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Testing the Fisher Effect in the case of Pakistan and China

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Abstract: *Interest rate (NIR) and inflation rates (INR) play critical roles in the analysis and implementation of monetary policy (MP), investment assessment. Furthermore, the real interest rate (RIR) is fundamental since it influences the majority of economic consumption, saving, and investment decisions. According to the Fisher's effect (FE) that there are one-to-one link between nominal interest rate and predicted inflation. Therefore, the main aims of the study to investigate the existence of fisher hypothesis in the case of Pakistan and China. Therefore, this study used the data period from 2004 to 2024 in the case of Pakistan and 1987 to 2024 of China and based on the behaviour of the data recommended the use of ARDL techniques for estimations. This study found that in the long run (LR), inflation rate has encouraging and noteworthy effect on interest rate in both countries. Furthermore, in the short run (SR), inflation rate has encouraging but insignificant effect on interest rate in Pakistan, while, encouraging and noteworthy effect on interest rate in China. Therefore, this study concluded that the Fisher-hypothesis (FE) does not exist in the both countries. This study recommended the monetary authorities play their rule in the reducing inflation rate to reduce the interest rate.*

Introduction

Interest rate (NIR) and inflation rates (INR) play critical roles in the analysis and implementation of MP, investment assessment. Furthermore, the real interest rate (RIR) is fundamental since it influences the majority of economic consumption, saving, and investment decisions (Mishkin, 1988). According to Taylor (2000), used to analyze monetary policy include linkages between GDP, INR, and RIR. On a micro level, assessments of both INR and RIR are required to assess and choose private and governmental investment opportunities. Given the importance of the Fisher connection in finance and economics, it is critical to look into plausible causes for the gap between theory and data. Fisher (1930) inaugurate the one-to-one link between NIR and predicted inflation in his classic work 'the theory of interest'. This theory is commonly known as Fisher's effect (FE) or Fisher's equation (FE) (both terms are used inter unsteadily). Fisher's theory, in the LR, predicts monetary super noninvolvement and the absence of

360

money illusion. Conversely, if there is a less-than-proportional link between the NIR and predicted future INR, this would result in partial money illusion, also known as the Fisher's effect conundrum in the pertinent literature.

The RIR is a significant predictor of Investment, and saving, therefore any upsurge in predicted INR may generate serious economic issues in the nonappearance of Fisher's premise (Bundesbank, 2001). The Fisher effect holds that the central bank's MP is active. As a result, one might deduce that the MP rate is dependent on inflation expectations. Another key aspect of FE is that NIR are strong predictors of inflationary-expectations (Christopoulos & León-Ledesma, 2007). To improve the discernibility and expectedness of INR, one of the underlying expectations of this link is a market-determined NIR structure, which is feasible in industrialized nations. However, in developing economies where NIR are managed or regulated, projected INR and NIR may or may not move at the same rate. This raises the intriguing question of whether FE remains valid (Adil et al., 2020).

The lack of a direct extent of INR-expectations is a significant issue when testing for FE. Over the years, a variety of methods have been employed to develop proxies for the projected inflation rate. The majority of early research on Fisher's impact, notably Fisher (1930), employed a distributed lag on historical INR as a proxy for inflationary-expectations. He utilized yearly data from 1890-1927 in the US and 1820-1924 in the United Kingdom. He discovered that inflationary-expectations did not immediately affect NIR. However, the LR, NIR and INR were connected with a magnitude of 0.8600 in the United States, with a 20-year price lag. In the United Kingdom, a correlation value of 0.9800 was observed when price alterations were distributed across a 28-year period.

The inflation rate is an important aspect in analyzing monetary policy, evaluating investments, and making intertemporal decisions (Adil et al., 2020). Anari and Kolari (2019) discover that INR and NIR are causally related, and the calculated coefficients in the ex-post FE are a combination of FE and WicE. The experimental results confirmed Fisher's initial hypothesis that there is a one-to-one link between INR and RIR, and that ex-ante real rates are optimistic and reasonably constant over time. Crowder et al. (1999) investigation confirms Fisher's relationship without taking into account any changes in inflation dynamics across the sample-period. Jensen (2009) also provisions the LR Fisher effect, which states that increases in inflation result in an equal possibility of changes in nominal interest rates. The study highlights the inability to assess Fisher's effect in the long term using the reduced form technique. Koustas and Serletis (1999) undertake a research of postwar quarterly data from Canada, Belgium, France, Greece, Germany, Ireland, the Netherlands, Japan, the UK, and the US. The findings of this analysis are consistent with the majority of the literature on FE, which generally suggests that there is a less than one-to-one link between INR and NIR.

Lanne (2006) use a non-linear ARDL model to examine the link between INR and NIR using quarterly data from the US from 1953 to 2004. They discover that the actual interest rate is stable, which contradicts numerous earlier researches. However, it adheres to economic theory. Fisher's hypothesis previously studied the of FE. However, expost data can be an unreliable predictor of ex-ante factors. As a result, typical semi-parametric estimation based on ex-post data is criticized for underestimating the real degree. Sun and Phillips (2004) found the FE is not favorable in the LR. Maki (2005) examines the FE in Japan. The threshold cointegration methodology, unlike the Engle-Granger method, demonstrates a cointegration relationship with unequal adjustment toward equilibrium.

Panopoulou and Pantelidis (2016) use simulated critical values rather than asymptotic ones to evaluate the FE conundrum. Except for Ireland and Switzerland, the findings provide adequate evidence to establish the long-term link between INR and NIR in 17 OECD nations. Westerlund (2008) contends that

panel estimates are better suited for estimating the Fisher's effect since they are not relied on univariate testing. He uses two novel panel cointegration criteria to 20 (twenty) OECD nations. The results do not contradict the cointegration of INR and NIR. However, each discrete country's co-integration result contradicts FE. Aside from the foregoing, some empirical data does not support Fisher's effects. Like, Abubakar and Sivagnanam (2017) experimentally studied Fisher's impact using data from 1990-Jan to 2015-March in India. The results show that there is no LR symmetry link between the NIR and INR for both the complete sample and the sub-sample, which contradicts Fisher's claim. He provided the following explanations for his findings: First, the RBI conducts a passive MP. Second, there is distortion in the NIR pass-through channel, and third, India's dominating informal banking sector renders short-term policy rates useless as a monetary policy instrument.

According to Koustas and Serletis (1999), they are now left with a mystery that must be solved by future theoretical and empirical investigation. In light of the uncertainty around the existence and nonexistence of Fisher's impact in the preceding research, the current study examines the validity of FE in Pakistan and China. This study is differing in terms of explanatory factors, operational details, data frequency, and sample time. This study used the updated data period from 2004 to 2024 in the case of Pakistan and 1987 to 2024 in the case of China. Moreover, this study significantly contributed in the existing body of literature. Therefore, this study was conducted to test the Fisher Effect in the case of Pakistan and China.

Literature Review

The numerous studies test the FE in the different countries and growth of countries by using the different frequencies of data and methodologies. Like, they use the King and Watson (1997) technique, giving special attention to the variables' integration and cointegration features, which are important for significant Fisher effect testing. They find that the data typically disprove the Fisher effect. Furthermore, Sun and Phillips (2004) empirical estimates of LR dependency in the Fisher equation demonstrate this issue, resulting in an apparent imbalance in the memory properties of the variables in the FE. Results from INR forecast survey data, as well as direct computation of finite-sample biases, give evidence for this common underestimate. To discourse the issue of bias, they propose a bivariate exact Whittle (BEW) estimator that explicitly accounts for the existence of SR noise in data. The new technique improves the empirical ability to distinguish between low-frequency behavior and high-frequency instabilities, as well as producing estimates of LR dependency that are significantly less skewed when data is polluted with noise. Experimental approximations from the BEW approach indicate that with a memory parameter ranging from 0.7500 to 1. Because the ex-ante RIR has the same-degree of tenacity as projected INR, providing evidence against the existence of a co integrating relationship among the NIR and INR and, consequently, screening, little backing for a LR form of the FE.

Geetha et al. (2011) seek to understand the link between INR and stock performance. Inflation was classified as expected and unforeseen inflation. They discovered that there is a LR link between INR and stock-returns, but there is no SR link in Malaysia or the US, but one exists in China. Fatima and Sahibzada (2012) establish the prevalence of the FE in Pakistan from 1980-2010. However, the casual link between money supply (MS) and INR suggests that inflation is more than just a monetary phenomenon, with fiscal-imbalance and MS both playing major roles in rising inflation and money supply in the economy. Zainal et al. (2014) investigated the validity of the FE in the Malaysian MS. They used data from 2000 to 2012 and applied the ARDL test for estimate. The estimate findings show the presence of LR co integration among the variables and give support for the FE in Malaysia.

Khan et al. (2018) investigate the link between the stock-market and Pakistan's INR, estimate to

determine if the outcomes sustenance the Fisher hypothesis in Pakistan. The entire sample size empirical finding demonstrates a one-way causal relationship between the stock-market and the INR. It also demonstrates that in the face of structural-changes, the whole sample connection becomes unstable and untrustworthy. They employ rolling window estimates with time-varying parameters to conclude bi directional causation between the INR and the stock market in various sub-samples. The data are not compatible with Fisher's premise. Anari and Kolari (2019) study the time-varying link between NIR and INR. Using state-space illustrations of their model, they evaluated ex post FE and Wicksell equation (WicE) belongings factors, as opposed to their assessments of fixed coefficients throughout time. This method allowed for the recovery of ex-ante NIR and ex-ante INR data. Using this ex-ante NIR, they calculated the ex-ante FE factors and actual intercepts. Analyses of US NIR and INR data, as well as robustness tests for France, Canada, and the UK, were done. Their empirical findings verified Fisher's initial hypothesis that the ex-ante Fisher coefficient is roughly equal to unity and ex-ante RIR are optimistic and largely constant. They find that the ex-ante Fisher connection holds after accounting for WicE. FE and WicE both influence the relationships between NIR, RIR, and INR linkages.

Adil et al. (2020) investigate the FE using a India's dataset with the goal of determining whether a LR experimental link between NIR and INR expectation exists. They used monthly data from January 1993 to March, 2015 and used the ARDL. The limits' testing is used to examine the co-integration and relationships between variables for various combinations of the FE. They find that there is a LR link between Treasury bills and projected INR (as assessed by WPI), with a LR correlation of 0.5400, suggesting a partial FE. While, there is no LR association between Treasury bills and predicted inflation (as assessed by the CPI). Similarly, a LR association, albeit not one-to-one, exists between NIR and projected INR (calculated by WPI), with a factor equal to 0.5100. The conclusion implies that NIR are a good indication of INR-expectations. Zainal et al. (2021) investigate the presence of FE hypothesis in Malaysia's conservative and Islamic money markets and used data from 2011-2018. The first stage of research investigates the presence of a Fisher Effect link using the ARDL estimation method. The second stage of analysis uses the conventional asymptotic Chi-square in the Wald test to assess the strength of the FE association with a constraint of $\beta=1$. They discovered that the FE theory holds true in Malaysia's Islamic money market, but there is no confirmation for the regular market. This finding implies that the Islamic money market may effectively anticipate future inflation.

Mkhombo and Phiri (2022) investigate the time-frequency connection in the FE for South African Customs Union (SACU) nations using incessant wavelet-transforms. They utilize the Wavelet-power gamut to deconstruct the NIR and INR over a time frequency-space, followed by wavelet coherence tools to study the harmonization of the two time-frequency space. Their findings show that SACU nations saw comparable co-movement between NIR and INR after 2000, with greater Fisher effects during the global economic crisis and indications crisis era.

Schmitt-Grohé and Uribe (2025) show that the central bank (CB) effect and the neo-Fisher effect yield identical results: a monetary tightening causes a rise in INR and an expansion of real activity. Separate estimations of these impacts have the danger of confusing one with the other. To untangle these two stations, they incorporate a permanent MS that produces neo-Fisher effects and an aggregate demand (AD) shock to which the CB responds, resulting in CB effects. They estimate the model using data from the United States, which includes information on MS derived from high frequency sympathy and LR yields. They discover that the neo Fisher shock is a major driver of INR, but the CB shock explains a sizable portion of NIR changes. The CBI shock explains nothing about INR and production, but counterfactual exercises show that it reflects the CB success in insulating the economy from AD

fluctuations. The usual monetary shock makes just a tiny impact. These results are demonstrated to be valid given both full and imperfect knowledge.

Fisher Hypothesis

According to Fisher (1930) theory of NIR, the approximate connection between nominal interest rate (NIR) i_t, real interest rate (RIR) λ_0, and anticipated inflation rate $E_t\pi_t$ in period t is as follows:

$$i_t = \lambda_0 + \lambda_1 E_t\pi_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (1)$$

Where λ_1 is the Fisher effect, and the inflation rate expectations are designed at the starting period t.

The propositions of the theory are, first $\lambda_1 = 1$ and $\lambda_0 > 0 \ and \ stable$. However, according to (Feldstein (1976); Tanzi (1976)), that $\lambda_1 > 1$ due to different taxes.

Therefore, the empirical literature assumes the rational expectation and re-specifies the fisher equations in ex post term as;

$$i_t = \lambda_0 + \lambda_1\pi_t + e_t^\pi \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (2)$$

Where π_t is realized INR, and e_t^π is INR forecast error. Using NIR and INR to empirically estimate equation 2, Fisher (1930) discovered that estimates of λ_1 are much less than one, resulting in the Fisher Puzzle. As a result, the link between NIR and INR has well researched equations in finance and economics. Almost, all econometric approaches, ranging from regressions to co-integration analysis, have been used to answer the Fisher issue. When estimating the Fisher equation, it is to use a single-equation technique.

Alternative empirical paradox of the FE is that it predicts negative RIR. Over the last 50 years, academics have frequently observed the presence of negative RIR. Observed estimates can be generated using the Fisher equation, RIR, commodities, and INR instruments. The most often used approach for determining RIR rearranges the Fisher-equation (Anari & Kolari, 2019) as follows:

$$r_t = i_t - \pi_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (3)$$

Where r_t denotes RIR (Mishkin, 1981). Unapparent RIR are usually calculated by subtracting the INR from the NIR. The RIR should be optimistic due to favorable time preferences and investment possibilities. Fisher argues that the former derives from a desire for current goods over future ones, while the latter stems from both natural production and human ingenuity (Anari & Kolari, 2019). Spector and Stone (2012) examined the wide literature in an attempt to settle optimistic ex ante RIR with adverse estimated RIR. Alchian and Klein (1973) propose developing improved inflation metrics as a way to overcome this problem.

Shibuya (1992) developed price-inflation linkages, whereas Filardo (2000) presented a price index for MP research. However, none of the suggested indexes have received significant attention. Hosek and Zahn (1985) used quarterly US data to estimate unapparent RIR based on real return on capital. Mishkin (1988) calculated projected INR using certain commodities, then deducted these estimates from NIR. Another approach is to utilize yields on Treasury inflation-protected instruments (TIPS) as a direct indicator of RIR. TIPS yields are considered to represent nominal Treasury-rates less the sum of projected INR (Craig, 2003). Imperfect and restricted inflation measurements, as well as a lack of extended data series, are inherent difficulties with this technique. In light of these and other investigations, concluded that existing approaches are unlikely to produce RIR estimations consistent with FE of NIR (Anari & Kolari, 2019).

Methodology

This study used the data period from 2004 to 2024 in the case of Pakistan and 1987 to 2024 in the case of China. The data was collected from World Development Indicators (WDI) (2025).

Table 1: Description of Variables

Variables	Measurement	Marks
Inflation, consumer prices (annual %)	Percentage	INR_t
Deposit interest rate (%)	Percentage	NIR_t

Model Specification

This study used the following model developed by Fisher (1930).

$$NIR_t = \lambda_0 + \lambda_1 INR_t + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (4)$$

Where λ_0 and λ_1 are parameters and μ_t is error term.

Estimation Techniques

This study used the ARDL technique for estimation.

$$NIR_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} NIR_{t-i} + \sum_{i=0}^{n} \beta_{2i} INR_{t-i} + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. \quad (5)$$

$$\Delta NIR_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta NIR_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta INR_{t-i} + \gamma_1 INR_t + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots. \quad (6)$$

Results and Discussions

Unit Root Test Results

The unit root test results indicated that the orders of integration are mixed in the case of Pakistan whiles the 1st degree order of integration in both variables in the case of China. Therefore, the behaviour of the data recommended the use of ARDL techniques for estimations.

Table 2: ADF test results

Variable	At level		1st difference		Decision
	t-Statistic	Prob.*	t-Statistic	Prob.*	(order of integration)
In case of Pakistan					
NIR_t	-3.297947	0.0296	----	----	1(0)
INR_t	-2.456394	0.1402	-4.401542	0.0031	1(1)
In case of China					
NIR_t	-1.234547	0.6490	-5.146214	0.0002	1(1)
INR_t	-1.815891	0.3668	-4.772030	0.0005	1(1)

Regression Results

Table 3 presents the ARDL results, which shows that In the LR, INR has optimistic and noteworthy effect on interest rate in both countries. A % upsurge in the INR will lead to upsurge the NIR by 0.05% in the case Pakistan and 0.21% in the case of China. Furthermore, in the SR, inflation rate has optimistic but insignificant effect on interest rate in Pakistan, while, optimistic and noteworthy effect on NIR in China. A % upsurge in the INR will lead to increase the NIR by 0.18% in the case of China. Therefore, the Fisher hypothesis does not exist in the both countries. The fisher hypothesis were supported by Zainal et al. (2014) in Malaysia, Geetha et al. (2011) in China, Fatima and Sahibzada (2012) and Rehman et al. (2004) in Pakistan, while, Khan et al. (2018) not support in Pakistan. Moreover, the ECM value indicated that there are 53% in the case of Pakistan and 50% in the case of China speed of adjustment from SR to LR equilibrium. Furthermore, the Bounds test indicates that there is LR co integration among the variables

in both countries.

Table 3: ARDL results

Variables	Pakistan				China			
	Coefficient	Std. Error	t-Stat	Prob.	Coefficient	Std. Error	t-Stat	Prob.
INR_t	0.0486	0.0237	2.0526	0.0580	0.2135	0.0323	6.6114	0.0000
C	2.7873	0.9663	2.8845	0.0113	0.3949	0.2330	1.6948	0.0993
$D(INR_t)$	0.0013	0.0408	0.0322	0.9747	0.1753	0.0238	7.3681	0.0000
ECM_{t-1}	-0.5290	0.1589	-3.3284	0.0043	-0.4988	0.0653	-7.6380	0.0000
C	0.2155	0.2650	0.8130	0.4281	-0.1154	0.1038	-1.1113	0.2745
F-Bounds Test								
H_0: **No levels relationship**								
Test Statistic	Value	Signif.	I(0)	I(1)	Value	Signif.	I(0)	I(1)
F-statistic	4.429	10%	3.02	3.51	16.099	10%	3.02	3.51
k	1	5%	3.62	4.16	1	5%	3.62	4.16
		2.5%	4.18	4.79		2.5%	4.18	4.79
		1%	4.94	5.58		1%	4.94	5.58

Table 4 presents the diagnostic tests results, which shows that there are no serial correlation, heteroscakedasticity, and specification error in the model. Furthermore, the residual of the model is normally distributed and model is stable.

Table 4: Diagnostic Tests results

Test with H_0	Test Statistics	Pakistan		China		Decision about H_0
		Value	p-value	Value	p-value	
Breusch-Godfrey Serial Correlation LM Test: H_0: No serial correlation	F-statistic	0.4552	0.6440	0.8352	0.4430	Sustain
Heteroskedasticity Test: Breusch-Pagan-Godfrey H_0: Homoskedasticity	F-statistic	0.2832	0.8368	0.9923	0.4718	Sustain
Ramsey RESET Test H_0: No specification error in the data	F-statistic	1.8335	0.1927	0.6031	0.4441	Sustain
Normality Test H_0:Residuals are normally distributed	Jarque-Bera	3.8047	0.1492	2.3245	0.3128	Sustain
Stability test CUSUM and CUSUMOS	----	---	---	---	---	Stable

Conclusion and Recommendations

NIR and INR rates play critical roles in the analysis and implementation of MP, investment assessment. Furthermore, the RIR is fundamental since it influences the majority of economic decisions. According to

the Fisher's effect that there are one-to-one link between nominal interest rate and predicted inflation. Therefore, the main aims of the study to investigate the existence of fisher hypothesis in the case of Pakistan and China. Therefore, this study used the data period from 2004 to 2024 in the case of Pakistan and 1987 to 2024 in the case of China and based on the behaviour of the data recommended the use of ARDL techniques for estimations. This study found that in the LR, inflation rate has optimistic and noteworthy effect on interest rate in both countries. Furthermore, in the SR, INR has optimistic but insignificant effect on interest rate in Pakistan, while, optimistic and noteworthy effect on NIR in China. Therefore, this study concluded that the Fisher hypothesis does not exist in the both countries. As a result, the study suggests that the MP committee examine its MP actions by reassessing the NIR pass-through and MP transmission-mechanism. This will help to determine with better confidence the pace, sign, and amount of MP's influence on interest rates, inflation (present and forecast), and production. This study recommended the monetary authorities play their rule in the reducing inflation rate to reduce the interest rate.

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