THE RELATIONSHIP BETWEEN EXCHANGE RATES AND STOCK PRICES: THE CASE OF MEXICO

Gopalan Kutty[1]

Mansfield University, USA

E-mail:gkutty@mansfield.edu

ABSTRACT

This paper examines the relationship between stock prices and exchange rates in Mexico. The Granger causality test shows that stock prices lead exchange rates in the short run, and there is no long run relationship between these two variables. This finding corroborates the results of Bahmani-Oskooee and Sohrabian's (1992) conclusion, but contradicts the findings of other studies which reported a long term relationship between exchange rates and stock prices.

Keywords: Exchange rates; cointegration; stock prices

JEL: C52, F31

---

[1] Gopalan Kutty is a professor at the Department of Business & Economics Mansfield University, Mansfield, PA 16933, Telephone: 570-662-4516.

I. INTRODUCTION

Knowledge of the factors that influence the behavior of stock prices and exchange rates has attracted the attention of economists, policy makers, and the investment community for a long time. This is especially noteworthy since 1973 when the many countries in the world adopted freely floating (or managed floating) rate systems. There has been a never ending debate with regard to the desirable degree of flexibility in the exchange rate objectives in determining the monetary policy of a country. Proponents of the freely floating exchange rate system argue that foreign exchange rates should be determined by market forces. This argument is based on the assumption that in a perfect market, free of intervention by governments or monetary authorities, markets can allocate resources efficiently and determine nominal exchange rates. However, this is only achievable if markets are free of distortions. Whenever there are distortions like sticky prices, monetary authorities may target exchange rates to correct current account deficits. Therefore, it is safe to say that exchange rates are like prices of any other asset and are determined by expectations regarding future interest differentials between courtiers, current account deficits, the external debt, terms of trade, interest rate differential , and economic and political conditions. It is also important to identify at this point the factors that influence the behavior of stock prices. Movements in the daily stock prices are influenced by Gross Domestic Product (GDP), employment, interest rates, corporate performance exchange rates, trade balance, inflation, money supply, productivity rates and others.

Understanding the relationship between exchange rates and stock prices is important from the point of view of policy makers, and the investment community in this changing global environment. Currency is quite often included as an asset in the portfolio held by mutual funds, hedge funds and other professionally managed portfolios, and knowledge of the relationship between exchange rates and stock prices may enable the manger to manage risk efficiently. Furthermore, in the globally intertwined economy, in which there are little or few barriers to the flow of capital, has created investment opportunities for multinational corporations in developing and transition countries. This has, in turn created a need to understand the link between exchange rates and stock prices to hedge the portfolio risk. A large body of literature examines the relationship between stock prices and foreign exchange rates in developed as well as developing countries. However, there is no settled opinion with regard to the relationship between these variables. Controversy exists among economists and policy makers as to whether stock prices influence exchange rates or vice versa. This controversy makes the study of exchange rates and stock prices interesting and challenging.

II. THE THEORY

Economic theory postulates that interest rates, inflation, price level, and money supply and other factors are important variables in understanding the behavior of stock prices and predicting the trends and movements in exchange rates. Traditional economic models argue that changes in exchange rates affect balance sheet items of a firm through its competitiveness as expressed in foreign currency and ultimately, profits and equity. Branson and Masson (1977), Ghartey (1998), Meese and Rogoff (1983), and Wolff (1988) have found some relationship between macroeconomic variables and exchange rates. Furthermore, firms operating outside the sovereign boundaries of a nation face three different types of exposure, namely: operating exposure, transaction exposure, and translation exposure. Transaction exposure arises when international transactions denominated in a foreign currency are settled thereby resulting in gains and losses; translation exposure (also called accounting exposure) is the result of translating foreign currency denominated financial transaction into consolidated financial statements often expressed in the parent country's currency; economic exposure or operating exposure is the result of a change in the exchange rates.

There are basically two theories that link exchange rates and stock prices: The traditional approach argues that currency depreciation will result in higher exports and therefore corporate profits resulting in higher stock prices in the short run. The transmission mechanism according to this approach is the competitiveness of the firm's exports, resulting in changes in the value of the firm's assets and liabilities culminating in higher profits and reflecting its stock prices. This relationship is attributed to Solnick (1987). He argued that a real currency appreciation is a bad news for domestic corporation, because it will reduce its competitive ability to export, while a real depreciation enhances its ability to export in the short run.

Another theoretical argument in the relationship between stock prices and exchange rates is the portfolio adjustment approach. According to this theory, portfolio adjustments [movements in the foreign capital- inflows and outflows of foreign capital] occur whenever there is a change in the stock prices. If stock prices are on the increase, they will attract more foreign capital. However, a decline in the stock prices will result in diminished corporate wealth leading to the reduction in the country's wealth. This may lead to a fall in the demand for money and monetary authorities reduce the interest rates to alleviate this situation. When interest rates are lower (relatively speaking), capital may flow out of the country to take advantage of higher interest rates in other part of the world resulting in currency depreciation. Therefore, according to this theory, lower stock prices may lead to currency depreciation.

In examining the relationship between stock prices and exchange rates, we are confronted with the question regarding whether changes in the stock prices affect exchange rates or vice versa. We approach this question by using Granger (1969) causality tests. This model is quite simple and has been used extensively in applied economic research. Further, we make use of unit roots and cointegration tests to establish or refute the long-run relationship between stock prices and exchange rates.

The paper is organized as follows: section three is devoted to literature review, the model is presented in section four, empirical evidence is presented in section five and finally concluding remarks are presented in section six.

III. LITERATURE REVIEW

Several studies attempted to investigate the interaction between stock prices and exchange rates in the industrialized countries and emerging financial markets. However, the results of some of these studies are inconclusive. A BVAR model was employed by Abdalla and Murinde (1997) to examine the stock price interaction with exchange rates in four countries. They concluded that exchange rates Granger cause stock prices to change in India, Pakistan and Korea. However, they did not find any relationship between stock prices and exchange rates in the Philippines. Sjaastad and Scacciavillani (1996) found that when commodities that are traded internationally, a change in any exchange rate will result a change in the prices of those commodities. Solnick (1987) reported a weak positive relationship between changes in the stock returns and changes in the real exchange rates. Giovannini and Jordan (1987) conclude that *ex ante* returns and exchange rates tend to move together in the U.S.A. Chiang's (1991) study shows evidence that excess returns in the foreign exchange market are correlated with equity market returns. The study conducted by Ong and Izan (1999) shows that there is a weak relationship between exchange rates and stock prices in Australia and the Group of Seven countries. Bahmani-Oskooee and Sohrabian (1992) reported no long term relationship between stock prices and exchanges rates in the U.S.A. However, they reported a short term relationship between these two variables using Granger causality tests. The Ong and Izan (1999) examined the relationship between spot and 90-day forward exchange rates for G-7 countries and Australia and reported no significant relationship between equity prices and exchange rates. Stavarek (2004) reported unidirectional causality running from stock prices to exchange rates, and Tabak (2006) showed that a stock prices lead exchange rates with a negative relationship.

Academic textbooks often link macroeconomic variables and other fundamentals such as money supply, interest rates, and inflation to predict movements in stock prices and exchange rates. Studies conducted by Baillie and Selover (1987), Wolff (1988), and Ghartry (1998) found significant relationships between exchange rates and some of the macroeconomic variables. The Meese and Rogoff (1983) studies reported certain relationship between exchange rates and macroeconomic variables. Ajay and Mougoue (1996) investigated the relationship between stock market and foreign exchange market for Indonesia and Philippines. They reported that causality runs from the stock market to the currency market. However, they found no causal relationship between stock market and exchange market in Hong Kong, Thailand, Malaysia and Singapore. Nieh and Lee (2001) also reported no long run significant relationship between stock prices and exchange rates in G-7 countries, corroborating the findings of Ong and Izan (1999).

The relationship between stock prices and exchange rates examined by various authors in the past two decades reported mixed results and in some cases results are inconclusive. Furthermore, the direction of the influence between stock prices and exchange rates are far from settled. In this paper we will examine the relationship between stock prices and exchange rates in Mexico. To my knowledge this is the first study that addresses the relationship between these two variables.

IV. THE DATA

The stock index data for this study is obtained from Dow Jones News/Retrieval provided by Dow Jones. It consists of weekly closing of Bolsa, Mexico's equity index, a market capitalization weighted index of the leading 35-40 stocks. Mexican Peso per US dollar starting from the first week of January 1989 to the last week of December 2006 was obtained from the International Monetary Market. After eliminating some of the incompatible data, a total of 849 data points were generated.

V. THE MODEL

A. Unit roots

Many econometric studies published in the academic literature have suggested cointegration models to examine the long run relationships between macro economic variables. However, some economists also suggested specifying the regression with levels of economic variables rather than the difference. According to Plosser and Schwert (1978),when time series regression are computed using levels of economic variables, they may produce strong relationships with high R^2, but when the same model use differences in the variables, the relationships become negligible. Further, Granger and Newbold (1974), showed that when the time series variables are nonstationary, using levels may result in non constant mean over time and residuals which are highly autocorrelated with low Durbin-Watson statistics. For this reason Granger and Newbold (1974) recommended using difference of each variables until each variable is stationary before running the regression. Furthermore, as pointed out by Plosser and Schwert (1978) in an undifferenced regression, the disturbance term is nonstationary and is not well behaved. For this reason, they argue that with most economic time series it is better to work with the differenced economic data rather than data in levels. Madddala (1992) argues for the need for regression with differenced data rather than regressions with data in levels.

For the reasons discussed earlier, one has to exercise care when using data in levels rather than the differences. Griffiths, Hill and Carter (1993) argue that "The usual statistical properties of least squares hold *only* when the time series variables involved are stationary," and therefore, according to them nonstationary series has to be differenced before performing econometric analysis. In this study we use the Augmented Dickey Fuller Test ADF (1981) to test unit roots. Schwert (1989) suggested that the ADF with long lags is superior to other models. Accordingly, the general specification of the model can be as stated as follows:

$$\Delta y_t = \alpha + (1 - \emptyset) y_{t-1} + \gamma_t + \sum_{i=1}^{p} \beta_i \, \Delta y_{t-i} + \varepsilon_t \qquad (1)$$

where Δ is the first difference operator. For the purpose of this study, we define SP to be the stock price index of Mexico, and EX to be the exchange rate. Hence, the ADF test is based on the following formulation:

$\Delta SP_t = \alpha_o + (1-\lambda_1)SP_{t-1} + \gamma_{1t} + \sum_{i=1}^{p} \alpha_i \Delta SP_{t-1} + \varepsilon_{1t}$ (2)

$\Delta EX_t = \beta_o + (1-\lambda_2)EX_{t-1} + \gamma_{2t} + \sum_{i=1}^{n} \beta_i \Delta EX_{t-1} + \varepsilon_{2t}$ (3)

Where $\Delta SP_t = SP_t - SP_{t-1}$ and

$\Delta EX_t = EX_t - EX_{t-1}$

where α_o, α_i, λ_1,λ_2, γ_1, γ_2, β_o, β_i are coefficients, and ε_{1t}, ε_{2t} are white noise terms. The null hypothesis for ADF test is stipulated that for H_o: $\lambda_1 = \lambda_2 = 0$ with the alternative hypothesis $H_a: -2 < \lambda_1 < 0$; and $H_a: -2 < \lambda_2 < 0$ for equation (2) and (3) respectively. The null hypothesis will be rejected if the t-statistics are less than the critical value. It is quite possible that we may fail to reject the H_o of unit root because of the low power of the unit root tests. However, Kwiatkowaski et al (1992) recommended a test in which the null hypothesis is stationary and the alternative hypothesis is a unit root. The test is stated as follows:

KPSS = $\frac{1}{T^2} \sum_{t=1}^{T} S_t^2 / S^2 L$ (4)

where KPSS is the Kwiatkowski, Phillips, Schmidt, and Shin test

$S^2 = \frac{1}{T} \sum_{t=1}^{T} e_t^2 + \frac{2}{T} \sum_{s=1}^{L} (1 - s/L+1) + \sum_{t=i+1}^{T} e_t\, e_{t-s}$ (5)

$S_t = \sum_{i=1}^{t} e_i$

B. Co-integration

Co-integration is a technique used to study the existence of an equilibrium relationship between two variables. Two or more time series may be individually non-stationary, but some linear combination of the variables under consideration, share prices and exchange rates may have time invariant properties and hence may be co-integrated. According to Banerjee et al (1994) "a series is said to be integrated if it accumulates past effects; such a series is non-stationary because its future path depends upon all such past influences, and is not tied to some mean to which it must eventually return." Following Engle and Granger (1987) we ran the following regression:

$SP_t = \alpha + \beta_1 EX_t + \eta_{1t}$ (6)

$EX_t = \beta_o + \beta_2 SP_t + \eta_{2t}$ (7)

We then estimate

$\Delta\hat{\eta}_t = a_1 \hat{\eta}_{t-1} + \sum_{i-1}^{n} a_{i+1} \Delta\hat{\eta}_{t-j} + \epsilon_t$ (8)

for both residuals η_{it} and η_{2t}. If -2 < a_1 < 0, then we conclude that the residuals are stationary and SP_t and FX_t are co-integrated, CI(1).

C. The Vector Autoregressive model and causality tests

In order to study the relationship between the two variables in our study, we have to examine whether changes in the stock prices cause exchange rates to change and vice versa. In this study we use VAR model to test the linear causality between stock prices and exchange rates. Equations (9) and (10) can be used if there is no co-integration between stock prices and exchange rates.

$$\Delta SP_t = \beta_o + \sum_{i=1}^{p} \beta_{1i}\, \Delta SP_{t-1} + \sum_{i=1}^{p} \beta_{2i}\, \Delta EX_{t-1} + \epsilon_{st} \qquad (9)$$

$$\Delta EX_t = \delta_o + \sum_{i=1}^{p} \delta_{1i}\, \Delta SP_{t-1} + \sum_{i=1}^{p} \delta_{2i}\, \Delta EX_{t-1} + \epsilon_{ft} \qquad (10)$$

Granger offered four definitions of causality in terms of the exchange rate to stock prices (EX → SP); stock prices to exchange rate (SP→ EX); independence between stock prices and exchange rates (SP ↔ EX); and feedback causality between exchange rate and stock prices.

If the stock prices and exchange rates are co-integrated, then the vector auto regressive model should include an error correction term which can be stated as follows:

$$\Delta SP_t = \beta_o + \varphi_1 (SP_{t-1} - \xi ER_{t-1}) + \sum_{i=1}^{p} \beta_{1i}\, \Delta SP_{t-1} + \sum_{i=1}^{p} \beta_{2i}\, \Delta EX_{t-1} + \epsilon_{st} \qquad (11)$$

$$\Delta EX_t = \delta_o + \varphi_2 (SP_{t-1} - \xi ER_{t-1}) + \sum_{i=1}^{p} \delta_{1i}\, \Delta SP_{t-1} + \sum_{i=1}^{p} \delta_{2i}\, \Delta EX_{t-1} + \epsilon_{ft} \qquad (12)$$

The error correction term φ_1, and φ_2, represents the previous periods disequilibrium between $SP_{t-1} - \xi ER_{t-1}$.

VI. EMPIRICAL RESULTS

The Augmented Dickey Fuller test for unit root and KPSS test for stationarity are presented in Table 1. The null hypothesis (H_o) is that both series SP_t and EX_t contain a unit against the alternative hypothesis that both variables are stationary. A large negative value

Table 1. Unit Root and Stationarity Test Results

Variable	ADF	KPSS
EX_t	-1.6832 (1)	0.02
SP_t	-2.027 (1)	0.05
ΔEX_t	-7.136*(1)	0.03
ΔSP_t	-6.313* (1)	0.06

Notes: The critical values for ADF are 5% = -2.86; 1% = -3.43. (Fuller 1976, page 373). The number of lags for ADF are given in parenthesis. * Significant at 1% level.

of ADF test statistics will lead to the rejection of the null hypothesis. As we can see from Table 1, the H_o that the time series EX_t and SP_t has a unit root cannot rejected. However, the null hypothesis of a unit root is rejected after the variables have been first differenced. The results are consistent with most economic business time series, indicating that the series are far from stationary I(1) when expressing in their original measurement.

We have examined whether stock prices cause exchange rates to change or vice versa. Prior to applying Granger causality tests we have selected the appropriate lag length for stock prices and exchange rates using Bayesian Schwarz information criteria into the causality model (equation 9 and 10). The optimum lag length for testing the Granger causality test from stock prices to exchange rates ($SP \rightarrow EX$) is seven for the stock prices and four for the exchange rates. The number of optimum lags for testing causality from exchange rates to stock prices is three for exchange rates and two for stock prices The results are reported in Table 2.

Table 2. Linear Causality tests for Stock Index and Exchange Rates

	Exchange rates cause stock prices ($ER \rightarrow SP$)	Stock prices cause exchange rates ($SP \rightarrow ER$)
Lag length	n_1=7 and n_2=4	n_1=3 and n_2=2
Dependent Variable	ΔSP_t	ΔEX_t
Constant	0.0051 (0.798)	2.581 (3.112)
ΔSP_{t-1}	-1.176 (-1.261)	13.563 (3.89)*
ΔSP_{t-2}	-0.271 (-0.893)	1.115 (1.231)
ΔSP_{t-3}	-0.615 (-0.831)	
ΔSP_{t-4}	0.711 (1.801)	
ΔEX_{t-1}	1.518	0.749

	(1.154)	(0.987)
ΔEX_{t-2}	-1.209	0.0565
	(-0.866)	(1.078)
ΔEX_{t-3}	1.872	-1.632
	(1.512)	(-1.187)
ΔEX_{t-4}	-1.982	
	(-1.182)	
ΔEX_{t-5}	0.2067	
	(0.948)	
ΔEX_{t-6}	-1.265	
	(-1.822)	
ΔEX_{t-7}	0.3448	
	(1.098)	

Notes: t-values in parenthesis; SP, EX and Δ are defined earlier. * significant at 1%.

Table 3. Estimation Result of Error Correction Model for Stock Index and Exchange Rates

Stock Index	β_o	φ_1	$\beta_{11}(1)$ ΔSP_{t-1}	$\beta_{11}(2)$ ΔSP_{t-2}	β_{21} (1) ΔEX_{t-1}	$\beta_{21}(2)$ ΔEX_{t-2}	F-stat
ΔSP	-6.53 (-1.31)	-0.22 (-1.61)	-0.89 (-4.98)*	-0.33 (-2.01)**	0.78 (2.77)**	0.55 (1.31)	8.76*
Exchange Rate	δ_o	φ_2	$\delta_{11}^{(1)}$ ΔSP_{t-1}	$\delta_{11}^{(2)}$ ΔSP_{t-2}	$\delta_{21}^{(1)}$ ΔEX_{t-1}	$\delta_{21}^{(2)}$ ΔEX_{t-2}	F-stat
ΔEX	-0.99 (-0.45)	-0.09 (-1.09)	-0.21 (-0.87)	-0.53 (-1.51)	-0.07 (-1.22)	-0.11 (-1.01)	1.53

*Significant at 1% level; ** significant at 5% level.

As can be seen from Table 2, stock prices cause exchange rates to change, in other words, there is only unidirectional causality. Further, the unidirectional causality is confined to only to one time lag, suggesting that the influence is instantaneous, and there is no long term causality. In Table 3, the short run relationship between exchange rates and stock prices can be captured by examining coefficients of β_{21} and δ_{11}. The long run disequilibrium coefficients φ_1, and φ_2 are not statistically significant, suggesting that there is no co-movement between stock prices and exchange rates. As can be seen from the t-statistics of coefficients β_{11}(1), β_{11}(2), β_{21} (1) , we may tend to argue that there are short turn co-movements between stock prices and exchanges but it is confined to a maximum of two lag length.

VII. CONCLUSION

The empirical evidence reported in this paper shows that there is some short run relationship between stock prices and exchange rates. The Granger causality tests reveals that stock prices lead exchange rates in the short run, and there is no long run relationship between these two financial variables. One of the practical implication of this study is that policy makers of the Mexican economy should be cautious in implementing or taking stock market regulation/or policies since it has short term implication on exchange rates. This study corroborates the finding of Bahmani et al (1992), and Nieh and Lee (2001) of no long term relationship between stock prices and exchange rates. However, this study supports the findings of Abdalla and Murinde (1997), who concluded that stock prices Granger influence exchange rates.

REFERENCES

1. Abdalla, I.S.A., and V. Murinde (1977) Exchange rate and stock price interactions in emerging financial markets: evidence of India, Korea, Pakistan and Philippines, *Applied Financial Economics*, 7, 25-35.
2. Ajay, R. A., and M. Mougoue (1996) On the dynamic relation between stock prices and exchange rates, *Journal of Financial Research*, 2, 193-207.
3. Bahmani-Oskooee, M., and A. Sohrabiab (1992) Stock prices and the effective exchange rate of the dollar, *Applied Economics*, 24, 459-464.
4. Baillie, R.T., and D.D. Selover (1987) Cointegration and model of exchange rate determination, *International Journal of Forecasting*, 3, 43-51.
5. Banerjee, A., J.J. Dolado, J.W. Galbraith, and D.F. Hendry (1993) *Co-Integration, Error Correction, and the Econometric Analysis of Non-Stationary Data,* (Oxford University Press, Oxford), 136-137.
6. Branson, W. H., and P. Masson (1977) Exchange Rate in the short run: the Dollar Deutsche mark rate, *European Economic Review*, 10, 303-324.

7. Chiang , T.C. (1991) International asset pricing and equity market risk, *Journal of International Money and Finance*, 10, 349-364.
8. Dickey, D.A., and W.A. Fuller (1981) Likelihood ratio statistics for autoregressive time series with a unit root, *Econometrica*, 49, 1057-1072.
9. Engle, R., and C. Granger (1987) Co-integration and error representation, estimation and testing, Econometrica, 55, 251-267.
10. Fuller, W. (1976) *Introduction to Statistical Time Series*, (Wiley, New York), 376.
11. Ghartey, E.E. (1988) Monetary Dynamics in Ghana: evidence from cointegration, error correction modeling, and exogeneity, *Journal of Development Economics,* 60, 203-233.
12. Giovannini, A., and P. Jordan (1987) Interest rates and stock premia in the stock market and in the foreign exchange market, *Journal of International Money and Finance*, 88, 829-853.
13. Granger, C. W. (1969) Investigating causal relations by econometric models and cross-spectral methods, *Econometrica*, 37, 424-439.
14. Granger, C.W.J., and P. Newbold (1974) Spurious regressions in econometrics, *Journal of Econometrics* , 2, 111-120
15. Griffiths, William E., Hill Carter E., and George G. Judge (1993) *Learning and Practicing Econometrics*, (John Wiley, New York), 695-702.
16. Kwiatkowski, D., P.C.B. Phillips, P. Schmidt, and Y. Shin (1992) Testing the null hypothesis of stationarity against the alternative of unit root, *Journal of Econometrics*, 54, 159-178
17. Meese, R.A., and K. Rogoff (1983) Empirical exchange rate models of the seventies: are any fit to survive? *Journal of International Economics*, 14, 3-24.
18. Nieh, C., and C. Lee (2001) Dynamic relationship between stock prices and exchange rate for G7 countries, *Quarterly Review of Economics and Finance*, 41, 477-490.
19. Ong, L.L., and H.Y. Izan (1999) Stock and currencies: are they related? *Applied Financial Economics*, 9, 523-532.
20. Plosser, Charles I., and William Schwert. (1978) Money, Income, and Sunspots: Measuring Economic Relationships and the Effect of Differencing, *Journal of Monetary Economics*, 4, 637-660.
21. Schwert, G.W. (1989) Tests for unit roots: A Monte Carlo investigation, *Journal of Business and Economic Statistics*, 7, 147-159.
22. Sjaastad, L. and F. Sacciavillani (1996) The price of gold and the exchange rates, *Journal of International Money and Finance*, 15, 879-897.
23. Solnik, B. (1987) Using financial prices to test exchange rate models: a note, *Journal of Finance*, 42, 141-149.
24. Stavarek, D. (2004) Stock prices and exchange rates in the EU and the USA: Evidence of mutual interactions, *Journal of Economics and Finance*, 55, 141-161.

25. Tabak, B.M. (2006) The dynamic relationship between stock prices and exchange rates: evidence for brazil, *International Journal of Theoretical and Applied Finance*, 9, 1377-1396
26. Wolff, C.C.P. (1988) Exchange rates, innovations and forecasting, *Journal of International Money and Finance*, 7, 49-61.

Acknowledgement

I would like to thank Emmanuel Anoruo and Chiaku Chukwuogor for helpful comments and suggestions on an earlier version of the paper.