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STOCK RETURNS AND INFLATION NEXUS IN TURKEY: EVIDENCE FROM ARDL BOUNDS TESTING APPROACH

Abstract: *This study examines the long-run and causal relationships between stock market prices and consumer prices in Turkey. The bounds testing approach of cointegration is employed to investigate this relation by using quarterly data for 1987-2008 period. The bounds F–test for cointegration test yields evidence of a long-run relationship between stock market returns and inflation at 1% significance level. The study also explores the causal relationship between these variables in terms of the three error-correction based Granger causality models. The empirical results are as follows: i) The estimated long-run coefficient of the inflation is about unity and positive. ii) Any deviation from the long-run equilibrium between stock market returns and inflation is corrected about 32% for each period. iii) There is a strong evidence of unidirectional causality running from inflation to stock market returns. The overall results support the generalized Fisher hypothesis which implies that stocks offer a hedge against inflation.*

Key words: *Inflation, stock market returns, ARDL cointegration, causality, Turkey.*

JEL Classification: C32, E31, G12

1. Introduction

The Fisher (1930) hypothesis states that the expected nominal stock market returns should equal to expected inflation plus the real rate of return. This hypothesis has come to be known as ‘the Fisher effect’ in the economic literature. According to this hypothesis, the expected nominal asset returns should move one for one with expected inflation. The Fisher hypothesis predicts a positive homogeneous relationships of degree one between stock market return and inflation. In other words, stocks provide a hedge against inflation when investors are totally compensated for the increases in the price level through increases in nominal stock market returns, thereby leaving real stock market returns unaffected

(Maghyereh, 2006). The Fisher model for real asset prices has great financial importance. In a global capital market where countries lead different monetary/budget/fiscal policies and business cycles are not fully synchronized, deviations from the Fisher model have significant asset allocation implications (Solnik and Solnik, 1997).

The empirical results of stock market return-inflation nexus could be classified into the following three categories:

i) Positive relationship between stock market returns and inflation which is consistent with the generalized Fisher hypothesis. With higher horizon, generalized Fisher hypothesis usually cannot be rejected [see, Jaffe and Mandelker (1976) for US; Firth (1979), and Boudoukh and Richardson (1993) for UK; Rapach (2002) for 16 industrialized countries; Spyrou (2004) for nine of 10 emerging markets (Chile, Mexico, Brazil, Argentina, S.Korea, Malaysia, Hong Kong, Philippines and Turkey); Horobet and Dumitrescu (2009) for 4 countries from Central and Eastern Europe(Czech Republic, Hungary, Poland and Romania].

ii) Negative relationship between stock market returns and inflation which is contrast to the generalized Fisher hypothesis [see, Lintner (1975), Bodie (1976), Nelson (1976), Fama and Schwert (1977), Fama (1981), Geske and Roll (1983), Hu and Willett (2000) for the US; Gultekin (1983) for twenty-six countries; Solnik (1983) for nine countries; Mandelker and Tandon (1985) for six major industrial countries; Kaul (1987) for US, Canada, UK and Germany; Solnik and Solnik (1997) for the pooling of data for several countries; Erb *et al.* (1995) for 41 developed and emerging equity markets; Zhao (1999) for China; Choudhry (2001) for Argentina, Chile, Mexico and Venezuela; Spyrou (2001) and Ioannides et al. (2005) for Greece].

iii) No relationship between stock market returns and inflation [see, Pearce and Roley (1988) for 84 US firms; Floros (2004), and Patra and Poshakwale (2006) for Greece, Jung et al. (2007) for Germany, Italy, UK and France].

Most of the empirical studies found that there is an evidence of negative relationship between stock market returns and inflation for US and a number of other countries. This negative correlation between stock market returns and inflation is often known as 'a stock return-inflation puzzle' in the financial economic literature (Maghyereh, 2006). Theoretical explanations for this negative short-term relation between stock market returns and inflation focus on the influence of revisions in inflationary expectations on stock prices. Bodie (1976) claims that there are two distinct ways to define stocks as a hedge against inflation. First, a stock is a hedge against inflation if it eliminates or at least reduces the possibility that the real rate of return on the security will fall below some specific floor value. Second, it is a hedge if and only if its real return is independent of the rate of inflation. Jaffe and Mandelker (1976) claim that a negative relationship between stock market returns and inflation suggest that the stock market is not even a partial hedge against inflation. A negative relationship implies that investors whose real wealth is diminished by inflation can expect this effect to be compounded by a lower than average return on the stock market. Feldstein (1980) offers that taxation related to depreciation and capital gains, is affected by inflation which, in turn, affects real asset valuation. Fama (1981) suggested 'proxy hypothesis' that is based on the money demand theory. Since stock market returns are positively related to real activity and real activity is negatively related to changes in the level of prices, stock market returns are negatively related to inflation. Geske and Roll (1983) and Kaul (1987) also provide a counter-cyclical monetary-policy explanation. An increase in the expected inflation leads to fears of a tightening of monetary policy that negatively affect stock prices. Sharpe (2002) adds that the negative relation between equity valuations and expected inflation occurs because rising inflationary expectations coincide with both lower expected real earnings growth and higher required real returns. The major link in all those models is a negative relation between stock price movements and revision in expected inflation.

Turkey has faced significant developments in the 1990s and 2000s not only in terms of high economic growth and dealing with high inflation, but also in terms of dramatic stock market expansion. Thus, the aim of this study is to investigate the long-run and causal relationships between stock market prices and consumer prices for the Turkish economy using quarterly data for 1987-2008 period. This paper employs recently developed autoregressive distributed lag (hereafter ARDL) bounds testing approach of cointegration by Pesaran and Shin (1999) and Pesaran *et al.* (2001), and error-correction based Granger causality models to examine the long-run and causal relationships between stock market prices and consumer prices for Turkey.

The remainder of the paper is organized as follow: Section 2 presents the model and data description. Section 3 discusses the methodology and section 4 reports the empirical findings. The last section presents a summary with some concluding remarks.

2. Model and Data

Following the empirical literature, the standard log-linear functional specification of long-run relationship between stock market prices and consumer prices may be expressed as:

$$sp_t = \alpha + \beta cp_t + \varepsilon_t \tag{1}$$

where sp_t is the stock market prices that are based on Istanbul Stock Exchange (ISE) National 100 index. cp_t is the consumer price index that is used to measure the inflation. The quarterly seasonally adjusted time series data are taken for 1987:1-2008:4 period from the Central Bank of the Turkish Republic electronic data delivery system (www.tcmb.gov.tr). Both variables were seasonally adjusted to remove the seasonal effects by using Census X-12 quarterly seasonal adjustment method. Then they are employed with their natural logarithms form to reduce heteroscedasticity and to obtain the growth rate of the relevant variables by their differenced logarithms.

3. Methodology

The long-run and causal relationships between stock market prices and consumer prices in Turkey will be performed in two steps. Firstly, we examine the long run relationships among the variables by using the ARDL bounds testing approach of cointegration. Secondly, we test causal relationships by using the error-correction based causality models.

3.1. Autoregressive Distributed Lag (ARDL) Cointegration Analysis

The ARDL bounds testing approach of cointegration is developed by Pesaran and Shin (1999) and Pesaran *et al.* (2001). Due to the low power and other problems associated with other test methods, the ARDL approach to cointegration has become popular in recent years. Pesaran and Shin (1999) and Pesaran *et al.* (2001) argue that the ARDL cointegration approach has numerous advantages in comparison with other cointegration methods such as Engle and Granger (1987), Johansen (1988), and Johansen and Juselius (1990) procedures:

First, the ARDL procedure can be applied whether the regressors are I(1) and/or I(0), while Johansen cointegration techniques require that all the variables in the system be of equal order of integration. This means that the ARDL can be applied irrespective of whether underlying regressors are purely I(0), purely I(1) or mutually co-integrated and thus no need for unit root pre-testing. Second, while the Johansen cointegration techniques require large data samples for validity, the ARDL procedure is statistically more significant approach to determine the cointegration relation in small samples. Third, the ARDL procedure allows that the variables may have different optimal lags, while it is impossible with conventional cointegration procedures. Fourth, the ARDL technique generally provides unbiased estimates of the long-run model and valid t-statistics even when some of the regressors are endogenous (see Harris and Sollis, 2003). Finally, the ARDL procedure employs only a single reduced form equation, while the conventional cointegration procedures estimate the long-run relationships within a context of system equations (see Pesaran and Shin, 1999; Pesaran *et al.* 2001).

The ARDL model for the standard log-linear functional specification of long-run relationship between stock market prices and consumer prices may be formulated as below:

$$\Delta sp_t = \alpha_1 + \sum_{i=1}^{p1} \phi_{1i} \Delta sp_{t-i} + \sum_{j=0}^{q1} \beta_{1j} \Delta cp_{t-j} + \delta_1 sp_{t-1} + \delta_2 cp_{t-1} + \varepsilon_{1t} \quad (2)$$

where ε_{1t} and Δ are the white noise term and the first difference operator, respectively. The ARDL method estimates $(m+1)^n$ number of regressions in order to obtain the optimal lag length for each variable, where *m* is the maximum number of lags to be used and *n* is the number of variables in the equation. An appropriate lag selection based on a criterion such as Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC) and Hannan-Quinn Information Criterion (HQIC).

The bounds testing procedure is based on the joint F-statistic or Wald statistic that is tested the null of no cointegration, $H_0 : \delta_r = 0$, against the alternative of $H_1 : \delta_r \neq 0$, $r = 1, 2$. Two sets of critical values that are reported in Pesaran et al. (2001) provide critical value bounds for all classifications of the regressors into purely *I(1)*, purely *I(0)* or mutually cointegrated. If the calculated *F*-

statistics lies above the upper level of the band, the null is rejected, indicating cointegration. If the calculated F-statistics is below the upper critical value, we cannot reject the null hypothesis of no cointegration. Finally, if it lies between the bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying regressors.

Recently, Narayan (2005) argues that exiting critical values, because they are based on large sample sizes, cannot be used for small sample sizes. Narayan (2005) regenerated the set of critical values for the limited data ranging from 30–80 observations by using the Pesaran et al. (2001)'s GAUSS code. With the limited quarterly Turkish data on stock market prices and consumer prices, this study employs the critical values of Narayan (2005) for the bounds F-test rather than Pesaran *et al.* (2001).

If there is an evidence of long-run relationships (cointegration), the second step is to estimate the following long-run and short-run models:

$$sp_t = \alpha_2 + \sum_{i=1}^{p2} \phi_{2i} sp_{t-i} + \sum_{j=0}^{q2} \beta_{2j} cp_{t-j} + \varepsilon_{2t} \quad (3)$$

$$\Delta sp_t = \alpha_3 + \sum_{i=1}^{p3} \phi_{3i} \Delta sp_{t-i} + \sum_{j=0}^{q3} \beta_{3j} \Delta cp_{t-j} + \psi ECT_{t-1} + \varepsilon_{3t} \quad (4)$$

where ψ is the coefficient of error correction term (hereafter ECT). It shows how quickly variables converge to equilibrium and it should have a statistically significant coefficient with a negative sign.

3.2. Causality Analysis

ARDL cointegration method tests whether the existence or absences of long run relationship between stock market prices and consumer prices. It does not indicate the direction of causality. Granger (1988) emphasizes that a vector error correction (VEC) modeling should be estimated rather than a VAR as in a standard Granger causality test, if the variables in model are cointegrated. Following Granger (1988), to test for Granger causality in the long-run relationship, we employ a two step process: Once estimating the long-run model in Equation (1) in order to obtain the estimated residuals, the next step is to estimate error-correction based Granger causality models:

$$\Delta sp_t = \alpha_4 + \sum_{i=1}^{p4} \phi_{4i} \Delta sp_{t-i} + \sum_{j=1}^{q4} \beta_{4j} \Delta cp_{t-j} + \psi_1 ECT_{t-1} + \varepsilon_{4t} \quad (5.a)$$

$$\Delta cp_t = \alpha_5 + \sum_{i=1}^{p5} \phi_{5i} \Delta sp_{t-i} + \sum_{j=1}^{q5} \beta_{5j} \Delta cp_{t-j} + \psi_2 ECT_{t-1} + \varepsilon_{5t} \quad (5.b)$$

Residual terms, ε_{4t} and ε_{5t}, are independently and normally distributed with zero mean and constant variance. Although stock market prices and consumer prices variables are in natural logarithm, their first differences imply the growth rate in these variables that are stock market returns (Δsp) and inflation (Δcp).

The VEC modeling approach allows us to distinguish between "short-run" and "long-run" Granger causality. The Wald-tests of the "differenced" explanatory variables give us an indication of the "short-term" causal effects, whereas the "long-run" causal relationship is implied through the significance or other wise of the t test(s) of the lagged error-correction term that contains the long-term information since it is derived from the long-run cointegrating relationship. Nonsignificance or elimination of any of the "lagged error-correction terms" affects the implied long-run relationship and may be a violation of theory. The nonsignificance of any of the "differenced" variables that reflects only short-run relationship, however, does not involve such violations because; theory typically has little to say about short-term relationships (see Masih and Masih, 1996).

Rejecting the null hypotheses indicate that stock market returns (Δsp) does Granger cause inflation (Δcp), and Δcp does Granger cause Δsp, respectively. Using Equations (5.a) and (5.b), Granger causality can be examined in three ways (Lee and Chang, 2008):

1) Testing hypotheses, which are $H_0 : \beta_{4j} = 0$ for all *j* in equations (5.a) and $H_0 : \phi_{5i} = 0$ for all *i* in equations (5.b), are evaluated as Granger weak causality. Masih and Masih (1996) and Asafu-Adjaye (2000) interpreted the weak Granger causality as 'short run' causality in the sense that the dependent variable responds only to short-term shocks to the stochastic environment.

2) Masih and Masih (1996) point out that another possible source of causation is the *ECT* in equations. The coefficients of the *ECT*'s represent how fast deviations from the long run equilibrium are eliminated following changes in each variable. The long-run causality can be tested by looking at the significance of the *ECT* in equations. Thus, long-run causalities are examined by testing $H_0 : \psi_1 = 0$ and $H_0 : \psi_2 = 0$ for equations (5.a) and (5.b), respectively. For example ψ_1 is zero, stock prices does not respond to the deviations from the long-run equilibrium in the previous period. $\psi_i = 0$, $i = 1, 2$ for all *i* is equivalent to both Granger non-causality in the long-run and the weak exogeneity (Hatanaka, 1996).

3) Asafu-Adjaye (2000) emphasizes that the joint test of two sources of causation indicates which variable(s) bear the burden of short run adjustment to re-establish long run equilibrium, following a shock to the system. Lee and Chang (2008) referred it as a strong Granger causality test that are detected by testing $H_0 : \beta_{4j} = \psi_1 = 0$ and $H_0 : \phi_{5i} = \psi_2 = 0$ for all *j* and *i* in in equations (5.a) and (5.b), respectively.

4. Empirical Results

This study examines the long-run and causal relationships between stock market prices and consumer prices in Turkey. The bounds testing approach of cointegration is employed to investigate this relation by using quarterly data for 1987-2008 period. Optimal lags for the ARDL model may based on any information criterion. While the SIC suggests the ARDL (2,0) model, both AIC and HQIC recommend the ARDL (4,0) model. When the ARDL (2,0) is employed it has not passed diagnostic tests like the Lagrange multiplier (LM) test for serial correlation[1]. Therefore, we augmented the number of lags and employ the ARDL (4,0) model.

After selecting the ARDL model, we estimated the long-run coefficients with their asymptotic standard errors and VEC model. Table 1 presents the estimated model that has passed several diagnostic tests that indicate no evidence of serial correlation and heteroskedasticity. Besides this, the ADF unit root test for the residuals revealed that they are stationary. The bounds *F* –test for cointegration test yields evidence of a long-run relationship between stock market prices and consumer prices at 1% significance level in Turkey. The estimated *ECT* is also negative (-0.32) and statistically significant at 1% confidence level. *ECT* indicates that any deviation from the long-run equilibrium between stock market prices and consumer prices is corrected about 32% for each period.

Table 1. Estimated short-run and long-run coefficients from ARDL (4,0) model

Variables			**Short-Run**		**Long-Run**
sp(-1)			1.1015 [0.000]		
sp(-2)			-0.2566 [0.073]		
sp(-3)			0.3184 [0.814]		
sp(-4)			-0.1964 [0.040]		
cp			0.3379 [0.000]		1.0570 [0.000]
Constant			0.4179 [0.000]		1.3070 [0.000]
ECT					-0.3197 [0.000]
R^2	0.9960	RESET	0.307 [0.579]	HET	0.480 [0.489]
Adj. R^2	0.9958	NORM	1.084 [0.582]	ADF	-6.603 (-4.915)
SEE	0.1924	LM	6.624 [0.157]	F	8.8192

Notes:

SEE is the standard error of the regression.
RESET is Ramsey's specification test with a χ^2 distribution with only one degree of freedom.
NORM is a test for normality of residuals with a χ^2 distribution with two degrees of freedom.
LM is the Lagrange multiplier test for serial correlation with a χ^2 distribution with four degrees of freedom.
HET is test for heteroskedasticity with a χ^2 distribution with only one degree of freedom.
ADF is unit root test statistics for residuals and its %5 critical value is in ().
F is the ARDL cointegration test. The critical values for the lower *I*(0) and upper *I*(1) bounds are 5.157 and 5.917 for 1 % significance levels, respectively (Narayan, 2005, Appendix: Case II)

In addition, due to the structural changes in the Turkish economy it is likely that macroeconomic series may be subject to one or multiple structural breaks. For this purpose, the stability of the short-run and long-run coefficients are checked through the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests proposed by Brown *et al.* (1975). Unlike Chow test, the CUSUM and CUSUMQ tests are quite general tests for structural change in that

[1] All unreported results are available from the authors upon request.

they do not require a prior determination of where the structural break takes place. Figure 1 presents the plot of cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) test statistics that fall inside the critical bounds of 5% significance level. This implies that the estimated parameters are stable over the sample period. The estimated long-run coefficient of the consumer prices is about unity and positive. This means that an increase in consumer prices, also equivalent to inflation rate, raise the market return rate at the same proportion.

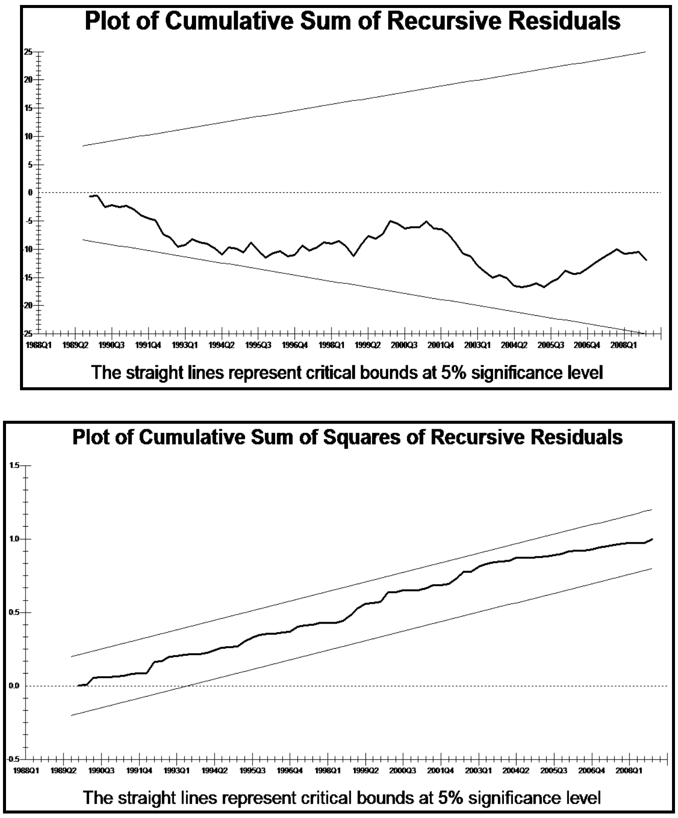

Figure 1. Plot of cusum of squares and cusum test

Finally, the existence of a cointegration relationship between stock market prices and consumer prices suggests that there must be Granger causality in at least one direction. In this study, we found that there is a strong evidence of unidirectional causality running from inflation to stock market returns in both short-run at 5% significance level and long-run at 1% significance level. In addition, we get the same result at 1% significance level when testing the strong Granger causality form (see Table 2).

Table 2. Granger causality test results

Short-run (or weak) Granger causality	
The null hypotheses	**F-statistics (p-values)**
$\Delta cp \rightarrow \Delta sp$	4.8590 (0.0305)
$\Delta sp \rightarrow \Delta cp$	0.4466 (0.5059)
Long-run Granger causality	
The null hypotheses	**F-statistics (p-values)**
$ECT \rightarrow \Delta sp$	9.1514 (0.0034)
$ECT \rightarrow \Delta cp$	0.1962 (0.6590)
Strong Granger causality	
The null hypotheses	**F-statistics (p-values)**
Δcp,ECT $\rightarrow \Delta sp$	7.8047 (0.0008)
$\Delta sp, ECT \rightarrow \Delta cp$	0.2382 (0.7886)

Notes: Δ is the first difference operator.
The null hypothesis is that there is no causal relationship between variables.

5. Concluding Remarks

The Fisher hypothesis has great importance for finance and economics literature. The Fisher hypothesis implies that there should be a one to one relationship between expected nominal stock market returns and expected inflation. Fisher hypothesis, therefore, predicts a positive homogeneous relationships of degree one between stock market return and inflation. However, in contrast to the Fisher hypothesis, most of the empirical evidence for developed economies suggests that the relationship between stock market returns and inflation is negative. These studies have rejected the one to one relationship between expected inflation and expected nominal returns.

This paper attempted to analyze the long-run and causal relationships between the stock market prices and consumer prices over the period of 1987-2008 in Turkey by using recently developed ARDL bounds testing approach of cointegration. The study also explores causal relationship between these variables in terms of the three error-correction based Granger causality models. The bounds *F*–test for cointegration test yields evidence of a long-run relationship between stock market prices and consumer prices at 1% significance level. The empirical results are as follows: i) The estimated long-run coefficient of the stock market prices and consumer prices is about unity and positive. ii) Any deviation from the long-run equilibrium between stock market prices and consumer prices is corrected about 32% for each period. iii) There is a strong evidence of unidirectional causality running from stock market returns to inflation in three types of Granger causality models.

The overall results support the generalized Fisher hypothesis which indicates that stocks offer a hedge against inflation. This could be explained by the significant relationship between money and inflation and by a possible positive relationship between inflation and output. Higher current inflation, therefore, may not necessarily be associated with expectations of lower future output (see Spyrou, 2004). There exists a high economic growth in the 1990s and 2000s in a high inflation environment in Turkish Case. Thus, it is possible that stocks are a good hedge against inflation in Turkey as predicted by theory.

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