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On the causality between stock prices and exchange rates: evidence from Turkish financial market

Abstract

The aim of this paper is to investigate the existence and direction of relationship between stock prices and exchange rates for Turkish financial market. Granger (1969) causality testing methodology was employed to reveal the nature of relationship between the two variables. This work contributes to the existing body of literature in the way that in Turkish financial market, there is a uni-directional causality running from stock prices to exchange rates using the daily observations for the sample period, which runs from February 23, 2001 to November 4, 2009. Also, the model used in this study extends the scope of exchange rate variables including a total of five currencies − US dollar, Euro, Japanese Yen, Pound Sterling, Swiss Franc and two baskets of currencies of Undersecretariat of Foreign Trade of Turkey. This evidence has implications for the policy makers and economic actors to perceive the movements in stock prices as a dynamic determinant, which may affect the success of their exchange rate policies.

Keywords: stock price, exchange rate, Augmented Dickey-Fuller test, Granger causality, Turkey.
JEL Classification: F31, C12.

Introduction

The nature of relationship between stock prices and exchange rates has been a subject of considerable attention among the numerous academicians and policy makers. Theoretical approaches on this issue reveal different results and bring different explanations about the link between the two variables. As stated in Stavarek, there is a theoretical consensus neither on the existence of relationship between stock prices and exchange rates nor on the direction of the relationship.

The causal relations between stock prices and exchange rates are explained by mainly two theoretical approaches (Granger, 2000). The first one is the traditional approach [argued also by Aggarwal (1981)]. In the case of a multinational firm, a change in exchange rate will change the value of that firm's foreign operation, which will be reflected on its balance sheet as a profit or a loss. Consequently, it contributes to current account imbalance. Once the profit or loss announced, that firm's stock price will change. In this approach, exchange rate change is expected to lead to a change in stock price. According to this argument, devaluation could either raise or lower a firm's stock price depending on whether that firm is an exporting firm or it is a heavy user of imported inputs[1]. Additionally, Adler and Dumas (1984) indicate that even firms whose entire operations are domestic in nature may be affected by exchange rates, if the movements in currency influence their input and output prices, and demand for their products.

The second theoretical basis is the portfolio approach. In this approach, changes in stock prices may influence movements in exchange rates via portfolio adjustments (inflows/outflows of foreign capital) (Tabak, 2006: 4). A decrease in stock prices causes a reduction in the wealth of domestic investors, which in turn leads to a lower demand for money with ensuing lower interest rates. The lower interest rates encourage capital outflows ceteris paribus, which in turn is the cause of currency depreciation. In this case, stock price is expected to lead exchange rate with a negative correlation [explained also by Krueger (1983)].

Before identifying the relationship between these two variables in Turkey, a good understanding of the relevant institutional context is required. The economic growth strategy of Turkey experienced a great transformation in the early 1980s. With the significant decisions taken in this period, many radical changes and structural reforms were realized to increase the economic efficiency and competitiveness, and to institutionalize the market-based economy approach. Since then, Turkey has adopted a liberal economic policy with a free market operating with the rules of demand and supply, free competition, and a liberalized foreign trade (Sayilgan et al., 2006). The main purpose of this policy is to establish a structural system enabling the determination of the foreign exchange rates by the market mechanism in Turkey. In this context, the Central Bank of Turkey determined the currencies on a daily basis as from 1981. With the ongoing structural reforms, the liberalization in foreign exchange rate and integration of Turkish financial system with the world economy continued increasingly.

Furthermore, Istanbul Stock Exchange was established in 1985 for the purpose of ensuring that secu-

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[1] Ma and Kao (1990) develop a view of causality in a wider perspective and explain the causality primarily by the export or import orientation of a country. They noted that for an import dominated country, the currency appreciation will lower import costs and generate a positive impact on the stock market. Conversely, for an export dominant country, the currency appreciation reduces the competitiveness of export markets and has a negative effect on the domestic stock market.

rities are traded in a secure and stable environment, and commenced to operate in 1986. ISE contributes to the development of Turkish capital markets and economy. Although the positive developments resulted from these reforms could not be sustained due to the sharp recessions and financial crises in 1994, 1999, and 2001, EU membership perspective contributes to economic predictability and supports Turkey's ongoing reform process in economic field.

The objective of this paper is to investigate causal relations between stock prices and exchange rates for Turkish financial market. The remainder of this paper is organized as follows. Section 1 highlights the previous studies and empirical evidence on the relation between stock prices and exchange rates. Section 2 discusses research design and defines the model as an empirical framework for investigating causal relationship between the two variables. Section 3 reports the econometric analysis and empirical results. The conclusions are presented in the last section.

1. Empirical evidence

To provide the empirical evidence on the relation between stock prices and exchange rates, a number of studies have been conducted for the past three decades. However, the empirical results are somewhat mixed as to the interactions or directions of causality between the two variables. The results of previous studies on the subject could be categorized into four main branches according. Most of the literature found a unidirectional causality from exchange rates to stock prices or from stock prices to exchange rates. Other empirical studies indicated two-way or bi-directional causality, or failed to find any relation between stock prices and exchange rates.

The first group of the studies displays the unicausality running from exchange rates to stock prices. Examining the relation between US stock market indexes and a trade-weighted value of the dollar for the period of 1974-78, Aggarwal (1981) finds that the stock prices and exchange rates are positively correlated. A change in exchange rate could alter stock prices of multinational firms directly and stock prices of the domestic firms indirectly. Donnelly and Sheey (1996), implying the direction of causality from exchange rates to stock prices, indicated that the full extent of UK stock market reaction to exchange rate movements takes several months to work through the share prices. According to Glaum et al. (2000), if parity changes are due to the changes in interest rates, as interest rate parity theory would predict, share prices may be affected because the market discounts the firms' future earnings streams with a different discount rate. The results of other empirical studies reveal one-way causality which runs from exchange rate to stock prices for India, Korea and Pakistan (Abdalla and Murinde, 1997), Korea (Granger et al., 2000), Singapore (Wu, 2000), South Korea and the Philippines (Ramasamy and Yeung, 2001), Sweden (Hatemi and Irandoust, (2002), India and Sri Lanka (Smyth and Nandha, 2003), Czech Republic, Poland and Hungary (Murinde and Poshakwale, 2004), Hong Kong, Japan, Malaysia, and Thailand (Pan et. al., 2007). The one-way causality, which runs from exchange rates to stock prices, supports the rationale of traditional approach.

The empirical results of the second category of literature reveal the unidirectional causality running from stock prices to exchange rates. Ajayi and Mougoue (1996) indicated that an increase in the aggregate domestic stock price has a negative short-run effect on domestic currency value. In the long run, however, increases in stock prices have a positive effect on domestic currency value. Ajayi et al. (1998), examining seven advanced markets and eight Asian emerging markets, find that stock and currency markets are well integrated in the advanced economies with the direction of causality running from stock returns to exchange rates[2]. Ramasamy and Yeung (2001) show that the direction of causality can vary according to the period of study and they also find that stock prices lead exchange rates for Malaysia, Singapore, Thailand, Taiwan and Japan. Similarly, Granger et al. (2000) found that, in addition to these countries except Japan and also for Philippines and Hong Kong, stock prices lead exchange rates to some extent. The nature of the causal relationships among stock prices and effective exchange rates in nine countries (Austria, France, Germany, UK, Czech Republic, Hungary, Poland, Slovakia and the United States) was investigated by Stavárek (2005) and it is found that causalities seem to be predominantly unidirectional, with the direction running from stock prices to exchange rates.

Some of the literature found a bi-directional causality between stock prices and exchange rates. Bahmani-Oskooee and Sohrabian (1992) concluded that there is a bi-directional causality between stock prices measured by S&P500 index and the effective exchange rate of dollar in the short run. Ramasamy and Yeung (2001) found a bi-causality between the two variables for Hong Kong. The results of Murinde and Poshakwale (2004) reveal mutually reinforcing interactions between exchange rates and

[2] Ajayi (1998) indicated that there is no consistent causal relationship between the stock and currency markets in the emerging economies while there exists a unidirectional causality in all the advanced economies. Similar results are also obtained by Stavárek (2005) who investigated the nature of the causal relationships between stock prices and effective exchange rates in four old EU member countries (Austria, France, Germany, and the UK), four new EU member countries (Czech Republic, Hungary, Poland, and Slovakia) and indicated that much stronger causality exists in countries with developed capital and foreign-exchange markets (i.e., old EU member countries and the United States).

stock prices for Czech Republic and Poland for the pre-Euro period (1995-1998). Tabak (2005), studying the dynamic relationship between these two variables in the Brazilian economy, found a linear Granger causality from stock prices to exchange rates in line with the portfolio approach and found an evidence of nonlinear Granger causality from exchange rates to stock prices in line with the traditional approach.

The last category of the papers contradicts the findings of studies and indicates no significant relationship between stock prices and exchange rates. Among them, Bahmani-Oskooee and Sohrabian (1992) found that there does not exist any long-run relationship between stock prices measured by S&P500 index and the effective exchange rate of dollar. Ajayi et al. (1998), examining seven advanced markets and eight Asian emerging markets, find that no consistent causal relations exist between stock and exchange rate markets in the case of emerging economies. Granger et al. (2000) found no relation between the stock and the exchange rate markets in Japan and Indonesia. The results of Nieh and Lie (2001) also show that there is no long-run significant relationship between stock prices and exchange rates for each G-7 country. Similarly, Smyth and Nandha (2003) examined the relationship between the two variables in Bangladesh, India, Pakistan and Sri Lanka and indicated that there is no long-run equilibrium relationship in any of the four countries. Their results also showed that exchange rates and stock prices are independent in Bangladesh and Pakistan. Morley (2002) indicates that there is less evidence of a stable short-run relationship between stock prices and exchange rates in Italy or France, whilst in Germany it appears to be unstable. Murinde and Poshakwale (2004) find that for the pre-Euro period (1995-1998), there is no interaction between stock prices and exchange rates in Hungary. Rahman and Uddin (2009) investigated the interactions between stock prices and exchange rates in three emerging countries of South Asia namely Bangladesh, India and Pakistan and indicated that there is no causal relationship between stock prices and exchange rates in the countries.

Apart from the above mentioned papers, it would be fruitful to mention the findings of Aydemir and Demirhan (2009) who examined how changes in exchange rates and stock prices are interrelated for Turkey using daily data from February 23, 2001 to January 11, 2008. National 100, services, financials, industrial, and technology indices are taken as stock price indices. The results of empirical study indicate that there is bi-directional causal relationship between exchange rate and all stock market indices. While the negative causality exists from national 100, services, financials and industrials indices to exchange rate (supporting portfolio balance approach), there is a positive causal relationship from technology indices to exchange rate. On the other hand, in their study a negative causal relationship from exchange rate to all stock market indices is determined.

This study departs from Aydemir and Demirhan (2009) in different ways. Firstly, this study uses Granger causality methodology to determine the relationship between SP and EX series while Aydemir and Demirhan (2009) use Toda-Yomamoto (TY) (1995) methodology. Secondly, this study analyzes a longer period running from February 23, 2001 to November 4, 2009 including a total of 2176 data into the model, and eventually, uses five different currencies and two different baskets of currencies instead of using one currency.

2. Data and research methodology

The data consist of daily observations of nominal effective exchange rates and stock price index. Since a sampling frequency less than one day may introduce spurious statistical significance into the causality tests, the daily data may be more desirable as noted in Granger (1969). The sample period runs from February 23, 2001 to November 4, 2009. The rationale for the starting date is that Turkey displayed a policy shift towards independently floating exchange rate regime since February 23, 2001. Therefore, this study with its covering period focuses on the correlation between two variables under the floating exchange rate regime.

Pair of 2176 data (exchange rates and stock price) in total was included in the analysis. The variables are obtained from the Istanbul Stock Exchange (ISE), Central Bank of Turkey (CBT) and Undersecretariat of Foreign Trade (UFT). Exchange rates included in the model consist of five currencies − US dollar (USD), Euro (EUR), Japanese Yen (JPY), Pound Sterling (GBP), Swiss Franc (CHF), and two baskets of currencies – UFT1 and UFT2 of Undersecretariat of Foreign Trade. In the calculations made by UFT considering the foreign trade data by the Countries, two different baskets of currencies are used as 1 Euro + 0.67 Dollar and 1 Euro + 0.25 Dollar consisting of the weightings of 60% Euro + 40% Dollar and 80% Euro + 20% Dollar, respectively.

Stock prices used in this study are represented by the closing ISE-100 stock price index, which contains 100 quoted firms selected by ISE based on the pre-determined criteria.

The research methodology consists of 3 phases. Since using non-stationary macroeconomic variables in time series analysis causes superiority problems in regression (Granger and Newbold, 1974), as

a first phase of the analysis, it was tested whether stock prices and exchange rates are integrated of order zero, *I* (0), that is whether SP_t and EX_t are stationary. This was achieved by performing Augmented Dickey-Fuller (ADF) test.

The Dickey-Fuller unit root test assumes the error terms are uncorrelated. In higher-order models and models where the error terms may be correlated, the ADF test is more appropriate (Ajayi and Mougoue, 1996). The ADF test is based on the regression (Stavárek, 2004),

$$\Delta y_t = \alpha + \beta_t + (\rho - 1)\, y_{t-1} + \sum_{t=1}^{k-1} \theta_t \Delta y_{t-1} + \varepsilon_t,$$

where $\Delta = 1 - Ly_t$ is a macroeconomic variable such as exchange rate or stock price; *t* is a trend variable; ε_t is a white noise term and *k* is the lagged values of y_t that are included to allow for serial correlation in the residuals. The null hypothesis is H_0: $\rho = 1$ and y_t is said to possess the unit root property if one fails to reject H_0. Table 1 reports the ADF test statistics under the null hypothesis of a unit root.

As Table 1 shows, the null hypothesis that SP and EX series contain unit roots cannot be rejected at the 1% significance level. ISE 100 Index, exchange rates (USD, EUR, JPY, GBP, CHF) and baskets of currencies (UFT1, UFT2) are non-stationary in the levels. Due to the lack of stationarity in variables, causality tests proceed with using the first difference version of the variables under study. ADF statistics strongly reject the null hypothesis of non-stationarity at the 1% level of significance after the variables have been first differenced. The first difference forms of variables are stationary as obviously seen in Table 1 [the variables are *I* (1) processes] and thus, these forms of variables were used in the analysis.

Table 1. ADF test results for SP and EX in the level and in the first difference

	Intercept	Trend-intercept	Intercept	Trend-intercept
USD	-3.5131 {0} (0.008)	-3.5642 {0} (0.033)	-45.964 {0} (0.0001)	-45.958 {0} (0.000)
EUR	-2.5248 {0} (0.109)	-3.433624 {0} (0.047)	-46.63710 {0} (0.0001)	-46.63061 {0} (0.000)
JPY	-2.359262 {0} (0.154)	-2.557178 {0} (0.301)	-47.02237 {0} (0.0001)	-47.01150 {0} (0.000)
GBP	-3.891569 {2} (0.002)	-3.566225 {2} (0.033)	-35.20058 {1} (0.000)	-35.24587 {1} (0.000)
CHF	-2.531237 {0} (0.108)	-3.159627 {0} (0.093)	-47.15793 {0} (0.0001)	-47.14887 {0} (0.000)
UFT-1	-3.152720 {0} (0.023)	-3.572167 {0} (0.032)	-46.50804 {0} (0.0001)	-46.50239 {0} (0.000)
UFT-2	-2.810613 {0} (0.057)	-3.511072 {0} (0.038)	-46.59715 {0} (0.0001)	-46.59111 {0} (0.000)
ISE 100 Index	-0.945187 {0} (0.774)	-1.801250 {0} (0.704)	-44.97504 {0} (0.0001)	-44.96479 {0} (0.000)

In addition to the need for testing the stationary property of the data, the Granger methodology is somewhat sensitive to the lag length used in the equations (Ramasamy and Yeung, 2001). Therefore, the second phase of this analysis focuses on the search for the optimum lag length, that produces the causality before applying Granger causality test. Table 2 indicates the optimum lag length between ISE 100 Index and USD as a sample, and the optimal lag lengths for all of exchange rates and baskets of currencies selected by different criteria are indicated in Table 3.

Table 2. Determination of the optimum lag length for USD

VAR Lag order selection criteria						
Endogenous variables: ISE USD						
Exogenous variables: C						
Date: 11/17/09 Time: 22:47						
Sample: 1 2176						
Included observations: 2167						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-11060.87	NA	93.18239	10.21031	10.21556	10.21223
1	-10856.01	409.1618	77.41448	10.02493	10.04066	10.03068
2	-10820.51	70.83189*	75.19641*	9.995858*	10.02207*	10.00544*
3	-10820.11	0.796007	75.44672	9.999181	10.03588	10.01260
4	-10818.04	4.130263	75.58097	10.00096	10.04815	10.01822
5	-10817.66	0.744488	75.83433	10.00431	10.06198	10.02540
6	-10815.04	5.207694	75.93101	10.00558	10.07374	10.03051
7	-10811.09	7.863460	75.93389	10.00562	10.08427	10.03438
8	-10808.13	5.869174	76.00698	10.00658	10.09571	10.03917

Notes: indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error. AIC: Akaike information criterion. SC: Schwarz information criterion. HQ: Hannan-Quinn information criterion.

Table 3. Optimal lag length between the ISE 100 Index and exchange rates

	FPE	AIC	SC	HQ
ISE-100 Index and USD	2	2	2	2
ISE-100 Index and EUR	2	2	2	2
ISE-100 Index and JPY	2	2	2	2
ISE-100 Index and GBP	2	2	2	2
ISE-100 Index and CHF	2	2	2	2
ISE-100 Index and UFT-1	2	2	2	2
ISE-100 Index and UFT-2	2	2	2	2

Table 3 indicates that optimal lag length between the ISE 100 and exchange rates is 2 days. A change in ISE 100 Index has an implication on exchange rates following the period of two days. This finding is the result of the T + 2 system (cash realization of stock exchange transactions following the period of two days) implementation. Hence, the finding indicates that in various regression models, 2 lagged data of ISE 100 (data of two days ago) could be used in the estimation of exchange rates as an independent variable.

All of the criteria (sequential modified LR test statistic, final prediction error, Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion) selected 2-lag length as an appropriate lag structure for both variables. After the determination of optimum lag length for the variables of exchange rate and stock price, Granger causality test was applied to investigate causality. Among the causality testing methods, the tests of Granger causality have been extensively used in nearly all of the studies focusing on the determination of causality between stock markets and exchange rates (see, for example, Bahmani-Oskooee and Sohrabian, 1992; Abdalla and Murinde, 1997; Ajayi et al., 1998; Wu 2000; Hatemi J. and Irandoust, 2002). It is the simplest and most straightforward method, but also the existence of causal ordering in Granger's sense points to a law of causation and implies predictability and exogeneity (Murinde and Poshakwale, 2004). Moreover, according to Hardouvelis (1988), Granger causality test performs well for small samples. Therefore, the methodology used in this study to investigate the causality between stock prices and exchange rates, is based on Granger (1969). Before introducing the econometric results, brief explanation of this method is provided below.

Granger causality test procedures involve estimating the following pairs of regressions (Hussain and Liew, 2004):

$$Y_t = a_0 + a_1 Y_{t-1} + \ + a_n Y_{t-n} + b_1 X_{t-1} + \ldots + b_m X_{t-m} + \quad (1),$$

$$X_t = c_0 + c_1 X_{t-1} + \ + c_n X_{t-n} + d_1 Y_{t-1} + \ + d_m Y_{t-m} + u_t \ (2),$$

where Y_t and X_t are two series (stock prices and exchange rates) undergoing test to determine their causal relationship, and coefficients a's, b's, c's and d's are constants to be estimated. e_t and u_t are two independent error terms. Two tests can be obtained from the above-written equations:

(i) If $H_{A(1)}$: $b_1 = b_2 = \ldots = b_m = 0$ is not rejected, then X does not cause Y. Otherwise, X causes Y.

(ii) If $H_{A(2)}$: $d_1 = d_2 = \ldots = d_m = 0$ is not rejected, then Y does not cause X. Otherwise, Y causes X.

In the context of this study, the hypotheses above can be interpreted as follows: for instance, X is the exchange rate and Y is the stock prices, then the first test analyzes the null hypothesis (1) that the exchange rate does not cause the stock index, and the second test analyzes the null hypothesis (2) that the stock index does not cause the exchange rate. Therefore, if we fail to reject the null hypothesis (1) and reject the hypothesis (2), then we can come to a conclusion that there is a causality which runs from stock prices to exchange rate.

To decide whether or not to reject the null hypothesis of the Granger causality test, Granger applies F test of overall significance, computed as:

$$F = [(RSS_R - RSS_{UR}) / m] / [RSS_{UR} / (T - k)],$$

where RSS_{UR} is the unrestricted residuals sum of squares from the estimated Equation (1) [or Equation (2)] and RSS_R is the restricted residuals sum of squares from the estimated Equation (1) [or Equation (2)] under the null hypothesis. F statistics follows F distribution with m and $(T - k)$ degrees of freedom, where m, k and T are, respectively, the number of restrictions, the number of regressors (including the constant term) in the right-hand side of Equation (1) or (2) and the sample size. If the computed F value exceeds the critical F value at chosen level of significance, the null hypothesis is rejected implying evidence of causality. Otherwise, the null hypothesis is not rejected implying causal relationship (Hussain and Liew, 2004). There are four possible outcomes of this Granger causality test:

1) Unidirectional causality from X to Y (denoted $X \rightarrow Y$) if $H_{A(1)}$ is rejected but $H_{A(2)}$ is not rejected.
2) Unidirectional causality from Y to X (denoted $Y \rightarrow X$) if $H_{A(2)}$ is rejected but $H_{A(1)}$ is not rejected.

3) Bi-directional or feedback causality (denoted $X \leftrightarrow Y$) if both $H_{A(1)}$ and $H_{A(2)}$ are rejected.
4) Y and X are independent if both $H_{A(1)}$ and $H_{A(2)}$ cannot be rejected.

The outcome of Granger causality test as to determine the interaction between the stock prices and exchange rates for the specified period in Turkey is indicated in Table 4.

Table 4. Results of Granger causality

ISE-USD Pairwise Granger causality tests			
Date: 11/17/09 Time: 23:12			
Sample: 1 2176			
Lags: 2			
Null hypothesis:	Obs	F-statistic	Probability
USD does not Granger cause ISE	2176	1.53467	0.21576
ISE does not Granger cause USD		258.594	2.E-101

ISE-EUR Pairwise Granger causality tests			
Date: 11/17/09 Time: 23:17			
Sample: 1 2176			
Lags: 2			
Null hypothesis:	Obs	F-statistic	Probability
EUR does not Granger cause ISE	2176	2.54987	0.07833
ISE does not Granger cause EUR		218.743	2.9E-87

ISE-JPY Pairwise Granger causality tests			
Date: 11/17/09 Time: 23:18			
Sample: 1 2176			
Lags: 2			
Null hypothesis:	Obs	F-statistic	Probability
JPY does not Granger cause ISE	2176	1.22891	0.29282
ISE does not Granger cause JPY		264.233	2.E-103

ISE-GBP Pairwise Granger causality tests			
Date: 11/17/09 Time: 23:19			
Sample: 1 2176			
Lags: 2			
Null hypothesis:	Obs	F-statistic	Probability
GBP does not Granger cause ISE	2176	1.09377	0.33514
ISE does not Granger cause GBP		201.314	6.4E-81

ISE- CHF Pairwise Granger causality tests			
Date: 11/17/09 Time: 23:20			
Sample: 1 2176			
Lags: 2			
Null hypothesis:	Obs	F-statistic	Probability
CHF does not Granger cause ISE	2176	2.51048	0.08147
ISE does not Granger cause CHF		256.469	1.E-100

ISE- UFT1 Pairwise Granger Causality tests			
Date: 11/17/09 Time: 23:21			
Sample: 1 2176			
Lags: 2			
Null hypothesis:	Obs	F-Statistic	Probability
UFT1 does not Granger cause ISE	2176	2.35839	0.09482
ISE does not Granger cause UFT1		262.595	8.E-103

ISE – UFT2 Pairwise Granger causality tests			
Date: 11/17/09 Time: 23:21			
Sample: 1 2176			
Lags: 2			
Null hypothesis:	Obs	F-statistic	Probability
UFT2 does not Granger cause ISE	2176	2.49212	0.08297
ISE does not Granger cause UFT2		242.763	7.3E-96

Table 4 shows that Granger causality test rejects both of the null hypotheses at the 5% significance level that exchange rates do not Granger cause stock prices and stock prices do not Granger cause exchange rates.

3. Empirical results

The methodology used in the analysis involves three phases. The first phase is to test the stationarity of variables by applying the ADF test. The results indicated that the series of stock prices and exchange rates are non-stationary in their levels, but stationary after first differencing. Therefore, the first differenced version of the series was used to determine the causal relationship. The second phase is to determine the optimum lag length. Based on the evidence provided by all of the criteria, the optimum number of lags is found to be 2. The last phase is to apply an Augmented Granger Causality test with appropriate lag to investigate the nature of relation between stock prices and exchange rates. The results presented in Table 4 represent an existence of uni-directional causality from stock prices to exchange rates. The uni-causality is summarized in the following table:

Table 5. Uni-causality from SP to EX

ISE → USD	2.E-101	A change in ISE 100 is reflected in US dollar as two days lagged. Hence, ISE 100 index is the result of a change in US Dollar. However, a change in US dollar is not a reason for a change in ISE 100 index.
ISE → EUR	2.9E-87	A change in ISE 100 is reflected in Euro as two days lagged. Hence, ISE 100 index is the result of a change in Euro. However, a change in Euro is not a reason for a change in ISE 100 index.
ISE → JPY	2.E-103	A change in ISE 100 is reflected in Japanese Yen as two days lagged. Hence, ISE 100 index is the result of a change in Japanese Yen. However, a change in Japanese Yen is not a reason for a change in ISE 100 index.
ISE → GBP	6.4E-81	A change in ISE 100 is reflected in Pound Sterling as two days lagged. Hence, ISE 100 index is the result of a change in Pound Sterling. However, a change in Pound Sterling is not a reason for a change in ISE 100 index.
ISE → CHF	1.E-100	A change in ISE 100 is reflected in Swiss Franc as two days lagged. Hence, ISE 100 index is the result of a change in Swiss Franc. However, a change in Swiss Franc is not a reason for a change in ISE 100 index.
ISE → UFT1	8.E-103	A change in ISE 100 is reflected in the basket of currency − UFT1 as two days lagged. Hence, ISE 100 index is the result of a change in UFT1. However, a change in UFT1 is not a reason for a change in ISE 100 index.
ISE → UFT2	7.3E-96	A change in ISE 100 is reflected in the basket of currency − UFT2 as two days lagged. Hence, ISE 100 index is the result of a change in UFT2. However, a change in UFT 2 is not a reason for a change in ISE 100 index.

This finding supports the results of Ajayi and Mougoue (1996), Ajayi et al. (1998), Ramasamy and Yeung (2001) Granger et al. (2000), Stavárek (2005). The one-way causality, which runs from stock prices to exchange rates, supports the rationale of portfolio approach. The findings of this study are not consistent with those of Aydemir and Demirhan (2009) which indicate that for Turkey there is bi-directional causal relationship between exchange rate and all stock market indices in their study.

Conclusion

Many studies have been carried out to provide the empirical evidence on the nature of relationship between stock prices and exchange rates. However, the empirical results are somewhat mixed as to the interactions or directions of causality between the two variables The results of existing body of literature on the subject could be categorized into four main branches. Most of the literature found a uni-directional causality from exchange rates to stock prices or from stock prices to exchange rates. Other empirical studies indicated two-way or bi-directional causality, or failed to find any relation between stock prices and exchange rates. It is worthwhile to note that the direction of causality seems to depend on specific characteristics of the country analyzed, the models used or the period of time selected.

The objective of this paper is to investigate causal relations between stock prices and exchange rates for Turkish financial market. The sample period runs from February 23, 2001 to November 4, 2009 and pair of 2176 data (exchange rates and stock prices) in total was included in the analysis. Exchange rates included in the model consist of five currencies − US dollar (USD), Euro (EUR), Japanese Yen (JPY), Pound Sterling (GBP), Swiss Franc (CHF), and two baskets of currencies – UFT1 and UFT2 of Undersecretariat of Foreign Trade. In the model, the stationarity of variables is tested by applying the ADF test, the optimum lag length is determined and finally, Augmented Granger Causality test is applied to determine the causality between the two variables.

This paper sheds light on the existence of causality between stock prices and exchange rates based on the daily observations of nominal effective exchange rates and stock price index in Turkey. The findings provide evidence to indicate a uni-directional causality running from stock prices to exchange rates for the Turkish stock and currency markets. This result supports the

arguments of Ajayi and Mougoue (1996), Ajayi et al. (1998), Ramasamy and Yeung (2001) Granger et al. (2000), and Stavárek (2005). The one-way causality, which runs from stock prices to exchange rates, supports the rationale of portfolio approach. This evidence has implications for the policy makers and economic actors to perceive the movements in stock prices as a dynamic determinant, which may affect the success of their exchange rate policies.

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