A Test of Relations between Japanese Industry Stock Prices and Exchange Rates

Chikashi TSUJI
Graduate School of Systems and Information Engineering
University of Tsukuba
1-1-1 Tennodai, Tsukuba, Ibaraki, Japan
E-mail: mail_sec_low@minos.ocn.ne.jp

Abstract

This paper examines the direct relations between the yen/US dollars exchange rates and stock prices of the Japanese electric appliances industry and that between the yen/US dollars exchange rates and the Japanese oil and coal products industry stock prices. We find that the linkage between Japanese oil and coal products industry stock prices and the exchange rates can be modeled by the Vector Error Correction Model because in our analyzing period, two variables are cointegrated. On the other hand, we find that the relation between Japanese electric appliances industry stock prices and the yen/US dollars exchange rates can be modeled by the standard Vector Autoregressive model.

Keywords: Cointegration, flow-oriented approach, stock-oriented approach, VAR, VECM.

1. Introduction

Economic theory of stock prices and foreign exchange (FX) rates such as the 'flow-oriented' approach (e.g. Dornbush and Fisher 1980) and the 'stock-oriented' approach (e.g. Branson 1983, Frankel 1983) insist different relations between stock prices and FX rates. Several preceding studies which investigated the direct linkage between two variables exist (Phylaktis and Ravazzolo (2005), Pan et al. (2007), Zhao (2010), and Walid et al. (2011), for example), however, as far as we know, academic international research on the direct relationships between the Japanese specific industry stock prices and FX rates cannot be found. Hence, for contributing to the body of related researches, the objective of this paper is to investigate the direct relationships between the yen/US dollars rates and the stock prices of Japanese electric appliances industry and Japanese oil and coal products industry by econometric modeling.

Selecting Japanese electric appliances industry and Japanese oil and coal products industry is interesting since the former is export-oriented industry and the latter is not. Thus from the viewpoint of the 'flow-oriented' approach, the linkage between the electric appliances industry stock prices and yen/US dollars rates might be stronger than that between the oil and coal products industry stock prices and yen/US dollars rates.
The contribution of this paper is as follows. First, this is the first research on the direct relations between Japanese specific industry equity prices and FX rates, and we emphasize that our research includes the important period of Lehman Shock. Second, we successfully model the linkage between Japanese oil and coal products industry stock prices and FX rates by the Vector Error Correction Model (VECM). Third, we also suitably model the relationships between Japanese electric appliances industry equity prices and FX rates by the Vector Autoregressive (VAR) model. Fourth, in our sample period, we find the weakly positive relationships between both two industry equity prices and FX rates in Japan. The rest of the paper is organized as follows. Section 2 documents the representative theories on FX rates and stock prices, Section 3 describes the data we use, Section 4 demonstrates our empirical results, and Section 5 summarizes the paper.

2. Theoretical Background

As to the relation between equity prices and exchange rates, economic theory insists two different approaches, namely, the 'flow-oriented' approach and the 'stock-oriented' approach. First, the flow-oriented approaches insist that FX rate changes affect international competitiveness and trade balance. Hence local currency depreciation works to strengthen their competitiveness of domestic companies as their exports will be cheaper in international trade. As a result, the flow-oriented approaches claim a *positive* linkage between equity prices and the FX rate. Next, in the stock-oriented approaches, the portfolio balance models are often considered. (Frankel 1983, Branson and Henderson 1985, for example) These approaches consider an internationally diversified portfolio, and these models suggest that the FX rate dynamics function to balance the demand and supply of domestic and foreign financial assets. Thus in these approaches, an increase in domestic equity prices will lead an appreciation of the domestic currency since investors' demand for domestic currency increases in order to purchase domestic equities. Therefore, these approaches suggest a *negative* relationship between FX rates and equity prices.

3. Data

The sample period of our data is from January 1995 to February 2011. All data are from QUICK Corp. As to

the notations, EX denotes the yen/US dollars exchange rates, DEX means the first difference of EX, ELEC denotes the stock prices of the Japanese electric appliances industry, DELEC means the first difference of ELEC, OIL denotes the stock prices of the Japanese oil and coal products industry, and DOIL means the first difference of OIL. Furthermore, DTOPIX is the first difference of Tokyo Stock Price Index (TOPIX), and DUSJ means the first difference of the yield spreads between 10-year US government bond and 10-year Japanese government bond.

4. Empirical Results

First, we show the results of the Augmented Dickey-Fuller (ADF) unit root tests. Table 1 indicates that EX, ELEC, and OIL have unit roots. Next, we examine the cointegration relationships. Table 2 shows that FX rates and electric appliances industry stock prices and electric appliances industry stock prices and oil and coal products industry stock prices possess no cointegrated relation. However, there exist cointegrated relationships between the FX rates and the oil and coal products industry stock prices. Thus we model the relationships between EX and OIL by the following VECM model.

$$\begin{aligned} DEX_t &= \nu + \vartheta_1 DEX_{t-1} + \vartheta_2 DEX_{t-2} + \vartheta_3 DEX_{t-3} + \varphi_1 DOIL_{t-1} + \varphi_2 DOIL_{t-2} + \varphi_3 DOIL_{t-3} \\ &\quad + \eta(\alpha + EX_{t-1} + \kappa OIL_{t-1}) + \delta_1 DTOPIX_t + \delta_2 DUSJ_t + \tau_t \end{aligned} \tag{1}$$

$$\begin{aligned} DOIL_t &= \mu + \lambda_1 DEX_{t-1} + \lambda_2 DEX_{t-2} + \lambda_3 DEX_{t-3} + \xi_1 DOIL_{t-1} + \xi_2 DOIL_{t-2} + \xi_3 DOIL_{t-3} \\ &\quad + \gamma(\alpha + EX_{t-1} + \kappa OIL_{t-1}) + \rho_1 DTOPIX_t + \rho_2 DUSJ_t + \omega_t \end{aligned} \tag{2}$$

On the other hand, we model the relationships between EX and ELEC, which are not cointegrated, by the following VAR model.

$$\begin{aligned} DEX_t &= \nu + \vartheta_1 DEX_{t-1} + \vartheta_2 DEX_{t-2} + \vartheta_3 DEX_{t-3} + \phi_1 DELEC_{t-1} + \phi_2 DELEC_{t-2} + \phi_3 DELEC_{t-3} \\ &\quad + \delta_1 DTOPIX_t + \delta_2 DUSJ_t + \tau_t \end{aligned} \tag{3}$$

$$\begin{aligned} DELEC_t &= \mu + \lambda_1 DEX_{t-1} + \lambda_2 DEX_{t-2} + \lambda_3 DEX_{t-3} + \xi_1 DELEC_{t-1} + \xi_2 DELEC_{t-2} + \xi_3 DELEC_{t-3} \\ &\quad + \rho_1 DTOPIX_t + \rho_2 DUSJ_t + \omega_t \end{aligned} \tag{4}$$

The estimation result of VECM is displayed in Table 3 and the estimation result of VAR is shown in Table 4. In both models, the estimation results are generally well. Further, in Tables 4 and 5, from the signs of the estimated coefficients in both models, we understand that both the yen/US dollars FX rates and electric appliances industry stock prices and the FX rates and oil and coal products industry stock prices are generally positively related in our sample period.

Table 1. Results of the Unit Root Tests

Results of Sample Period of January 1995 to February 2011							
		EX	DEX	ELEC	DELEC	OIL	DOIL
With	*t*-value	−1.830	−10.395***	−1.972	−13.864***	−2.040	−13.046***
constant	*p*-value	0.365	0.000	0.299	0.000	0.270	0.000
With trend	*t*-value	−2.470	−10.490***	−2.176	−13.869***	−1.968	−13.030***
and constant	*p*-value	0.343	0.000	0.500	0.000	0.615	0.000

The results of the Augmented Dickey-Fuller unit root tests are displayed. The null hypothesis is that the variable has a unit root. *** rejects the null hypothesis at the 1% statistical significance level.

Table 2. Results of the Cointegration Tests

Results of Sample Period of January 1995 to February 2011			
Exchange rates and electric appliances industry	Hypothesis	Trace statistic	*p*-value
	Cointegrated relation is zero	11.718	0.171
Exchange rates and oil and coal products industry	Hypothesis	Trace statistic	*p*-value
	Cointegrated relation is zero	14.126*	0.080
Electric appliances industry and oil and coal products industry	Hypothesis	Trace statistic	*p*-value
	Cointegrated relation is zero	11.162	0.202

* denotes that the trace test indicates one cointegrating equation at the 10% level.

Table 3. VECM Estimation on Exchange Rates and the Japanese Oil and Coal Products Industry

Results of January 1995 to February 2011						
	Cointegration Equation					
EX(−1)	1.000					
	Coef.		SE		*t*-value	
OIL(−1)	0.730***		0.243		3.005	
Constant	−938.786					
	DEX			DOIL		
Error Correction	Coef.	SE	*t*-value	Coef.	SE	*t*-value
Coint. Eq.	0.001	0.001	1.230	−0.524***	0.019	−2.746
DEX(−1)	0.241***	0.071	3.392	1.187	1.697	0.700
DEX(−2)	−0.026	0.073	−0.361	3.361*	1.738	1.934
DEX(−3)	−0.032	0.071	−0.457	1.011	1.683	0.601
DOIL (−1)	−0.001	0.002	−0.413	0.025	0.057	0.436
DOIL (−2)	0.001	0.002	0.528	−0.041	0.057	−0.721
DOIL (−3)	−0.002	0.002	−0.644	0.101*	0.057	1.784
Constant	0.020	0.207	0.098	−0.679	4.937	−0.137
DTOPIX	0.005	0.003	1.580	0.818***	0.078	10.532
DUSJ	2.787***	0.838	3.326	−10.173	19.971	−0.509
Adj. R^2		0.102			0.404	
AIC	16.327					

AIC denotes the Akaike Information Criterion, and Adj. R^2 is the adjusted *R*-squared value. *** (*) denotes the statistical significance of the coefficients at the 1 (10) % level.

Table 4. VAR Estimation on Exchange Rates and the Japanese Electric Appliances Industry

Results of January 1995 to February 2011						
	DEX			DELEC		
	Coef.	SE	*t*-value	Coef.	SE	*t*-value
DEX(−1)	0.250***	0.071	3.510	2.536	2.197	1.154
DEX(−2)	−0.015	0.073	−0.209	−4.433*	2.249	−1.976
DEX(−3)	−0.010	0.070	−0.141	−3.767*	2.157	−1.747
DELEC(−1)	0.001	0.002	0.478	−0.102**	0.047	−2.192
DELEC(−2)	0.000	0.001	0.278	0.045	0.045	0.979
DELEC(−3)	−0.003*	0.001	−1.888	0.000	0.045	0.000
Constant	0.027	0.205	0.132	3.531	6.346	0.556
DTOPIX	0.005	0.003	1.535	1.766***	0.100	17.624
DUSJ	2.868***	0.856	3.352	38.968	26.437	1.474
Adj. R^2		0.114			0.633	
AIC	16.787					

AIC denotes the Akaike Information Criterion, and Adj. R^2 is the adjusted *R*-squared value. *** denotes the statistical significance of the coefficients at the 1 % level, ** denotes the statistical significance of the coefficients at the 5 % level, * denotes the statistical significance of the coefficients at the 10 % level, respectively.

5. Conclusions

This paper examined the direct relationships between FX rates and stock prices of the Japanese electric appliances industry and the Japanese oil and coal products industry.

Our interesting findings and contributions are as follows. First, we find that we can model the linkage between Japanese oil and coal products industry stock prices and FX rates by the VECM since in our analyzing period, two variables have cointegrated relations. On the other hand, we also find that it is suitable to model the relationships between Japanese electric appliances industry stock prices and FX rates by the standard VAR model. This is very interesting since in general, it is considered that the linkage between Japanese electric appliances industry stock prices and FX rates is stronger than that between Japanese oil and coal products industry stock prices and FX rates. Third, in our sample period, we find the weak positive relationships between industry stock prices and FX rates in Japan, and this is consistent with flow-oriented approaches and inconsistent with stock-oriented approaches.

We consider that research on the direct linkage between exchange rates and equity prices of specific industries are undeveloped topic. Thus related future researches on this topic around the world are interesting and valuable to deepen our understanding on financial markets.

Acknowledgements

The author thanks the Japan Society for the Promotion of Science for the generous financial assistance for our research. Furthermore, I greatly thank the paper invitation from the Chief Editor of this Journal.

References

Branson, W. H. (1983). Macroeconomic determinants of real exchange risk. In Managing Foreign Exchange Risk, Edited by R. J. Herring, Cambridge (Cambridge University Press), 33–74.

Branson, W. H. and Henderson, D. W. (1985). The specification and influence of assets markets. In Handbook of International Economics, 2, Edited by R. W. Jones and P. B. Kenen, Amsterdam (Elsevier), 749–805.

Dornbush, R. and Fisher, S. (1980). Exchange rates and the current account. American Economic Review, 70, 960–971.

Frankel, J. (1983). Monetary and portfolio balance models of exchange rate determination, In Economic Interdependence and Flexible Exchange Rates, Edited by J. Bhandari and B. Putnam, Cambridge (MIT Press), 84–114.

Pan, M. S., Fok, R. C-W., and Liu, Y. A. (2007). Dynamic linkages between exchange rates and stock prices: Evidence from East Asian markets. International Review of Economics and Finance, 16, 503–520.

Phylaktis, K, and Ravazzolo, F. (2005). Stock prices and exchange rate dynamics. Journal of International Money and Finance, 24, 1031–1053.

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

Zhao, H. (2010). Dynamic relationship between exchange rate and stock price: Evidence from China. Research in International Business and Finance, 24, 103–112.