-Fourth Annual Meeting of the American Finance Association Dallas, Texas December 28-30 ,1975, pp. 459-470.

Breitung, J. (2005), 'A Parametric Approach to the Estimation of Cointegration Vectors in Panel Data', *Econometric Reviews*, 151-174.

Breitung, J. and Mayer, W., (1994), 'Testing for Unit Roots in Panel Data: Are Wages on Different Bargaining Levels Cointegrated?', *Applied Economics*, 26, 353-61.

Cagan, P. (1956), 'The Monetary Dynamics of Hyper-Inflation', in M. Friedman (ed.),

*Studies in the Quantity Theory of Money*, University of Chicago Press, Chicago.

Cagan, P. (1974), 'Common Stock Value and Inflation-The Historical Record of Many Countries', National Bureau Report Supplement, *National Bureau of Economic Research and Columbia University*, INC: New York, N.Y. 10016.

Camarero M. and Carrion-i-Suilvestre J. L.(2008), 'Does the real interest Parity Hold for OECD Countries ? New Evidence Using Panel Stationarity Tests, With Cross Section Dependence and Structural Breaks' *University of Valencia*, ACOMPLE 07/102.

Cargill, T. F. (1976), 'Anticipated Price Changes and Nominal Interest Rates in the 1950's', *Review of Economics and Statistics*, 58, 368-7.

Cargill, T. F. (1977), 'Direct Evidence of the Darby Hypothesis for the United States',

*Economic Inquiry*, 15, 132-34.

Carmichael, J. and Stebbing P.W. (1983), 'Fisher's Paradox and the Theory of Interest',

*The American Economic Review*, 73:4, 619-30.

Carr J., Pesando J. E. and Smith L. B. (1976), 'Tax Effects, Price Expectations and the Nominal Rate of Interest', *Economic Inquiry*, 14:2, 259-69.

Choi, W. G., (2001), 'Unit Root Tets for Panel Data' *Journal of International Money and Finance*, 20, 249-72.

Choi, W. G., (2002), 'The Inverted Fisher Hypothesis: Inflation Forecastability and Asset Substitution', IMF Staff Papers, *Macmillan Journals*, 49: 2, 212-41.

Chortareas G., Kapetanios G. and Magkonis G. (2018), 'Resuscitating Real Interest Rate Parity: New Evidence from Panels', *The European Journal of Finance*. 1176-1189

Choudhry, T. (1997), 'Cointegration analysis of the inverted Fisher effect: evidence from Belgium, France and Germany', *Applied Economics Letters*, 4:4, 257-60.

Coppock L., Poitras M., (2000), 'Evaluating the Fisher Effect in Long-Term Cross-Country Averages', *International Review of Economics and Finance*,9:2000, 181-92.

Crowder, W. J. and Hoffman D. L., (1996), 'The Long-Run Relationship between Nominal Interest Rates and Inflation: The Fisher Equation', *Journal of Money, Credit and Banking*, 28:1, 102-118.

Crowder, W. (2003), 'International Evidence on the Fisher Relation', Discussion paper, *University of Texas at Arlington*.

Cumby, R.E. and Obstfeld M. (1981), ' A note on Exchange Rate Expectations and Nominal Interest Differentials: A Test of the Fisher Hypothesis', *The Journal of Finance*,36:3, 697-703.

Darby, M. R., (1975), 'The Financial and Tax Effects of Monetary Policy on Interest Rates', *Economic Inquiry*.

Dwyer, M. M. (1981) 'Are Expectations of Inflation Rational? : Or is Variation of the Expected Real Interest Rate Unpredictable', *Journal of Monetary Economics*, North Holland Publishing Company, 8, 59-84.

Engle, R. F. and Granger, C. W. J., (1987), 'Cointegration and Error Correction: Representation, Estimation and Testing', *Econometrica*, 55, 251-76.

Engsted, T., (1995), 'Does the Long-Term Interest Rate Predict Future Inflation? A Multi-Country Analysis', *The Review of Economics and Statistics*, 77:1, 42-54.

Ezrati M. J., (1982), ‘Inflationary Expectations, Economic Activity, Taxes and Interest Rates: Comment’, *The American Economic Review*, 72:4, 854-57.

Evans M. D. and Lewis K. K., (1995), ‘Do Expected Shifts in Inflation Affect Estimates of the Long-Run Fisher Relation?’, *The Journal of Finance,* 50: 1, 225-53.

Fahmy, Y. A.F. and Kandil, M., (2003), ‘The Fisher effect: New Evidence and Implications’, *International Review of Economics and Finance,* 12, 451–65.

Fama, E. F. (1970), ‘Efficient Capital Markets: A Review of Theory and Empirical Work’, *Journal of Finance* 25, 383– 417.

Fama, E. F. (1975), ‘Short Term Interest Rates as Predictors of Inflation’, *American Economic Review,* 65, 269– 82.

Fama, E. F. and Schwert,(1977), ‘Asset Returns and Inflation’, *The Journal of Financial Economics*, 15,115– 46.

Fahmy, Y. A. F. and Kandil, M., (2003), ‘The Fisher Effect: New Evidence and Implications’, *American Economic Review,* 66, 809-20.

Feldstein, M. (1976), ‘Inflation, Income Taxes and the Rate of Interest: A theoretical Analysis’, *International Review of Economics and Finance* , 12, 451-65.

Feldstein, M. (1982), ‘Domestic Savings and International Capital Movements in the Long Run and the Short Run’, *NBER Working Paper* No. 947.

Feldstein, M. (1983), ‘Domestic Savings and International Capital Movements in the Long Run and the Short Run’, *European Economic Review,* 21, North Holland.

Firth, M., (1979), ‘The Relationship between Stock Market Returns and Rates of Inflation’, *Journal of Finance,* 34, 743-49.

Fisher, I., (1930), ‘The Theory of Interest’, *Macmillan*, New York.

Fried, J. and Howitt, (1983), ‘The Effects of Inflation on Real Interest Rates’, *The American Economic review,* 73:5, 968-80.

Friedman, M., (1968), ‘The Role of Monetary Policy’, *American Economic Review.*

Friedman, M., (1969), 'The Optimum Quantity of Money', in the Optimum Quantity of Money and other Essays', *Chicago.* :Aldine 1-50.

Gallagher, M. (1986), 'The Inverted Fisher Hypothesis: Additional Evidence', *The American Economic Review,* 76:1, 247-9.

Garbade, K. and Watchel P., (1978), 'Time Variation in the Relationship between Inflation and Interest Rates', *Journal of Monetary Economics,* 4, 755-65.

Geske R. and Roll R., (1983), 'The Fiscal and Monetary Linkage Between Stock Returns and Inflation', *The Journal of Finance,* 38:1,1-33.

Ghazali, N.A. and Ramlee, S.,(2003), 'A long memory test of the long-run Fisher effect in the G7 countries', *Applied Financial Economics,* 13: 10, 763-69.

Gibson, W. E. (1970), 'Price-Expectations Effects on Interest Rates', *Journal of Finance* 25, 19–34

Gibson, W. E. (1972), 'Interest Rates and Inflationary Expectations: New Evidence', *American Economic Review* 62, 854–65.

Gultekin, N. B., (1983), 'Stock Market Returns and Inflation Forecasts', *The Journal of Finance,* 38:3, 663-73.

Gupta, K. L., (1991), 'Interest Rates, Inflation Expectations and the Inverted Fisher Hypothesis,' *Journal of Banking and Finance,* 15: February, 109-16.

Hadri, K. (1999). 'Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root in Panel data With Serially Correlated Errors ', Manuscript Department of Economics and Accounting, *University of Livepool.*

Hadri, K. (2000). 'Testing for Stationarity in Hetrogenous Panel Data' .*Econometrics Journal,* 148-61.

Hakan B., Nildag B. C., and Hasan O.,(2007) 'Inflation uncertainty and interestrates: is the Fisher relation universal?', *Applied Economics*, 39: 1, 53 — 68.

Hasan, H. (1999), ‘Fisher Effect in Pakistan’, *The Pakistan Development Review*, 38:2, 153-66.

Hanson I. and Charles S., (1986), ‘The Fisher Hypothesis and International Capital Markets’, *Journal of Political Economy*, 94:6, 1330-37.

Harris R.D. F. and Tzavalis, E. (1999), ‘Influence for Unit Roots in Dynamic Panels Where the Time Dimension is Fixed’, *Journal of Econometrics*, 91, 201-226.

Hatemi-J A., (2009), ‘The International Fisher Effect: Theory and Application’,

*Investment Management and Financial Innovations*, 6:1, 117-21.

Herwartz H. (2011), ‘Convergence of Real Capital Market Interest Rates- Evidence From Inflation Indexed Bonds’ *Journal of Money Credit and Banking*’, 43:7.

Holmes M. J., (2002), ‘Does long-run real interest parity hold among EU countries? Some new panel data evidence’, *The Quarterly Review of Economics and Finance*, 42, 733–46.

Holmes M. J., (2009), ‘Are Real Interest Rates of EU Accession Countries Characterized by Non-Linear Convergence?’, *Research in Applied Economics*, 1:1, 733–46.

Huizinga J. and Mishkin F. S., (1984), ‘Inflation and Real Interest rates on Assets with Different Risk Characteristics’, *The Journal of Finance*, 39:3, Papers and Proceedings , Forty-Second Annual Meeting, American Finance Association, san Francisco, CA, December 28-30, 1983, 699 -712.

Im, K.S., Pesaran M. H., and Shin Y., (1997), ‘Testing for Unit Roots in Heterogeneous Panels’, Nimeo, Department of Applied Economics, *University of Cambridge*.

Im, K.S., Pesaran M. H., and Shin Y., (2003), ‘Testing for Unit Roots in Heterogeneous Panels’, *Journal of Econometrics*, 115, 53–74.

Jaffe, J. and G. Mandelker, (1976), ‘The Fisher effect for Risky Assets: An Empirical Investigation’, *Journal of Finance*, 31, 447-58.

Johansen, S., (1995), ‘Likelihood Based Influence in Cointegrated Vector Autoregressive Models’, *Oxford University Press*.

Johnston J., (1991), ‘Econometric Methods’, *McGraw-Hill International Editions*.

Kao, C. (1999), ‘Spurious Regression and Residual-Based Tests for Cointegration in Panel Data’, *Journal of Econometrics,* 901-44.

Kinal T. and Lahiri K., (1988), ‘A Model for Ex Ante Real Interest Rates and Derived Inflation Forecasts’, *Journal of the American Statistical Association,* 83:403, 665-73.

Lahiri K., (1976), ‘Inflationary Expectations: Their Formation and Interest Rate Effects’,
*The American Economic Review,* 66:1, 124-31.

Lahiri, K. and Lee, J. (1979), ‘Tests of Rational Expectations and Fisher Effect’,
*Southern Economic Journal*, 46, 413–424

Levi, M. D. and Makin, J. H. (1978), ‘Anticipated Inflation and Interest Rates: Further Interpretation of Findings on the Fisher equation’, *American Economic Review,* 68, 801-12.

Levi, M. D. and Makin, J. H. (1979), ‘Fisher, Phillips, Friedman and the Measured Impact of Inflation on Interest’, *Journal of Finance*, 34, 35-52.

Levin, A. and Lin, C. F., (1992), ‘Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties’, Working Paper 23, Department of Economics, *University of California at San Diego.*

Levin, A., Lin, C.F., & Chu, C.S. J. (2002). ‘Unit root tests in panel data: asymptotic and finite-sample properties’. *Journal of Econometrics* , 1-24.

Ling T., Liew, V. K. and Wafa S.A.S.W., (2007), ‘Fisher hypothesis: East Asian evidence from panel unit root tests’, *MPRA*, 5432, 04:43.

Liu Y., Chang H. and Su C., (2013), ' Do Real Interest Rates Converge Across East Asian Countries Based on China’, *Economic Modelling*, 31, 467-473.

Macdonald R. and Nagayasu J., (2000), 'The Long -Run Relationship between Real Exchange Rates and real Interest Rate Differentials: A Panel Study', *IMF Staff Papers*, 47:1, 116-28.

Maddala G.S., Wu S. (1999), 'A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test', *Oxford Bulletin of Economics and Statistics*, 61(Supplement 1), 631–652.

Makin, J. H., (1978), 'Anticipated Inflation and Interest Rates in an Open Economy', *Journal of Money, Credit, and Banking*, 10:3, 275-89.

Mankiw N. G., Reis R. and Wolfers J. (2003), 'Disagreement about Inflation Expectations', *NBER Macroeconomics Annual*, 18:1, 209-248.

Mc Coskey S. and Ka6, C. (1998a), 'A Residual Based Test for the Null of Cointegration in Panel Data', *Econometric Reviews*, 117, 57-84.

Mehra Y. P., (2002), 'Survey Measures of Expected Inflation: Revisiting the Issues of Predictive Content and Rationality', *Federal Reserve Bank of Richmond Quarterly Review*, 88, 17-36.

Mitchell W. D., ( Jun.1985), 'Expected Inflation and Interest Rates in a Multi-Asset Model: A Note', *The Journal of Finance*, 40: 2, 595-599

Mishkin F. S., (1992), 'Is the Fisher effect for real?', *Journal of Monetary Economics*,30, pp. 195-215.

MISHKIN, F.S., (2003) 'The Economics of Money, Banking, and Financial Markets', 6$^{th}$ Edition (Addison Wesley, Boston).

Moon H.R., Perron B., (2004), 'Testing for a Unit Root in Panels with Dynamic Factors', *Journal of Econometrics*, 122:1, 81–126.

Moosa, I. A. and Bhatti, R.H. (1996), 'The European Monetary System and Real Interest Parity: Is There Any Connection?', *Swiss Journal of Economics and Statistics*, 132, 223-35.

Moosa, I.A. and Bhatti, R.H. (1997), 'Are Asian Markets Integrated? Evidence for Six Countries Vis-A-Vis Japan', *International Economics Journal*, 11: 1, 51- 67.

Muth, J. F. (1961) 'Rational Expectations and the Theory of Price Movements', *Econometrica* 29, 315–335.

Mundell, R. A. (1963), 'Inflation and Real Interest', *Journal of Political Economy,* 280-83.

Nelson C. R., (1976), 'Inflation and Rates of Return on Common Stocks', The Journal of Finance, 31: 2, *Papers and Proceedings of the Thirty-Fourth Annual Meeting of the American Finance Association Dallas, Texas* December 28-30, 471-83.

Nelson C. R. and Schwert, G. W., (1977), 'Short Term Interest as Predictors of Inflation: On Testing the Hypothesis that the Real Rate of Interest is Constant', *American Economic Review,* 67, 478-86.

Omotor, Douglason G. (2010), 'Relationship Between Inflation and Stock Market Returns: Evidence from Nigeria', *CBN Journal of Applied Statistics,* ISSN 2476-8472, The Central Bank of Nigeria, Abuja, Vol. 1, Iss. 1, pp. 1-15.

Opera D. S., (2014), 'The Fisher Effect: Evidence from the Romanian Stock Market', *International Journal of Academic Research in Business and Social Sciences',* 4:5, 637-43.

Oudet, Bruno (1973), 'The Variation of Returns on Common Stocks', *Journal of Financial and Quantitative Analysis,* 8:2, 247-58.

Ozean B. and Ari A. (2015), 'Does the Fisher Hypothesis Hold for the G7? Evidence from the Panel Data Cointegration Test' *Economic Research,* 28:1-271-283.

Phylaktis, K. and Blake D., (1993), 'The Fisher Hypothesis: Evidence from Three High Inflation Economies', *Weltwirtschaftliches Archiv,* Bd. 129, H. 3, 591-9.

Pyle, D.H. (1972), 'Observed Price Expectations and Interest Rates', *Review of Economics and Statistics,* 54, 275-80.

Pedroni, P. (1995), 'Panel Cointegration : Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an application of PPP Hypothesis', *Indiana University Working Papers in Economics,* 95-013.

Pedroni, P. (1997a), 'Panel Cointegration : Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an application of PPP Hypothesis, New Results', *Indiana University Working Papers in Economics.*

Pedroni, P. (1999), 'Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors', *Oxford Bulleton of Economics and Statistics*, 61, Special Issue, 653-70.

Phillips P. C. B. and Moon H. R. (2000), 'Non Stationary Panel Data Analysis: An Overview of Some Recent Developments', *Econometric Reviews*,19, 263-86.

Phiri, A. (2017), 'Long-run Equilibrium Adjustment between Inflation and Stock Market Returns in South Africa: A Nonlinear Perspective',*Int. J. Sustainable Economy*, .9: 1, 19-33.

Quah, D., (1994). 'Exploiting Cross-Section Variation for Unit Root Inference in Dynamic Data', *Economics Letters*, 44(1-2), 9–19.

Reilly, F. K., Johnson, G. L. and Smith R. E., (1970), ' Inflation, Inflation Hedges, and Common Stocks', *Financial Analyst Journal* , 26:1, 104-10.

Roberts J. M., (1997), 'Is Inflation Sticky?', *Journal of Monetary Economics*, 39, 173-196.

Rose, A. K. (1988), 'Is the Real Interest Rate Stable?', *The Journal of Finance*, 43: 5, 1095-1112.

Satake, M. (2011), 'Testing the Fisher Hypothesis: A Survey of Empirical Studies', *The Doshisha University Economic Review*, 62:4, 423-81.

Sathye, M., and Sharma D. and Liue S., (2008), 'The Fisher Effect in an Emerging Economy: The Case of India', *International Business Research*, 1:2, 99-04.

Sargent, T. J.,(1972), 'Anticipated Inflation and the Nominal Rate of Interest', *Quarterly Journal of Economics*, 86, 212-25.

Shi Q., Li B. and Alexiadis S. (2012), Testing the Real Interest Parity Hypothesis in Six Developed Countries, *International Research Journal of Finance and Economics*, ISSN 1450-2887, 86, Euro Journals Publishing, Inc.
http://www.internationalresearchjournaloffinanceandeconomics.com

Shresta K., and Tan K. H., (2005), 'Real Interest Rate Parity: Long Run and Short Run Analysis Using Wavwlets', *Review of Quantitative Finance and Accounting,* 25: 139-57.

Silva N. L. C., (2016), 'Effects of inflation on Stock Prices: Evidence from Sri Lanka', *International Journal of Scientific and Engineering Research*, 7:4, 1278-79

Singh M., and Banerjee A., (2006), 'Testing Real Interest Parity in Emerging Markets', *IMF,* Working Paper.

Solnik B. and Solnik V., (1997), 'A multi-country test of the Fisher model for stock returns', *Journal of International Financial Markets*, Institutions and Money, 7, 289-301.

Tanzi V., (1980), 'Inflationary Expectations, Economic Activity, Taxes and Interst Rates', *The American Economic Review,* 70:1, 12-21.

Tobin J., (1965), 'Money and Economic Growth', *Econometrica*, 33, 671-84,

Taylor H., (1981), 'Fisher, Phillips, Friedman and the Measured Impact of Inflation on Interest', *Journal of Finance,* 36: 4, 955-62.

Taylor J.B., (1993), 'Discretion versus Policy Rule in Practice', *Carnegie-Rochester Conference series on Public Policy,* 39: 4, 195-14.

Tripathi V. (2014), 'Relationship between Inflation and Stock Returns- Evidence from BRICS Markets Using Panel Cointegration Test', *International Journal of Accounting and Financial Reporting,* ISSN 2162-3082, 4:2, 647-.658.

Uwubanmwen A. and Eghosa I. L., (2015), 'Inflation Rate and Stock Returns: Evidence from the Nigerian Stock Market', *International Journal of Business and Social Science,* 6: 11, 155-167.

Viren, M., (1986), 'The Relationship between Interest Rates and Inflation during the Prewar Period', *Economic Letters*, 20, 23-27.

Wallace, M. S. and Warner, J. T. (1993), 'The Fisher Effect and the Term Structure of Interest Rates: Tests of Cointegration', *Review of Economics and Statistics,* 75, 320–324.

Westerlund J., (2006), ‘Panel Cointegration Tests of Fisher Effect’, *Journal of Applied Econometrics*, 193-233.

Wu J. and Chen S., (1998), ‘A Re-Examination of Real Interest Rate Parity’, *The Canadian Journal of Economics*, 31:4, 837-851.

Zisimos K., and Apostolos, S., (1999), ‘On The Fisher Effect’, *Journal of Monetary Economics*, 44:1, 105-30.

# APPENDIX
## Yearly Data Samples

**Table A1**

| **Types** | **FH** | **FH in Stock Market** | **FH in Open Economy** |
|---|---|---|---|
| Above Average | Australia | Australia | Australia |
| Money Supply/GDP Countries | Bangladesh | Bangladesh | Bangladesh |
| | Bhutan | Mauritius | Bhutan |
| | Kazakhstan | Mexico | Kazakhstan |
| | Mauritius | Pakistan | Mauritius |
| | Mexico | Ukraine | Mexico |
| | Nigeria | Venezuela | Nigeria |
| | Pakistan | | Pakistan |
| | Saudi Arabia | | Saudi Arabia |
| | Tanzania | | Tajkistan |
| | Uganda | | Uganda |
| | Ukraine | | Ukrine |
| | Venezuela | | Venezuela |
| | | | |
| Below Average | Albania | Argentina | Albania |
| Money Supply/GDP Countries | Argentina | Bahrain | Angola |
| | Armenia | Bosnia and Herzegovina | Bahrain |
| | Aruba | Botswana | Argentina |
| | Austria | Brazil | Armenia |
| | Azerbaijan | Bulgaria | Aruba |
| | Bahamas | Colombia | Austria |
| | Belarus | Denmark | Balize |
| | Belize | Croatia | Azerbaijan |
| | Benin | Czech Republic | Boahamas |
| | Bolivia | Estonia | Benin |
| | Bosnia | Fiji | Belarus |
| | Botswana | France | Bolivia |
| | Brazil | Germany | Botswana |
| | Brunei Darussalam | Hungary | Brazil |
| | Burkina Faso | Iceland | Barbados |
| | Burundi | Indonesia | Burkina Faso |
| | Cambodia | Japan | Burundi |
| | Cameroon | India | Cambodia |
| | Cape Verda | Iran | Cameroon |
| | Central | Italy | Cape Verda |

| | | | |
|---|---|---|---|
| | African republic | | |
| | Chad | Kenya | Chad |
| | Chile | Korea | Chile |
| | China | Kuwait | China |
| | Colombia | Latvia | Columbia |
| | Costa Rica | Malaysia | Costa Rica |
| | Cote d'Ivoire | Maldives | Cote d'Ivoire |
| | Croatia | Netherlands | Croatia |
| | Cyprus | Newzealand | Cyprus |
| | Czech Republic | Papua New Guinea | Czech Republic |
| | Denmark | Peru | Denmark |
| | Djibouti | Philippines | Djibouti |
| | Dominican Republic | Poland | Dominican Republic |
| | Egypt | Portugal | Egypt |
| | Elsalvadore | Qatar | Elsalvadore |
| | Equatorial Guinea | Singapore | Equatorial Guinea |
| | Estonia | South Africa | Estonia |
| | Ethiopia | Sri Lanka | Ethopia |
| | Euro Area | Sweeden | Euro Area |
| | Fiji | Thailand | Fiji |
| | France | United Kingdom | Gabon |
| | Germany | United States | Georgia |
| | Gabon | Vietnam | India |
| | Georgia | Zambia | Indonesia |
| | Ghana | Serbia | Iran |
| | Greece | Russian Federation | Israel |
| | Guatemala | Hong Kong | Italy |
| | Guinea Bissau | China | Jamaica |
| | Guyana | Israel | Japan |
| | Haiti | | Jordan |
| | Honduras | | Kenya |
| | Hungary | | Korea |
| | Iceland | | Kuwait |
| | Indobesia | | Kyrgyz |
| | India | | Latvia |
| | Iran | | Iceland |
| | Israel | | Indonesia |
| | Italy | | India |
| | Jamaica | | Iran |
| | Japan | | Ireland |
| | Jordan | | Israel |
| | Kenya | | Italy |

| | | | |
|---|---|---|---|
| | Korea | | Jamaica |
| | Kuwait | | Japan |
| | Kyrgyz | | Jordan |
| | Latvia | | Kazakhstan |
| | Lesotho | | Kenya |
| | Libya | | Korea |
| | Lao People's Dem | | Kosovo |
| | Luxembourg | | Kuwait |
| | Macedonia | | Kyrgyz |
| | Madagascar | | Lesotho |
| | Malawi | | Latvia |
| | Malaysia | | Libya |
| | Maldives | | Lao People's Dem |
| | Mali | | Luxemberg |
| | Malta | | Macedonia |
| | Mauritania | | Madagascar |
| | Netherlands | | Madagscar |
| | Newzealand | | Malawi |
| | Nicaragua | | Malaysia |
| | Norway | | Maldives |
| | Oman | | Mali |
| | Papua New guinea | | Malta |
| | Paraguay | | Mauritania |
| | Peru | | Netherlands |
| | Philippines | | Newzealand |
| | Poland | | Nicaragua |
| | Portugal | | Norway |
| | Qatar | | Oman |
| | Romania | | Papua New guinea |
| | Russian Federation | | Paraguay |
| | Serbia | | Peru |
| | Sri Lanka | | Philippines |
| | Singapore | | Poland |
| | St. | | Portugal |
| | St. Kitts & Navis | | Qatar |
| | Spain | | Romania |
| | St. Lucea | | Russian Federation |
| | St. Vincent Grens. | | Serbia |
| | Swaziland | | Sierra Leone |
| | Serbia | | Singapure |

| | | | |
|---|---|---|---|
| | Thailand | | Sint Maarten |
| | Timor-Leste | | Spain |
| | Togo | | St. Kitts & Navis |
| | United Kingdom | | St. Lucea |
| | United States of America | | St. Vincent Grens. |
| | Uganda | | Switzerland |
| | Vietnam | | Sweden |
| | Yemen | | Syrian Arab Republic |
| | Zambia | | Thailand |
| | | | Timor- Leste |
| | | | Togo |
| | | | United Kingdom |
| | | | United States of America |
| | | | Uganda |
| | | | Vietnam |
| | | | Yemen |
| | | | Zambia |

**Quarterly Data Samples**

**Table A2**

| **Types** | **FH** | **FH in Stock Market** | **FH in Open Economy** |
|---|---|---|---|
| Above Average | Bangladesh | Australia | Bangladesh |
| Money Supply/GDP Countries | Kazakhstan | Bangladesh | Kazakhstan |
| | Mauritius | Mauritius | Mauritius |
| | Pakistan | Pakistan | Pakistan |
| | Saudi Arabia | Saudi Arabia | Saudi Arabia |
| | Mexico | Ukraine | Tajikistan |
| | Tajikistan | | Uganda |
| | Pakistan | | Ukrine |
| | Uganda | | |
| | Ukrine | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Below Average | Angola | Austria | Angola |
| Money | Armenia | Bosnia and | Armenia |

| | | | |
|---|---|---|---|
| Supply/GDP Countries | | Herzegovina | |
| | Aruba | Botswana | Aruba |
| | Austria | Brazil | Austria |
| | Bahamas | Canada | Bahamas |
| | Bolivia | China | Bolivia |
| | Bosnia & Herzegovina | Hong Kong | Botswana |
| | Botswana | Columbia | Brazil |
| | Brazil | Croatia | Buruni Darussalam |
| | Buruni Darussalam | Kenya | Burundi |
| | Burundi | Korea | Cambodia |
| | Cambodia | Kuwait | Cameroon |
| | Cameroon | Latvia | Canada |
| | Canada | Luxemburg | Cape Verda |
| | Cyprus | Maldives | China |
| | China | Newzealand | Hongkong |
| | Hongkong | Norway | Columbia |
| | Colombia | Portugal | Croatia |
| | Croatia | Poland | Kenya |
| | Cape Verda | Philippines | Korea |
| | Kenya | Peru | Bosnia & Herzegovina |
| | Korea | Papua New Guinea | Kuwait |
| | Kuwait | Qatar | Kyrgyz Republic |
| | Kyrgyz Republic | Russian Federation | Lesotho |
| | Lesotho | Serbia | Libya |
| | Libya | Singapore | Malawi |
| | Malawi | South Africa | Maldives |
| | Maldives | Spain | Poland |
| | Poland | Srilanka | Philippines |
| | Philippines | Sweden | Peru |
| | Peru | Thailand | Papua New Guinea |
| | Papua New Guinea | United Kingdom | Romania |
| | Romania | United States of America | Russian Federation |
| | Russian Federation | Venezuela | |
| | Serbia | Zambia | Singapore |
| | Singapore | | Sweden |
| | Sweden | | Syrian Arab Republic |

| | | | |
|---|---|---|---|
| | Syrian Arab Republic | | Thailand |
| | | | Timor-Leste |
| | Timor-Leste | | Togo |
| | Togo | | United States of America |
| | United States of America | | Uruguayy |
| | Uruguay | | Vietnam |
| | Vietnam | | Yemen |
| | Yemen | | Zambia |
| | Zambia | | Israel |
| | Israel | | Iran |
| | Iran | | Indonesia |
| | Indonesia | | India |
| | India | | Iceland |
| | Honduras | | Honduras |
| | Hati | | Haiti |
| | | | |

**Variance Inflation Factor**

| Variable | Coefficient Variance | Uncentred VIF | Centered VIF |
|---|---|---|---|
| Constant | 7.229169 | 1.166786 | NA |
| $P_{i,t}$ | 1.71E-06 | 1.156734 | 1.000872 |
| $Y_{i,t}$ | 4.66E-13 | 1.009679 | 1.000496 |
| $m_{i,t}$ | 1.97E-17 | 1.002976 | 1.000409 |