International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2017, 7(4), 603-607.

Granger Causality Between Exchange Rate and Stock Price: A Toda Yamamoto Approach

Sima Siami-Namini*

Department of Agricultural and Applied Economics, Texas Tech University, USA. *Email: sima.siami-namini@ttu.edu.

ABSTRACT

This research article attempts to examine the relationship between exchange rate (EX) and stock price using quarterly data of Iran on nominal EX, stock price index, liquidity and consumer price index covering the period of 1994:02 to 2010:01. It also investigates the long-run relationship between variables using Johansen and Juselius (1990) co-integration test and the short-run dynamic causal relationship by using Toda and Yamamoto (1995) procedure. Likewise, variance decompositions serve as tools for evaluating the dynamics interactions and strength of causal relations among variables in the system. The results show that there is no any significant evidence of a relationship between stock prices and EXs.

Keywords: Exchange Rates, Stock Prices, Johansen and Juselius Co-integration Test, Toda Yamamoto Causality Test
JEL Classifications: C32, E31, G15

1. INTRODUCTION

Here are a few reasons explaining why the relationship between exchanges rates and stock prices are important. First, it influences both monetary and fiscal policy decisions in response to the economic crisis. Second, to reduce investment risk, many investors diversify their funds between stock and foreign exchange markets. For example, for U.S. investors who own foreign stocks or stock funds, they are, in effect placing two bets: One on the stock itself and one on currency. The question is that how much of an impact does currency have on the total return in each foreign stock portfolio? Correspondingly, the value of the U.S. Dollar relative to developed markets has a cyclical pattern. While the falling U.S. Dollar has helped investments in foreign stocks over the last decade or so, there have been periods in the past where a rising U.S. Dollar has caused concern and substantial losses in many cases for foreign stocks (Forbes, 2012). Therefore, an accurate estimate of the linkage between exchange rates (EX) and stock prices is helpful in investment decision.

The theoretical explanations on whether exchanges rates Granger-cause the stock prices or vice versa have been attempted through the portfolio balance approach which is largely attributed to Branson (1972; 1976), McKinnon (1969), Dornbusch (1975), Branson et al. (1977; 1979), Girton and Henderson (1977) and Branson and Henderson (1985). Accordingly, a sharp rise in the real value of stock prices will lead to an appreciation in EXs due to an increase in the demand of local currency. On the other hand, an increase in the demand for money cause an increase in interest rates, and higher interest rates will cause capital inflows resulting in an appreciation of the domestic currency (Krueger, 1983). Subsequently, an increase in the EXs (depreciation) does cause a slight drop in output but overall, the relationship is positive and strengthens with time. This is consistent with a long-run relationship between the EX and the current account.

Empirically, there are several research studies that attempt to determine the impact of EXs on stock prices (Ibrahim, 2000). Some studies give evidence of positive effects of EXs on stock markets (Aggarwal, 1981), while others found negative effects (Soenen and Hennigar, 1988). Other studies concluded that the changes of EX have no significant impact on the stock market (Solnik, 1984).

Based on Granger causality approach, however, the studies of Giovannini and Jorion (1987), Solnik (1987) and Smith (1992) indicate that there is significant positive relationship between EXs and stock prices. On the other hand, the results of the studies of Muhammad and Rasheed (2002), Bhattacharya and Mukherjee (2003), Rahman and Uddin (2009) provided evidences of negative relationship between EXs and stock prices. The studies of Bahmani-Oskooee and Sohrabian (1992), Kumar (2010), Andreou et al. (2013) and Mozumder et al. (2015) established bidirectional relationship, while Abdalla and Murinde (1997), Kanas (2000), Mishra (2004), Morales (2008), Fedorova and Saleem (2010), Walid et al. (2011), Alagidede et al. (2011) and Bonga-Bonga and Hoveni (2013) indicated unidirectional relationship. Finally, the studies of Ong and Izan (1999), Phylaktis and Ravazzolo (2000), Nieh and Lee (2001), Smyth and Nandha (2003), Muhammad and Rasheed (2002), and Yau and Nieh (2006) concluded that there is no empirical relationship between EXs and stock prices.

For example, as a case study, Wu (2000) employed co-integration analysis to provide evidence that Singapore currency's appreciation against the U.S. Dollar and Malaysia ringgit and depreciation against the Japanese yen and Indonesian rupiah have positive long-run effects on stock prices. Hatemi and Irandoust (2002) used the Granger testing procedure developed by Toda and Yamamoto (1995) to analyze the relationship between stock prices and EXs in Sweden using monthly nominal effective EXs and stock prices covering the period 1993-98. They found that Granger causality is unidirectional and is running from stock prices to effective EXs. Khalid and Kawai (2003) as well as Ito and Yuko (2004), claimed that the linkage between the stock and currency markets helped propagate the Asian Financial Crisis in 1997.

This research article aims to investigate the relationship between EXs and stock prices using quarterly data of Iran over period 1994:02 to 2010:01. By employing Johansen's multivariate co-integration test, I will study the dynamic causal relationship between variables and examine the momentum of adjustment in the causal relationship through variance decompositions (VDCs). The contribution of this research article to the existing literature point out that there is no relationship between EXs and stock markets using Iran's data. The layout of this research article is as follows. Next section set out the data and methods used to investigate the relation between variables. Two next sections present empirical results and conclusion.

2. DATA AND METHODS

My dataset consists of quarterly data of Iran, covering the sample period from 1994:02 to 2010:01. The main data source for the analysis reported here is the Central Bank of Iran website. The variables include stock price index (SPI), consumer price index (CPI), liquidity (M2), and EX. All series are transformed into natural logarithm form.

I proceed to test the existence of co-integrating relations among the EX and stock price using the Johansen co-integration test and the short-run dynamic causal relationship by using Toda and Yamamoto (1995) procedure. Likewise, VDCs serve as tools for evaluating the dynamics interactions and strength of causal relations among variables in the system. As pointed out by Toda and Yamamoto (1995) and Zapata and Rambaldi (1997), the power of unit roots and co-integration test are very low against the alternative hypotheses of stationary. Then, Toda and Yamamoto causality method use for testing of causality between variables on asymptotic theory.

To apply Toda and Yamamoto causality method firstly, it is necessary to determine maximum order of integration of series say dmax; since Toda and Yamamoto method is valid for integrated and co-integrated variables. Secondly, it is necessary to determine optimal lag of vector auto-regression (VAR) model using Schwarz information criterion (SIC), say k. Thirdly it is necessary to estimate $(k + dmax)^{th}$ order of VAR model with seemingly unrelated regression. Lastly, the hypothesis is tested using a standard Wald statistic test which has an asymptotic Chi-square distribution with m degrees of freedom. Let consider the simple example of a bivariate model with k lag, based on the following equations:

$$Y_t = \alpha_y + \sum_{i=1}^{k+d} \theta_{y,i} X_{t-i} + \sum_{i=1}^{k+d} \vartheta_{y,i} Y_{t-i} + \varepsilon_{y,t} \quad (1)$$

$$Y_t = \alpha_x + \sum_{i=1}^{k+d} \theta_{x,i} X_{t-i} + \sum_{i=1}^{k+d} \vartheta_{x,i} Y_{t-i} + \varepsilon_{x,t} \quad (2)$$

Where K is the optimal lag order; d is the maximal order of integration of the series in the system and error terms $\varepsilon_{y,t}$ and $\varepsilon_{x,t}$ are assumed to be white noise. It needs to determine the maximal order of integration, and I then construct a VAR model in their levels with a total of (k + "d-max") lags. In equation Y; X "does not Granger-cause" Y if it is $\theta_{y,i} = 0$ for $i \leq k$ similarly, in equation X; Y "does not Granger-cause" X if it is $\vartheta_{x,i} = 0$ for $i \leq k$. Notice that the additional lags (d) are unrestricted. Their function is to ensure that the asymptotical critical values can be applied when test of causality between integrated variables are conducted, according to Toda and Yamamoto (1995). The zero restriction are tested by computing the modified Wald test statistic. This method is applicable whether the VAR's stationary, integrated of an arbitrary order, or co-integrated of an arbitrary order.

3. EMPIRICAL RESULTS

Before conducting any econometric analysis, the time series properties of the data must be investigated. This part of article, first conducts augmented Dickey–Fuller (1981) and Philip–Perron tests to establish the order of integration for SPI, CPI, liquidity (M2), and EX. Table 1 shows the results of the tests for presence of

Table 1: Unit root tests

Variables	ADF		PP	
	Levels	First difference	Levels	First difference
EX	−2.45	−3.65	−2.48	−7.67
SPI	−0.80	−3.77	−3.24	−7.80
M2	0.21	−7.70	−0.71	−27.07
CPI	−1.10	−3.99	−2.96	−3.67

EX: Exchange rate, SPI: Stock price index, CPI: Consumer price index, ADF: Augmented Dickey-Fuller PP: Philip–Perron a unit root in the levels and in the first differences. The results clearly do not provide evidence against the unit roots in the levels. Meanwhile, the test for a unit root in the first difference series indicated strong rejection of the null hypothesis in all series. Then, all data series are integrated of order one. So, the first difference of the data series of the variables is stationary.

We now employ Johansen's (1990) maximum likelihood method to examine whether the logarithms of variables included EX, SPI, liquidity, and CPI are co-integrated together in the long run. The Johansen tests are based on trace test and eigenvalues of transformations of the data and represent. Both trace test and eigenvalue test are based on pure unit root assumption. As can be seen in Table 2, there is a co-integrating relationship between the series. Results clearly reveal that there is a co-movement between all data series in this research article.

The existence of a long-run relationship between data series means that these variables are causally related at least one direction. Is change in EX causing change in stock price and vice versa, change in stock price causing change in EX? To answer this question, I implement the Engel and Granger (1987) non-causality test. I first determine the optimal order of the VAR Model. Table 3 presents optimal lag of VAR model using SIC, d = 2.

Then, I construct a VAR model in their levels with a total of 3 lags (d + k = 3, k = 1). Table 4 represents the Chi-square statistic and probability values constructed under the null hypothesis of non-causality. It can be observed that EX does not affect SPI and CPI, but affects liquidity. We have also observed that SPI does not affect EX and CPI, but affects liquidity. Therefore, the findings are consistent with the results of Smyth and Nandha (2003), Nieh and Lee (2001) and Bahamani-Oskooee and Sohrabian (1992), who did not find any significant evidence of a relationship between stock prices and EXs. The results show that liquidity does affect stock price and consumer price does affect liquidity at 5 percent significance level.

The VDCs of stock price and EX are presented in Table 5. It is useful in quantifying causal linkage between variables. Refer to the Table 5, through main diagonal, the extent to which a variable is exogenous explains most of its shock can be found; it then does not allow variances of other variables to contribute to it being explained. Obviously, in term of the own shock being explained, SPI itself and secondly the EX to lesser degree illustrates its relative exogeneity with over 85.38% and 68.55% of own variances being explained by their own innovations, respectively. Besides that, I also found that EX illustrates VDC of SPI with 10.83%, and SPI explains VDC of EX with 18.08%.

4. CONCLUSION

In this research article, I explored the association between EX, stock price, liquidity and CPI using a quarterly data of Iran for the

Table 2: Johansen and Juselius Co-integration test

Based on maximal Eigenvalue of the stochastic matrix				Based on trace of the stochastic matrix			
Null	Alternative	Statistics	95% critical value	Null	Alternative	Statistics	95% critical value
r=0	r=1	86.35	28.27	r=0	r≥1	159.31	53.48
r≤1	r=2	41.50	22.04	r≤1	r≥2	72.96	34.87
r≤2	r=3	19.33	15.87	r≤2	r≥3	31.46	20.18
r≤3	r=4	12.13	9.16	r≤3	r≥4	12.13	9.16

Table 3: Selecting the optimal order of the VAR model

LL	AIC	SIC	Order
656.45	492.45	329.35	10
617.37	469.37	322.19	9
588.19	456.19	324.92	8
554.72	438.72	323.36	7
524.38	424.38	324.93	6
511.26	427.26	343.72	5
493.08	425.08	357.45	4
473.72	421.72	370.00	3
445.74	409.74	373.93*	2
393.19	373.19	353.30	1
31.91	27.91	23.93	0

VAR: Vector auto-regression

Table 4: Test for Granger-causality applying the Toda and Yamamoto (1995)

Dependent variable	Independent variable			
	SPI	EX	M2	CPI
SPI	-	3.1502 (0.3690)	53.6521 (0.0000)	6.2738 (0.0990)
EX	0.7168 (0.8692)	-	4.1310 (0.2477)	6.5802 (0.0866)
M2	24.8285 (0.0000)	13.2823 (0.0041)	-	29.7986 (0.0000)
CPI	6.5927 (0.0861)	2.7889 (0.4253)	1.6828 (0.6408)	-

SPI: Stock price index, EX: Exchange rate, CPI: Consumer price index

Table 5: VDC

EX	CPI	M2	SPI	SE	Period
VDC of SPI					
0.000000	0.000000	0.000000	100.0000	0.118067	1
2.948291	0.305632	0.860974	95.88510	0.191988	2
3.442654	0.237737	1.478969	94.84064	0.230452	3
2.981586	0.199551	1.795269	95.02359	0.252059	4
2.701484	0.178827	2.083117	95.03657	0.267147	5
2.758031	0.180904	2.341900	94.71917	0.278288	6
3.110861	0.201643	2.583401	94.10410	0.286853	7
3.686322	0.229615	2.773519	93.31054	0.293621	8
4.391920	0.257576	2.929352	92.42115	0.299218	9
5.150790	0.280556	3.047401	91.52125	0.303889	10
5.913748	0.296629	3.141613	90.64801	0.307850	11
6.652013	0.305875	3.213105	89.82901	0.311202	12
7.349635	0.309786	3.270600	89.06998	0.314061	13
7.998616	0.310055	3.315869	88.37546	0.316492	14
8.595781	0.308246	3.353890	87.74208	0.318570	15
9.140709	0.305539	3.385855	87.16790	0.320342	16
9.634464	0.302741	3.414464	86.64833	0.321860	17
10.07899	0.300343	3.440400	86.18027	0.323161	18
10.47676	0.298585	3.465136	85.75952	0.324278	19
10.83059	0.297546	3.489052	85.38281	0.325240	20
VDC of EX					
79.41878	15.57185	0.572140	4.437228	0.050953	1
80.11894	11.83364	5.239986	2.807436	0.069379	2
83.01011	10.37235	4.250277	2.365464	0.077377	3
82.52462	9.753245	4.788860	2.933270	0.083985	4
82.79785	9.478312	4.357713	3.366128	0.089292	5
81.34700	9.288724	4.603406	4.760866	0.094276	6
80.67007	9.219251	4.397980	5.712698	0.097925	7
79.12110	9.175666	4.479627	7.223612	0.101293	8
78.00962	9.191504	4.362990	8.435889	0.103867	9
76.53039	9.207613	4.369545	9.892456	0.106225	10
75.36246	9.246897	4.287901	11.10274	0.108054	11
74.09065	9.278050	4.256637	12.37466	0.109690	12
73.05103	9.315574	4.190207	13.44319	0.110974	13
72.03550	9.343708	4.144172	14.47662	0.112094	14
71.20245	9.370987	4.089314	15.33725	0.112974	15
70.44610	9.390282	4.044291	16.11933	0.113719	16
69.83343	9.406448	4.003602	16.75652	0.114300	17
69.30860	9.416787	3.970386	17.30423	0.114778	18
68.89323	9.423935	3.947797	17.73504	0.115146	19
68.55565	9.427257	3.933138	18.08396	0.115437	20

VDC: Variance decomposition

period of 1994:02 to 2010:01. First, I applied unit root tests to find the stationary of time series. The results show that all the series are integrated of order one, I (1). Second, I applied Johansen procedure to test for the possibility of a co-integrated relationship between time series. The findings show that there is a co-integrating relationship between variables. Then I test Granger's causality applying the Toda and Yamamoto procedure to investigate the empirical relationship between stock price and EX. Accordingly, I did not find any significant evidence of a relationship between stock prices and EXs using Iran's data. Therefore, the findings are consistent with the results of Smyth and Nandha (2003), Nieh and Lee (2001), and Bahamani-Oskooee and Sohrabian (1992), who did not find any significant evidence of a relationship between stock prices and EXs.

The VDC showed the same results. Obviously, in term of the own shock being explained, SPI itself and secondly the EX to lesser degree illustrates its relative exogeneity with over 85.38% and 68.55% of own variances being explained by their own innovations. Also, EX illustrates VDC of SPI with 10.83%, and SPI explains VDC of EX with 18.08%.

REFERENCES

Abdalla, I.S., Murinde, V. (1997), Exchange rate and stock price interactions in emerging financial markets: Evidence on India, Korea, Pakistan and the Philippines. Applied Financial Economics, 7, 25-35.

Aggarwal, R. (1981), Exchange rates and stock prices: A study of the US capital markets under floating exchange rates. Akron Business and Economic Review, 12, 7-12.

Alagidede, P., Panagiotidis, T., Zhang, X. (2011), Causal relationship between stock prices and exchange rates. The Journal of International Trade and Economic Development, 20 (1), 67-86.

Andreou, E., Matsi, M., Savvides, A. (2013), Stock and foreign exchange market linkages in emerging economies. Journal of International Financial Markets, Institutions and Money, 27, 248-268.

Bahmani-Oskooee, M., Sohrabian, A. (1992), Stock prices and the effective exchange rate of the dollar. Applied Economics, 24, 459-464.

Bhattacharya, B., Mukherjee, J. (2003), Causal Relationship between Stock Market and Exchange Rate, Foreign Exchange Reserves and Value of Trade Balance: A Case Study for India. Article Presented at the Fifth Annual Conference on Money and Finance in the Indian Economy.

Bonga-Bonga, L., Hoveni, J. (2013), Volatility spillovers between the equity market and foreign exchange market in South Africa in the 1995-2010 period. South African Journal of Economics, 81 (2), 260-274.

Branson, W.H. (1972), Macroeconomic Equilibrium with Portfolio Balance in Open Economies. IIES Seminar Paper No. 22.

Branson, W.H. (1976), Asset Markets and Relative Prices in Exchange Rate Determination. IIES Seminar Paper No. 66.

Branson, W.H., Halttunen, H., Masson, P. (1977), Exchange rates in the short run: The Dollar-Deutschemark rate. European Economic Review, 10, 303-324.

Branson, W.H., Halttunen, H., Masson, P. (1979), Exchange rates in the short run: Some further results. European Economic Review, 12, 395-402.

Branson, W.H., Henderson, D.W. (1985), The specification and influence of asset markets. In: Jones, R.W., Kenen, P.B., editors. Handbook of International Finance 2. International Monetary Economics and Finance. Amsterdam, North Holland: Elsevier.

Dickey, D.A., Fuller, W.A. (1981), Likelihood ratio statistics for the autoregressive time series with a unit root. Econometrica, 49, 1057-1072.

Dornbusch, R. (1975), A portfolio balance model of the open economy. Journal of Monetary Economics, 1, 3-20.

Engle, R.F., Granger, C.W. (1987), Co-integration and error correction: Representation, estimation and testing. Econometrica, 55, 251-276.

Fedorova, E., Saleem, K. (2010), Volatility spillovers between stock and currency markets: Evidence from emerging Eastern Europe. Czech Journal of Economics and Finance, 60 (6), 519-533.

Forbes. (2012). Currency's Impact on Your Portfolio: Five Things You Need to Know Now.

Giovannini, A., Jorion, P. (1987), Interest rates and risk Premia in the stock market and in the foreign exchange Market. Journal of International Money and Finance, 6, 107-124.

Girton, L., Henderson, D.W. (1977), Central bank operations in foreign and domestic assets under fixed and flexible exchange rates. In: Clark, P., Logue, D., Sweeney, R., editors. The Effects of Exchange Rate Adjustments. Washington, DC: U.S. Government Printing Office.

Granger, C.W.J., Huang, B., Yang, C.W. (2000), A bivariate causality between stock prices and exchange rates: Evidence from recent Asian flu. The Quarterly Review of Economics and Finance, 40, 337-354.

Hatemi, J.A., Irandoust, M. (2002), On the causality between exchange rates and stock prices: A note. Bulletin of Economic Research, 54, 197-203.

Ibrahim, M.H. (2000), Co-integration and Granger causality tests of stock prices and exchange rates interactions in Malaysia. ASEAN Economic Bulletin, 17, 36-47.

Ito, T., Yuko, H. (2004), High-Frequency Contagion between the Exchange Rates and Stock Prices. NBER Working Article No. 10448.

Johansen, S., Juselius, K. (1990), Maximum likelihood estimation and inference on co-integration with application to the demand for money. Oxford Bulletin of Economics and Statistics, 52, 169-210.

Kanas, A. (2000), Volatility spillovers between stock returns and exchange rate changes: International evidence. Journal of Business Finance and Accounting, 27 (3-4), 447-467.

Khalid, A.M., Kawai, M. (2003), Was financial market contagion the source of economic crisis in Asia? Evidence using a multivariate VAR model. Journal of Asian Economics, 14, 131-156.

Krueger, A.O. (1983), Exchange-Rate Determination. Cambridge: Cambridge University Press.

Kumar, M. (2010), Causal relationship between stock price and exchange rate: Evidence from India. International Journal of Economic Policy in Emerging Economies, 3(1), 85-101.

McKinnon, R. (1969), Portfolio balance and international payments adjustment. In: Mundell, R.A., Swoboda, A., editors. Monetary Problems of the International Economy. Chicago: University of Chicago Press.

Mishra, A.K. (2004), Stock market and foreign exchange market in India: Are they related? South Asia Economic Journal, 5 (2), 209-232.

Morales, L.N. (2008), Volatility spillovers between equity and currency markets: Evidence from major Latin American countries. Latin American Journal of Economics-Formerly Cuadernos de Economía, 45 (132), 185-215.

Mozumder, N., Vita, G., Kyaw, K.S., Larkin, C. (2015), Volatility spillover between stock prices and exchange rates: New evidence across the recent financial crisis period. Economic Issues, 20 (1), 43-64.

Muhammad, N., Rasheed, A. (2002), Stock Prices and Exchange Rates: Are they Related? Evidence from South Asian Countries. Article Presented at the 18th Annual General Meeting and Conference of the Pakistan Society of Development Economists.

Nieh, C.C., Lee, C.F. (2001), Dynamic relationship between stock prices and exchange rates for G-7 countries. The Quarterly Review of Economics and Finance, 41, 477-490.

Ong, L.L., Izan, H.Y. (1999), Stock and currencies: Are they related? Applied Financial Economics, 9 (5), 523-532.

Phylaktis, K., Ravazzolo, F. (2002), Measuring financial and economic integration with equity prices in emerging markets. Journal of International Money and Finance, 21(6), 879-903. Available from: <http://www.sciencedirect.com/science/journal/02615606>.

Rahman, L., Uddin, J. (2009), Dynamic relationship between stock prices and exchange rates: Evidence from three South Asian countries. International Business Research, 2 (2), 167-174.

Smith, C. (1992), Stock markets and the exchange rate: A multi-country approach. Journal of Macroeconomics, 14, 607-629.

Smyth, R., Nandha, M. (2003), Bivariate causality between exchange rates and stock prices in South Asia. Applied Economic Letters, 10 (11), 699-704.

Soenen, L.A., Hennigar, E.S. (1988), An analysis of exchange rates and stock prices: The US experience between 1980 and 1986. Akron Business and Economic Review, 19, 7-16.

Solnik, B.H. (1987), Using financial prices to test exchange rate models: A note. Journal of Finance, 42 (1), 141-149.

Solnik, B.H. (1984), Stock and money variables: The international evidence. Financial Analyst Journal, 40, 69-73.

Toda, H.Y., Yamamoto, T. (1995), Statistical inference in vector auto-regressions with possibly integrated processes. Journal of Econometrics, 66, 225-250.

Walid, C., Chaker, A., Masood, O., Fry, J. (2011), Stock market volatility and exchange rates in emerging countries: A Markov-state switching approach. Emerging Markets Review, 12 (3), 272-292.

Wu, Y. (2000), Stock prices and exchange rates in a VEC model: The case of Singapore in the1990s. Journal of Economic and Finance, 24 (3), 260-274.

Yau, H., Nieh, C.C. (2006), Interrelations among stock prices of Taiwan and Japan and NTD/Yen exchange rate. Journal of Asian Economics, 17, 535-552.

Zapata, H., Rambaldi, A. (1997), Monte Carlo evidence on co-integration and causation. Oxford Bulletin of Economics and Statistics, 59, 285-298.