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EXCHANGE RATE AND EQUITY PRICE RELATIONSHIP: EMPIRICAL EVIDENCE FROM MEXICAN AND CANADIAN MARKETS

Sekhar M. Amba, New York Institute of Technology
Binh H. Nguyen, New York Institute of Technology

ABSTRACT

This paper examines the relationship between stock prices and exchange rates in Mexican and Canadian Markets using weekly data from Jan 2013 to December 2018. Cointegration, Vector Error Correction model, Vector Auto Regression model and Granger causality tests are used to examine the long-term relationship and casual relationship between exchange rates and stock prices. Johansen cointegration tests confirm the insignificant existence of long-run relationships between stock prices and exchange rates in Canadian and Mexican markets. However, the Granger causality test confirms the existence of short-run unidirectional causal relationship from exchange rates to stock prices in the Mexican market.

JEL: G150

KEYWORDS: Exchange Rates, Stock Prices, Cointegration, Canada, Mexico

INTRODUCTION

The nexus between exchange rates and stock return has drawn the attention of economists for theoretical reasons as they influence developing country's economy. This relationships between exchange rates and stock returns are used in forecasting future trends by investors as well as multinational firms. The interactions between stock prices and exchange rates are important for many reasons. First, it may affect the monetary and fiscal policy decisions. According to Gavin (1989) a bullish stock market has a positive impact on aggregate demand and if this demand is large, it will neutralize impact of the policies such as monetary policies targeting interest rates and or fiscal policies targeting real exchange rates. Second, the knowledge of relationship between these markets would guide multinational corporations in managing foreign markets exposure and hedging currency risk, further help investment fund managers in managing their investment portfolio risk and returns. Lastly, the understanding of the stock price-exchange rate relationship may prove helpful to foresee a crisis, helping policy makers to take preventive action before the spread of a crisis.

According to Statistics Canada, in year 2018 Canada imported 51 CAD billions worth of goods of which US alone contributes to 33 CAD billons and Mexico contributes to 2 CAD billions, when it comes to imports it stands at 49 CAD billions of which 36 CAD billions imports from US and 1 CAD billion imports from Mexico. Pertaining to Canada's Foreign Direct Investment (FDI), grew by 13.0 USD billions in Dec 2018, as compared to an increase of $6.8 billions in the previous quarter. Canada's Direct Investment Abroad rose by 10.1 USD billions in Dec 2018. Mexico's FDI increased by 4.5 USD billions in Dec 2018, compared with an increase of 5.4 USD billions in the previous quarter and Mexico's Direct Investment Abroad expanded by 394.0 USD millions in Dec 2018. Its FDI increased by 7.2 USD billions in Jun 2018 (CEIC, 2019). These trade interactions between the countries affect stock prices which is directly propositional to public wealth. An increase in stock prices increases domestic public wealth, thus increases

demand for money hence put upward pressure on interest rates. This attracts international investment in country economy resulting in appreciation of domestic currency rates. However, decrease in stock prices would result in reduction of domestic wealth hence decrease demand for money and lower interest rates resulting in capital outflows contributing to currency depreciation. Tabak (2006) states stock prices affects exchange rates under the portfolio approach. Khalid and Kawai (2003), Ito and Yuko (2004) claim that the link between the stock and currency markets helped propagate the Asian Financial Crisis in 1997. According to Aggarwal (1981) and Ma and Kao (1990), a change in exchange rates has two implications on stock prices: a direct effect through multinational firms involved in exports impacting demand for its products in international markets reflecting in its balance sheet as profit and loss and an indirect effect through domestic firms affecting its stock prices.

If stock prices and exchange rates are interrelated and if exchange rates cause stock prices, then the stock markets crisis can be prevented by regulating the exchange rates. On the other hand, if the causation runs from stock prices to exchange rates then governments can focus on domestic economic policies to stabilise the stock market. If the two markets/prices are related, then investors can use this information to predict the behaviour of one market using the information on other market. This exchange rates/stock prices interaction has become important again from the view point of large cross border movement of funds due to portfolio of investments in stock funds and not due to actual trade flows, but indirectly as trade flows having some impact on stock prices of the companies whose main sources of revenue comes from foreign markets. As Canada and Mexico both follow "floating exchange system", this paper examines the relationship between exchange rates and stock prices and between Canadian and Mexican markets. The remaining part of this paper is organized as lliterature review, data and methodology, empirical results, summary and conclusions.

LITERATURE REVIEW

Empirical research on relationship between exchange rates and stock prices for both fixed exchange rate and flexible exchange rate regime has provided contradictory results. Research conducted by Smith (1992); Solnik (1987), Aggarwal (1981), Phylaktis and Ravazzolo (2005) have noted positive relationship between exchange rates and stock prices which are statistically significant, on the contrary Soenen and Hennigar (1998), Tsai (2012) observed a significant negative relationship between the two variables. Another interesting research by Franck and Young (1972); Bartov and Bodnar (1994) reported a very weak or no association between stock prices and exchange rates. Interestingly on the issue of causation Abdalla and Murinde (1997) revealed causation runs from exchange rates to stock prices while Ajayi and Mougou (1996) reported a reverse causation where as Bahmani-Oskooee and Sohrabian (1992) research revealed short-run bi-directional causality between stock prices and exchange rates but not in the long-run.

Kim (2003) analyzed the relationship between stock and foreign exchange markets in the U.S. from 1974 to 1998 adopting the multivariate cointegration and error correction model; results showed that stock prices and exchange rates, are negatively correlated. Ibrahim and Aziz (2003) used monthly data of stock prices, exchange rates, and money supply in Malaysia from 1977 to 1998 found that the relation between stock and foreign exchange markets is negative. Granger et al. (2000) investigated the relationship between stock and foreign exchange markets of nine Asian countries during the Asian financial crisis. They found that foreign exchange market has an impact on the stock market in Japan and Thailand; stock market impacts foreign exchange market in Taiwan; the relationship is bidirectional in Indonesia, South Korea, Malaysia, and the Philippines; and that no such relation exists in Singapore. Doong et al. (2005) used the data in six Asian countries and found there is no long-term cointegration in these markets. Pan et al. (2007) found that the relationship between stock and foreign exchange markets in Asian differs depending on countries and time (before or after the Asian financial crisis).

Gopalan (2010) who examined relationship between exchange rates of Peso per USD and stock prices in Mexican capital market using weekly data from January 1989 to December 2006 employing Granger

Causality test found no long-run relationship between these two variables but concludes stock prices lead exchange rates in the short-run. Delgado et al. (2018) examining relationship between oil prices, exchange rates, and stock prices in Mexican economy found that exchange rate has significant negative relationship on stock market index. Alzyoud et al. (2018) who researched on dynamics of Canadian oil prices and its impact on exchange rate and stock prices using monthly data for the period 1980 to 2015 found that change in stock market returns does not cause change in exchange rates, concluding no cause and effect between stock return and exchange rate. Gupta, Chevalier and Fran (2000) who examined causal relationship between interest rates, exchange rates and stock prices in emerging market Indonesia using data for five-year period from 1993 to 1997 found a weak unidirectional causality from exchange rate to stock prices. Kumar (2008), examined relationship between stock prices, exchange rates and inflation in Indian capital market using daily data from 3rd July 1998 to 14th March 2008 employing cointegration methodology, did not find either long-term or short-term relationship among these variables.

Ravazzolo and Phylaktis (2000) studied the long-run and short-run dynamics between stock prices and exchange rates in a group of Pacific Basin countries for the period 1980 to 1998, found that stock prices and exchange rates are positively related when US stock market act as a conduit. They also found that 1997 Asian financial crisis had a temporary effect on the long-run co-movement of exchange rates and stock prices in these markets. Gundiiz and Hatemi (2004) examined the causality between the exchange rates and stock prices in the Middle East and North Africa Region before and after Asian financial crisis for the period 1996 – 2000 found mixed results. They found unidirectional Granger causality from exchange rate and stock prices for Israel and Morocco before and after the Asian financial crisis, and for Jordan only after the crisis. But the causality runs from stock prices to exchange rates for Turkey after the Asian financial crisis and did not find any support for causal relationship between these two variables for Egypt.

According to Stavarek (2005) there exists a stronger causality with developed capital and foreign exchange markets in Austria, France, Germany, UK and US than the new EU countries Czech Republic, Hungary, Poland, and Slovakia. His research also observed stronger relations applying real effective exchange rate than nominal effective exchange rate. Murinde and Poshakwale (2004) who conducted research in capital markets, Hungary, Czech Republic and Poland. They used daily observations during 2/1/1995 - 31/12/1998 for the pre-Euro period and 1/1/1999 - 31/12/2003 for the Euro period before and after adoption of Euro by employing bivariate vector autoregressive model found that stock prices unidirectionally Granger-cause exchange rates in Hungary during pre-Euro period but bidirectional causality found in Czech Republic and Poland. However, their research found high degree of positive correlations among all three markets during Euro period.

DATA AND METHODOLOGY

The data for this research consists of weekly closing stock market indices: S&P/TSX composite index representing 247 companies of Canadian stock market, and Mexican Bolsa IPC Index representing 35 companies the Mexican stock market. Variables SPTSX represents Canadian stock market, S&P/TSX Composite Index, MEXBOL represents Mexican stock market Index Mexican Bolsa IPC, CAD represents Canadian dollar per USD and PESO represents Mexican Peso per USD. All data sets were extracted from Bloomberg database for the period January 2013 to December 2018. Many econometric studies published in the academic literature advocated employing cointegration models to examine long run and short run relationships between macro-economic variables. According to Nelson and Plosser (1982) it is often necessary to test nonstationary of the data series before carrying out a cointegration test. Johansen and Juselius (1990) multivariate cointegration approach, Vector error correction model (VECM), and Vector auto regression (VAR) model have been used to investigate the dynamic linkages between the variables.

First, we used Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979, 1981) to test the presence of unit roots of the variables with the equation of ADF test as follows:

$$\Delta y_t = \alpha + (\rho - 1) y_{t-1} + \sum_{i=1}^{k-1} \theta_i \Delta y_{t-i} + e_t \quad (1)$$

where y_t is the share price / exchange rate, Δ is the first difference operator and e_t is residual term. The null hypothesis is that the variable has unit root which we fail to reject when ADF statistic less than tabulated circle values meaning that the series are stationary (Culver and Papell, 1997). Therefore, Phillips-Perron (PP) test (Phillips and Perron, 1988) has been used to detect the presence of unit root. The Philips-Perron (PP) unit root test differs from ADF tests, how they deal with serial correlation and heteroscedasticity in the errors. ADF tests use a parametric regression to approximate ARMA structure of the error in the regression, PP test correct this bias induced by auto correlation. PP tests tend to be more powerful than the ADF tests, but PP test can severe with size distortions and sensitive to model misspecifications. To overcome size distortions KPSS (Kwiatkowski, Phillips, Schmidt, and Shin) test (1992) can be used to test for presence of unit root. Contrary to ADF and PP tests, KPSS tests the presence of unit root is not the null hypothesis but alternative. Once the variables lnCAD, lnPESO, lnSPTSX and lnMEXBOL are tested for stationarity at I (1), Johanson and Juselius cointegration methodology developed by Johansen (1991) and Johansen (1995) is used in order to test the long run relationship and short-term dynamics between the time series and the variables (Kennedy, 2003). According to Johansen (1988), a *p*-dimensional vector autoregression (VAR) of order *k* can be specified as follows:

$$\Delta y_t = \alpha + \Pi_k y_{t-k} + \sum_{i-1}^{k-1} \theta_i \Delta y_{t-i} + e_t \quad (2)$$

Here Δ is the first difference operator, $\prod$ and θ are m by m matrices of unknown parameters and e_t is a Gaussian error term. Long-run information about the relationship between exchange rates and stock prices is contained in the impact matrix Π. Upon identifying presence of cointegration vector, VECM is used to analyze long term lead-lag relationship among variables exchange rates and stock prices. The VECM model formulated by Granger (1988) is as follows:

$$\Delta Y = \alpha + \beta \Delta X + \gamma \upsilon_{t-1} + e_t \quad (3)$$

where υ_{t-1} is the co-integration error, which can be written as:

$$\upsilon_{t-1} = Y_{t-1} - \delta_0 - \delta_1 X_{t-1} \quad (4)$$

The equation shows the change of X to Y in the long term, which would be balanced by a previous error. The ΔX value describes the X variable as a short-term "error." If γ is significant, then the coefficients become an adjustment to fluctuations in relationships between long-term variables. If $\upsilon_{t-1} > 0$, then the model is not in a balanced situation because the variable Y_{t-1} has a value above its equilibrium value. To return to equilibrium, the y value is expected to be negative. So, if the value of $\gamma\, \upsilon_{t-1} < 0$, the value of $\Delta Y<0$ will return to its equilibrium. When the value of Y_t is above its equilibrium, then in the next period it will decline to correct the "errors" that occurred. Conversely, if $\upsilon_{t-1} < 0$, then Y is below the equilibrium and the γ value can expected to be negative, so that the value of $\gamma\, \upsilon_{t-1} > 0$ and $\Delta Y > 0$. In the absence of cointegration vector VAR model is used to test causal relationship between the variables exchange rates and stock prices.

$$Y_t = \sum_{i=1}^{n} \alpha_i X_{t-i} + \sum_{j=1}^{n} \beta_j Y_{t-j} + u_{1t} \quad (5)$$

$$X_t = \sum_{i=1}^{n} \lambda_i X_{t-i} + \sum_{j=1}^{n} \delta_j Y_{t-j} + u_{2t} \quad (6)$$

Based on the two regression equations above, it was assumed that u_{1t} and u_{2t} do not have a relationship. So, the equation produced four possible relationships that can occur based on the coefficient value, as follows: 1) Causality unidirectional from X to Y, if $\sum \alpha \neq 0$ and $\sum \delta = 0$, 2) Causality unidirectional from Y to X, if $\sum \alpha = 0$ and $\sum \delta \neq 0$, 3) Causality bilateral, if $\sum \alpha \neq 0$ and $\sum \delta \neq 0$, and 4) No causality or independent if $\sum \alpha = 0$ and $\sum \delta = 0$.

EMPIRICAL RESULTS

Table 1 represent descriptive statistics of the variables used in this research paper. Each variable has 313 observations that corresponds to number of weeks analyzed in this paper. Table indicates minimum CAD/USD is 0.985, maximum 1.454 representing 48% depreciation of CAD against USD where PESO against USD depreciated 79% during the period of observation Jan. 2013 to Dec. 2018. The minimum value of SPTSX 11995.66 was noticed at 6/21/2013 whereas maximum value 16561.12 was noticed on7/13/2018 representing a 38% growth in Canadian stock market where as MEXBOL highest value 51564.62 was observed on 7/12/2017 minimum of 37950.97 was noticed on 3/14/2014 representing a growth of 36% during the period of observation of this study.

Table 1: Descriptive Statistics

	CAD/USD	PESO/USD	MEXBOL	SPTSX
Mean	1.222	16.458	45,033	14,512
Median	1.268	17.244	44,888	14,726
Maximum	1.454	21.584	51,565	16,561
Minimum	0.9847	12.073	37,951	11,996
Std. Dev.	0.1179	2.770	3,094.6	1163.8
Skewness	-0.5512	-0.1611	0.0906	-0.3662
Kurtosis	1.876	1.524	2.145	2.101
Jarque-Bera	32.336	29.754	9.970	17.536
Probability	0.00	0.00	0.01	0.00
Sum	382.607	5,151.4	14,095,170	4,542,156
Sum Sq. Dev.	4.340	2,393.6	0.0000	0.0000
Observations	313	313	313	313

This table shows descriptive statistics of the data used in this research.

Table 2 represent correlation matrix among the variables under consideration in this research. There is a moderate positive correlation exists between exchange rates and stock prices in both markets Canada and Mexico which are significant at 1% level.

Table 2: Correlation Matrix

Variable	CAD/USD	SPTSX	PESO/CAD	MEXBOL
CAD/USD	1.00	--	--	--
SPTSX	0.46**	1.00	--	--
PESO/CAD	0.91**	0.57**	1.00	--
MEXBOL	0.53**	0.68**	0.66**	1.00

This table shows the results of correlations among the variables used in the research.
*** represents significance at 5% level.*

Table 3 shows the results of unit root tests. We have used three different unit root tests to test stationarity of the time series. The results shown in the Table 3 imply that variables are non-stationary at levels and stationary at first difference. Thus, the variables lnCAD, lnPESO, lnSPTSX and lnMEXBOL are stationary at I(1). Given the variables are I(1), Johanson and Juselius (1988) test is used to determine the long run equilibrium relationship between stock prices and exchange rates and the results are presented in Table 4. The value of optimal lag length 1 is selected by the smallest Akaike information criteria (AIC) and Schwartz criterion (SC) for the variable lnPESO and lnMEXBOL whereas optimal lag length is chosen as 2 for lnCAD and lnSPTSX.

Table 3: Unit Root Test

Variable	ADF	PP	KPSS
lnCAD	-1.80	-1.87	0.44
ΔlnCAD	-17.03***	-17.02***	0.06***
lnPESO	-1.92	-1.99	0.34
ΔlnPESO	-17.53***	-17.54***	0.07***
lnSPTSX	-2.53	-1.80	0.14***
Δ lnSPTSX	-11.92***	-18.65***	0.07***
lnMEXBOL	-2.49	-2.91	0.14
Δ lnMEXBOL	-19.94***	-20.03***	0.09***

*This table shows results of unit root tests representing ADF , PP and KPSS tests results. The values reported are the statistic t-value. For KPSS test LM statistics are reported *** indicates significance at 1% level.*

Table 4 shows the results of Johansens cointegration test results with Trace and Max-Eigen statistic along with Critical values and p- values. From Table 4 we notice that for Canadian market trace statistic and max-eigen statistic are more than critical values at 5% level, thus the null hypothesis: no cointegration is rejected, confirming that the variables exchange rates and stock prices in Canadian market have long run equilibrium. We may safely conclude existence of cointegration is weakly significant at 5% level. In Mexican market trace statistic and max-eigen statistic are less than critical values at 5% level, thus the null hypothesis: no cointegration cannot be rejected, confirming that the variables exchange rates and stock prices in Mexican market have no long run equilibrium.

Table 4: Johansens's Cointegration Tests between Exchange Rates and Stock Prices

Ho	Statistic		
	Eigen Value	**Trace**	**Max-Eigen**
Canadian market			
None	0.015	8.40	4.55
		[15.49]	[14.26]
		(0.42)	(0.80)
At most	0.012	3.85	3.84
1		[3.84]	[3.84]
		(0.049)**	(0.049)**
Mexican market			
None	0.0336	10.71	9.65
		[15.49]	[14.27]
		(0 .22)	(0.30)
At most	0.0034	1.06	1.06
1		[3.84]	[3.84]
		(0.23)	(0.30)

*This table shows the results of cointegration tests. Values in [ ] represents critical values at 5% significance level , values in ( ) represents p values. **indicates 5% level of significance.*

As the variables lnCAD and lnSPTSX are cointegrated, we run VECM model for Canadian market. VECM model results are shown in the Table 5.

Table 5: VECM – Canadian Market

	Δ Lnsptsx	**Δ LnCAD**
ECT_{t-1}	-0.0020	-0.0244
	[-1.104]	[-1.623]
	(0.27)	(0.11)
$\Delta lnSPTSX_{t-1}$	-0.07500	-0.0847
	[-1.298]	[-1.731]
	(0.20)	(0.08)***
$\Delta lnCAD_{t-1}$	-1.2840	0.0149
	[-1.895]	[0.258]
	(0.06)***	(0.80)
C	0.0057	0.0012
	[0.6493]	[1.657]
	(0.08)	(0.10)

This table shows the results of VECM model Coefficients, t statistic represented in [ ] and p values are shown in ()
****indicates 10% level of significance.*

From Table 5, we notice that error correction term is negative but not statistically significant, short run causality from exchange rates to stock prices vice versa significant at 10% level. We conclude no significant long run or short run causality run from exchange rates and stock prices in Canadian market at 5% level of significance, but short run causality does exist and is significant at 10% level. In Mexican market, lnPESO, and lnMEXBOL are I(1)and not cointegrated hence no long term association between exchange rates and stock prices exists. Now we examine the issue of causation between exchange rates and stock prices using Pairwise Granger causality test. Table 6 represent test result of exchange rates and stock pries in Mexican market. Pairwise granger causality tests suggest that exchange rates do granger causes stock prices in Mexican market which is statistically significant at 5% levels.

Table 6: Bivariate Granger Causality Test

	F-Statistic	P-Value
lnMEXBOL does not Granger Cause lnPESO	1.4280	0.23
lnPESO does not Granger Cause lnMEXBOL	6.1835	0.01**

*This table shows the bivariate testes results between exchange rates and stock prices in Mexican market. ** represents results are significant at 5% level*

SUMMARY AND CONCLUSIONS

The main objective of this research is to examine the relationship between exchange rates and stock prices in Canadian and Mexican markets, using weekly data for the years 2013-2018, transforming all the variables into logarithmic scale to normalize the series. The study becomes more important as Canada and Mexico are main trading partners connected by NAFTA trade pact. ADF, PP and KPSS tests are used to test the stationarity of the series. It found that the series are I(1). Next we used Johansen cointegration test to study long-run association between stock prices and exchange rates. Since the Johansen cointegration vector existed in Canadian market not in Mexican market, VECM test is used to verify long-run, short-run associations between the variables in Canadian market, concluding no evidence of long-run association at 5% level of significance, however exchange rates has weak causal effect on stock prices at 10% level of significance. Bivariate Granger causality model is used in Mexican market found that unidirectional causality, that is exchange rates does Granger cause stock prices and is significant at 5% level. Thus, evidence suggest no long-run association between the variables in Canada and Mexican capital markets but found short-run relationship from exchange rates to stock prices in Mexican market only at 5% level of significance. This research suggests policy makers in Canadian capital markets to explore using other economic tools influencing these variables, as neither stock market regulations or policies nor exchange rate policy have any influence on relationship between exchange rates and stock prices. However, it also suggests policy makers in Mexican market should be cautious in using exchange rate policy as it has short-term implications on stock prices. This research paper contributes to the existing, sparingly available academic research pertaining to Canadian and Mexican markets. Authors suggest further research by using other economic variables such as interest rates, oil prices and tax rates in exploring relationship between exchange rates and stock prices.

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BIOGRAPHY

Dr Sekhar Amba is an associate professor at New York Institute of Technology.

Binh H. Nguyen, is an assistant professor at New York Institute of Technology.