

Multilateral Exchange Rates and Fundamentals: The Case of Taiwan

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Abstract

Pundits in the international finance have long puzzled over the lack of an empirical relationship between exchange rates and fundamentals and theoretical exchange rate models are difficult to verify using actual data related to fundamentals. This may be related to the length of the sample period or the choice of bilateral/multilateral exchange rates. This study utilized monthly data to increase the number of samples and construct the multilateral exchange rate models. The cointegration relationships between multilateral exchange rates and fundamentals were found, and short-run fluctuations in multilateral exchange rates contribute to forecast changes in fundamentals. We surmise that the reason for this is that multilateral exchange rates provide more comprehensive empirical information, which can enhance the explanatory power of conventional exchange rate models in empirical applications.

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1 Introduction

Exchange rates are theoretically determined by fundamentals; however, the random walk trend makes it difficult to use fundamentals to interpret changes in exchange rates. Pundits in the international finance have long puzzled over the lack of an empirical relationship between exchange rates and fundamentals and theoretical exchange rate models are difficult to verify using actual data related to fundamentals. Utilizing data from the 1970's, Meese and Rogoff (1983) employed out-of-sample fit to evaluate a

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number of exchange rate models and found that when applied to the interpretation of trends in exchange rates, these models were unable to overcome the influence of random walk. Although a number of researchers have expressed the opinion that the effect of random walk can be mitigated by long-run variation in exchange rates (Chinn and Mess, 1995; Mark, 1995; Mark and Sul, 2001), more recent studies have indicated that the explanatory power of random walk cannot be mitigated using any model (Cheung et al., 2005).

Obstfeld and Rogoff (2000) referred to this problem as the exchange rate disconnect puzzle. Kilian (1999) indicated that the reason for this lack of empirical results may be the fact that empirical models disregard the possibility of cointegration between exchange rates and fundamentals. Nonetheless, even after considering the cointegration relationship between exchange rate and fundamentals, Kilian (1999) was still unable to mitigate random walk in the performance of out-of-sample forecasts. Chinn and Mess (1995), Mark (1995), and Mark and Sul (2001) indicated that exchange rates and fundamentals present consistent variation over long-run sample periods. MacDonald and Taylor (1993), McNown and Wallace (1994), Moosa (1994) and Baharumshah et al. (2010) claimed that the theoretical exchange rate models can be regarded as an effective framework for the interpretation of trends in exchange rates.

Engel and West (2004, 2005) proposed another line of thinking: If exchange rates could be expressed in the form of asset-pricing, then short-run fluctuations in exchange rates would undoubtedly be influenced by expected changes in fundamentals. The grasp of market information is reflected in expectations regarding future fundamentals; therefore, fluctuations in exchange rates may influence the forecasting of changes in fundamentals. Extending the discourse of Engel and West (2004, 2005), Chou and Tseng (2008) researched various Asian-Pacific nations to determine how exchange rates between the local currencies and the USD affected the expected performance of economic fundamentals in each nation. They found that the exchange rate is highly volatile and unpredictable.

Krugman and Obstfeld (2009) indicated that exchange rates reflect not only the currency exchange ratio but also relative economic conditions between nations. The stronger the interdependent relationship between two nations, the more clearly fluctuations in exchange rates reflect changes in economic circumstances. Chou and Lin (2011) integrated the concept of nominal effective exchange rate (NEER) to construct multilateral exchange rate models. They believed that multilateral exchange rates would provide more comprehensive information, which could enhance the explanatory power of conventional exchange rate models when they are applied within an empirical context.

In summary, the information provided by exchange rates determines the empirical relationship between exchange rates and fundamentals. This may be related to the length of the sample period or the choice of bilateral/multilateral exchange rates. Previous studies have been limited to quarterly data, resulting in a small number of samples. This study gathered a larger number of samples from monthly data and employed multilateral exchange rates to explore the feasibility of various exchange rate models. Our results indicate that the multilateral exchange rate of Taiwan has a stable long-run relationship with fundamentals, which can improve the effectiveness of forecasting short-run changes in fundamentals.

The analytic structure of this study is as follows. In section 2, we deduce the fundamentals that could theoretically dominate exchange rates and construct an exchange rate model in the present-value form based on the money-income model and Taylor rule model. Section

3 presents the data sources. Section 4 presents the relevant empirical results. Conclusions are drawn in Section 5.

2 Exchange Rate Models

In this section, we identify the fundamentals that determine exchange rates, in accordance with the money-income model and Taylor rule model, respectively. We defined s_t as the nominal exchange rate from which the natural logarithm has been obtained. Exchange rate in this study was defined as the price of a unit of foreign currency in New Taiwan Dollars (NTD). Taiwan was designated as the home country.

2.1 Money-Income Model

In accordance with the money demand theory of liquidity preference, the money market relationship of the home country was hypothesized as follows (see Engel and West, 2004, 2005; Chou and Lin, 2011):

$$m_t - p_t = \gamma y_t - \alpha i_t + v_t \quad (1)$$

where m_t is the money supply, p_t is the price levels, i_t indicates interest rates, and y_t is the output levels. v_t indicates the error term. With the exception of i_t , all of the above variables are expressed in the form of natural logarithms; $\gamma > 0$ represents income elasticity in money demand, while $\alpha > 0$ indicates the semi-elasticity of the interest rate of money demand. We also hypothesized that other nations have similar money market relationship:

$$m_t^f - p_t^f = \gamma y_t^f - \alpha i_t^f + v_t^f \quad (2)$$

The “ f ” superscript of the variables indicates foreign nations; otherwise the variables are consistent with the descriptions above. As the sum of purchasing power parity (PPP) plus real exchange rate (x_t), nominal exchange rate can be expressed as follows:

$$s_t = p_t - p_t^f + x_t \quad (3)$$

In the finance market, the interest parity relationship is:

$$E_t(s_{t+1}) - s_t = i_t - i_t^f + \varphi_t \quad (4)$$

where $E_t(\cdot)$ is rational expectation and φ_t is risk premium or expected error. Using Eqs. (1)-(4), we get:

$$s_t = \frac{1}{1+\alpha} (m_t - m_t^f) - \frac{\gamma}{1+\alpha} (y_t - y_t^f) + \frac{\alpha}{1+\alpha} E_t(s_{t+1}) + \mu_t \quad (5)$$

Equation (5) presents the money-income exchange rate model, where $\mu_t = [x_t - \alpha\varphi_t - (v_t - v_t^f)]/(1 + \alpha)$ is unpredictable random disturbance. In the above equation, the coefficient of $(m_t - m_t^f)$ is $1/(1 + \alpha) > 0$, indicating that if domestic monetary authorities pursue a more relaxed monetary policy, compared to other nations, this will subject the currency of the home country to the pressure of depreciation. The reason for the reverse relationship between $(y_t - y_t^f)$ and exchange rate (its coefficient is

$-\gamma/(1 + \alpha) < 0$) is because when domestic output exceeds foreign output, public demand for the money of the home country rises, which in turn increases the exchange rate.

We overlapped Eq. (5) and used iterated expectation and no-bubble conditions ($\lim_{j \rightarrow \infty} E_t(s_{t+j}) \rightarrow 0$) to obtain:

$$s_t = \sum_{j=1}^{\infty} \left(\frac{1}{1+\alpha} \right)^j E_t \left[\alpha (m_{t+j} - m_{t+j}^f) - \gamma (y_{t+j} - y_{t+j}^f) \right] + \mu_t \quad (6)$$

Equation (6) expresses the exchange rate in the form of asset-pricing. In other words, exchange rates can be expressed as the discounted value sum of current and future fundamentals, in which $1/(1 + \alpha)$ is the discount rate.

2.2 Taylor Rule Model

Assuming that the monetary policy of the central bank adheres to the principle of interest rate manipulation in the Taylor rule (see Taylor, 1993 ; Engel and West, 2004, 2005; Chou and Lin, 2011):

$$i_t = \beta_0 (s_t - \bar{s}_t) + \beta_1 y_t^g + \beta_2 \pi_t + \eta_t \quad (7)$$

where \bar{s}_t represents the target exchange rate; y_t^g indicates output gap, η_t is the error term, and $\pi = p_t - p_{t-1}$ is the rate of inflation. Coefficient $\beta_0 > 0$ indicates that the responsibility of the central bank is to maintain the stability of foreign currency values. Therefore, when the exchange rate exceeds the target exchange rate, interest rates rise, thereby attracting the inflow of capital, which causes the exchange rate to appreciate. Conversely, when the exchange rate is lower than the target exchange rate, a drop in interest rates reduces capital inflow or increases capital outflow, thereby forcing the exchange rate to depreciate. $\beta_2 > 1$ also indicates that the central bank is responsible for the stability of its domestic currency. The central bank increases (reduces) interest rates in order to reduce (increase) the supply of money in the home country, thereby relieving (avoiding) a rise (fall) in commodity prices. $\beta_1 > 0$ represents the “leaning against the wind” measure employed by the central bank in the face of economic overheating (see, for example, Taylor, 1999 ; Aklan and Nargelecekenler, 2008).

Assuming that monetary authorities designate the exchange rate established under PPP as the target exchange rate (or long-run exchange rate), then $\bar{s} = p_t - p_t^f$. Combined with Eq. (4), Eq. (7) can be modified as follows:

$$s_t = \frac{1}{(1+\beta_0)} [i_t^f + \beta_0 (p_t - p_t^f) - \beta_1 y_t^g - \beta_2 \pi_t] + \frac{1}{(1+\beta_0)} E_t(s_{t+1}) + \varepsilon_t \quad (8)$$

Equation (8) is the exchange rate model of interest rate regulations. The fundamentals in this equation include i_t^f and $(p_t - p_t^f)$. The unobservable impacts are assumed to be y_t^g , π_t , $E_t(s_{t+1})$ and $\varepsilon_t = -\varphi_t - \eta_t$. Equation (8) shows that an increase in foreign interest rates increases capital outflow, which subjects the exchange rate to the pressure of depreciation. An increase in commodity prices in the home country relative to foreign commodity prices indicates that the relative purchasing power of the home currency has decreased, which causes the exchange rate to depreciate.

We overlapped Eq. (8) and used iterative expectations and no-bubble conditions to infer the following:

$$s_t = \frac{1}{1+\beta_0} \sum_{j=0}^{\infty} \left(\frac{1}{1+\beta_0}\right)^j E_t \left[i_{t+j}^f + \beta_0 (p_{t+j} - p_{t+j}^f) - \beta_1 y_{t+j}^g - \beta_2 \pi_{t+j} \right] + \varepsilon_t \quad (9)$$

where $1/(1 + \beta_0)$ is the discount rate.

2.3 Multilateral Exchange Rate Models

We further explored the combined concepts of effective exchange rates and multilateral exchange rates. An effective exchange rate (s_t^w) can be expressed as follows (for more detail, see Howitt, 1986; Weymark, 1986; Chou and Lin, 2011):

$$s_t^w = \sum_{i=1}^n s_t^i w_t^i \quad (10)$$

In the equation above, variables with subscript “w” are weighted; s_t^i is the bilateral exchange rate between NTD and the currency of the i -th trade rival, n represents the number of trade rivals included in the currency basket, and w_t^i indicates the trade-weight of Taiwan to the i -th trading rival. In the above equation, $\sum_{i=1}^n w_t^i = 1$. Equation (10) shows an effective exchange rate with floating weight, which is due to the consideration of temporal changes in trade-weight. Using the same concept, we can calculate the fundamentals of trade rivals in the currency basket based on trade-weight. The extent of trade dependence was used to measure the relationships between the fundamentals of Taiwan and its trade rivals. The fundamentals of nations with a greater trade ratio had a more significant influence on Taiwan (Weymark, 1995). Accordingly, multilateral exchange rate models based on the money-income model and Taylor rule model can be expressed as follows:

$$s_t^w = \frac{1}{1+\alpha} (m_t - m_t^{fw}) - \frac{\gamma}{1+\alpha} (y_t - y_t^{fw}) + \frac{\alpha}{1+\alpha} E_t (s_{t+1}^w) + \mu_t^w \quad (11)$$

$$s_t^w = \frac{1}{(1+\beta_0)} \left[i_t^{fw} + \beta_0 (p_t - p_t^{fw}) - \beta_1 y_t^g - \beta_2 \pi_t \right] + \frac{1}{(1+\beta_0)} E_t (s_{t+1}^w) + \varepsilon_t^w \quad (12)$$

The multilateral exchange rate models expressed in the form of asset-pricing by Eqs. (6) and (9) can be modified as follows:

$$s_t^w = \sum_{j=1}^{\infty} \left(\frac{1}{1+\alpha}\right)^j E_t \left[\alpha (m_{t+j} - m_{t+j}^{fw}) - \gamma (y_{t+j} - y_{t+j}^{fw}) \right] + \mu_t^w \quad (13)$$

$$s_t^w = \frac{1}{1+\beta_0} \sum_{j=0}^{\infty} \left(\frac{1}{1+\beta_0}\right)^j E_t \left[i_{t+j}^{fw} + \beta_0 (p_{t+j} - p_{t+j}^{fw}) - \beta_1 y_{t+j}^g - \beta_2 \pi_{t+j} \right] + \varepsilon_t^w \quad (14)$$

3 The Data

This study selected monthly data from 1999M1 to 2011M4. Data was collected from 16 nations (listed in descending order below) according to their ratio of trade with Taiwan: China, Japan, US, Korea, Singapore, Germany, Malaysia, Indonesia, Philippines, Netherland, UK, France, Italy, Canada, Brazil, and South Africa. The Taiwan-U.S. exchange rate is from the Directorate General of Budget, Accounting and Statistics, Executive Yuan (DGBAS). The exchange rate between the US dollar and the currency of all other nations was obtained from the International Financial Statistics (IFS) (line rf) (The Euro-USD exchange rate was used for Germany, France, the Netherlands and Italy). The exchange rate between TWD and all other currencies was calculated using cross rates.

Data on fundamentals in Taiwan was obtained from DGBAS. Information on fundamentals in all other sample nations was obtained from IMF-IFS. Broad money (M2) was substituted for money supply (line 59, but Germany and Italy are line 34 plus line 35) and GDP was substituted for output (line 99b). This study employed the industrial production index (line 66) to convert quarterly GDP data into monthly data. Money market rates were substituted for interest rates (line 60b) and consumer price index (CPI) (line 64) was substituted for price levels.

All of the above variables were seasonally adjusted and converted using natural logarithms (apart from interest rate). We measured the degree to which Taiwan depends on each trade rival (data source: DGBAS), the values of which were weighted in accordance with the bilateral trading total. With the exception of the bilateral exchange rate between Taiwan and the U.S., all nations were divided into three currency baskets based on trade ratio to calculate multilateral exchange rates. The four cases below were used as a basis from which to discuss the empirical implications of exchange rate models. Case 1 is the conventional bilateral model of exchange rates between Taiwan and the U.S. Case 2 is a multilateral model of exchange rates among China, Japan, and the U.S. Case 3 is a model of exchange rates among China, Japan, the US, Korea, Singapore, and Germany, while Case 4 incorporates all trade rivals sampled in this study. The categories described above are presented in Table 1.

Table 1: Countries discussed with regard to multilateral exchange rates

	Countries in the currency basket	Proportion of Taiwanese trade volume (%)
Case 1	US	13.67%
Case 2	China, Japan, US	44.49%
Case 3	China, Japan, US, Korea, Singapore, Germany	55.76%
Case 4	China, Japan, US, Korea, Singapore, Germany, Malaysia, Indonesia, Philippines, Netherland, UK, France, Italy, Canada, Brazil, South Africa	69.07%

The proportions in Taiwanese trade volumes are based on the average annual data of 1999-2011. Data used in this study was obtained from DGBAS.

4 Empirical Results

Based on the exchange rate models in Section 2 (Eqs. (5), (8), (11), and (12)), the observable fundamentals that determine s_t were as follows : $m_t - m_t^f$, $y_t - y_t^f$, i_t^f and $p_t - p_t^f$. Table 2 compiles the ADF (augmented Dicky-Fuller) statistics of exchange rates and fundamentals for all four cases. This study included ADF regression on constants and time trend and employed Schwarz Criterion to determine optimal lags. Test results did not generally reject the null hypothesis of the existence of unit roots (only 4 out of 20 tests rejected the null hypothesis at a 10% level of significance: $y_t - y_t^f$ of Cases 1 and 2, and s_t and $y_t - y_t^f$ of Case 4). However, after obtaining the first-order differential, all variables rejected the null hypothesis of unit root at a 10% level of significance. We therefore infer that exchange rates and fundamentals are I(1) variables. Table 3 shows the basic statistics for relevant variables expressed as first-order differentials.

Table 2: ADF Tests

Variables	Case 1	Case 2	Case 3	Case 4
s_t	-2.385	-2.035	-2.700	-3.670**
$m_t - m_t^f$	-1.422	-2.510	-2.373	-2.575
$y_t - y_t^f$	-10.390***	-1.565	-3.334*	-3.416*
i_t^f	-1.712	-1.903	-1.549	-1.642
$p_t - p_t^f$	-1.851	-0.368	-0.428	-0.340
Δs_t	-8.612***	-10.405***	-3.659**	-3.756**
$\Delta(m_t - m_t^f)$	-11.378***	-3.366*	-3.423*	-3.307*
$\Delta(y_t - y_t^f)$	-11.047***	-6.510***	-7.564***	-7.597***
Δi_t^f	-5.177***	-9.539***	-8.563***	-7.544***
$\Delta(p_t - p_t^f)$	-10.934***	-4.565***	-4.800***	-5.147***

Optimal lags in ADF regression were determined using the Schwarz Criterion (maximum lags = 12). ***, **, and * indicate that the null hypothesis of a unit root was rejected at 1%, 5%, and 10% significance levels.

The basic statistics in Table 3 enabled a comparison of the differences between the fundamentals that determine bilateral and multilateral exchange rates. Using $\Delta(m_t - m_t^f)$ as an example, the average monthly growth rate in the money supply between Taiwan and the U.S. remains largely unchanged (Case 1); however, it is 0.3-0.4% higher than the average monthly growth rate of money supply between Taiwan and other nations in the currency basket (Cases 2-4). The average monthly growth in the output of Taiwan ($\Delta(y_t - y_t^f)$) also exceeded that of its major trade rivals, while its rate of inflation ($\Delta(p_t - p_t^f)$) was lower.

Table 3: Basic Statistics

Variables	Case 1		Case 2		Case 3		Case 4	
	Mean	ρ_1	Mean	ρ_1	Mean	ρ_1	Mean	ρ_1
Δs_t	-0.000 (0.011)	0.061	-0.001 (0.070)	0.040	-0.002 (0.065)	0.003	0.003 (0.082)	-0.041
$\Delta(m_t - m_t^f)$	-0.000 (0.005)	0.094	0.004 (0.190)	-0.400	0.003 (0.151)	-0.389	0.003 (0.124)	-0.383
$\Delta(y_t - y_t^f)$	0.001 (0.051)	-0.504	0.002 (0.089)	-0.319	0.007 (0.102)	-0.126	0.005 (0.089)	-0.164
Δi_t^f	-0.029 (0.200)	0.700	0.001 (0.155)	0.249	-0.002 (0.137)	0.349	-0.033 (0.331)	0.018
$\Delta(p_t - p_t^f)$	-0.001 (0.006)	-0.195	-0.008 (0.021)	0.039	-0.006 (0.017)	0.050	-0.006 (0.015)	0.001

The numbers in [.] under the mean refers to standard deviation. ρ_1 is the first-order autocorrelation. Data are monthly, spanning the period from 1999M1 to 2011M12.

The long-run equilibrium relationships between exchange rates and relevant fundamentals can be investigated using cointegration tests. Johansen (1988, 1991) and Johansen and Juselius (1990) proposed two types of likelihood ratio tests to test for cointegration

relationships between two I(1) variables. This study employed Schwarz Criterion to determine optimal lag for bivariate VAR, in order to conduct the Johansen-Juselius cointegration test (results are presented in Table 4). As indicated by the maximum eigenvalue statistics, only 1 of the 4 tests under bilateral exchange rate rejected the null hypothesis that no cointegration relationship exists at a 10% level of significance. In relation to multilateral exchange rates however, all 12 tests rejected the null hypothesis at a 10% level of significance.

Table 4: Cointegration Tests on Exchange Rates and Fundamentals

Fundamentals	Case 1	Case 2	Case 3	Case 4
Panel A : maximum eigenvalue statistics				
$m_t - m_t^f$	4.885	22.264**	23.385**	24.430**
$y_t - y_t^f$	14.023*	14.522*	18.244**	27.415***
i_t^f	6.102	13.047*	19.542**	18.747***
$p_t - p_t^f$	8.100	29.189***	16.611**	23.806***
Panel B : trace eigenvalue statistics				
$m_t - m_t^f$	4.476	19.880*	16.654**	18.504**
$y_t - y_t^f$	11.105	10.939	12.453*	17.520**
i_t^f	7.179	19.569**	16.412**	22.673***
$p_t - p_t^f$	4.475	23.530*	14.068*	17.570**

Optimal lags in the bivariate VAR system were determined in accordance with the Schwarz Criterion (maximum lags = 12). ***, **, and * indicate that the null hypothesis of no cointegration was rejected at 1%, 5%, and 10% significance levels.

The trace eigenvalue statistics also showed similar results (none of the tests using the bilateral exchange rates rejected the null hypothesis, while up to 91.67% of tests using a multilateral exchange rate rejected the null hypothesis). Echoing an issue that has been debated in previous literature, these results indicate that an empirical relationship cannot be easily identified between bilateral exchange rates and fundamentals. Multilateral exchange rates, however, provide more comprehensive information and enhance the explanatory power of conventional exchange rate models in empirical applications (Chou and Lin, 2011).

Although cointegration tests confirmed the existence of a long-run equilibrium relationship between multilateral exchange rates and fundamentals, actual data on economic variables was generated through the process of isostatic adjustment (Davidson et al., 1978). According to the asset-pricing exchange rate model, exchange rates can be expressed as the linear sum of the discounted value of current and future fundamentals (as shown in Eqs. (6), (9), (13) and (14)). Engel and West (2004, 2005) emphasized that if exchange rates can be expressed in the form of asset pricing, then short-run fluctuations in exchange rates are undoubtedly influenced by expected changes in fundamentals. Because the market grasp of information is reflected by expected changes in fundamentals, fluctuations in exchange rates can be used in the forecasting of changes in

fundamentals. If fluctuations in exchange rates can Granger cause the changes in fundamentals (although the reverse is not established), this would strengthen the empirical reliability of exchange rate models. This study conducted bivariate Granger Causality Tests between fluctuations in exchange rates and changes in fundamentals, the results of which are shown in Table 5.

The null hypothesis of Panel A in Table 5 is Δs_t cannot Granger-cause changes in fundamentals. Eleven out of the 16 tests rejected the null hypothesis at a 10% level of significance. The null hypothesis in Panel B is changes in fundamentals can't Granger-cause Δs_t . Here only two cases rejected the null hypothesis at a 10% level of significance. The strong contrast between Panels A and B demonstrates that exchange rates could be employed in the forecasting of fundamentals (although the reverse was not established). A comparison of bilateral and multilateral exchange rates shows that variations in multilateral exchange rates are more meaningful to the forecasting of changes in fundamentals. In Case 1, only 25% of the samples rejected the null hypothesis at a 10% level of significance; however in Cases 2-4, the null hypothesis was rejected in 83.33% of samples (percentage of rejection increased to 100% in relation to $\Delta(m_t - m_t^f)$, Δi_t^f and $\Delta(p_t - p_t^f)$). These results support the inferences made previously in this study. Multilateral exchange rates can enhance the forecasting of changes in fundamentals and improve the reliability of theoretical exchange rate models.

Table 5: Bivariate Granger Causality Tests

Null Hypothesis	Case 1	Case 2	Case 3	Case 4
Panel A: Δs_t can't Granger-cause changes in fundamentals				
$\Delta s_t \nrightarrow \Delta(m_t - m_t^f)$	0.142	2.622*	5.144**	11.237***
$\Delta s_t \nrightarrow \Delta(y_t - y_t^f)$	0.344	0.209	1.054	3.000*
$\Delta s_t \nrightarrow \Delta i_t^f$	3.080*	8.445***	4.014**	12.414***
$\Delta s_t \nrightarrow \Delta(p_t - p_t^f)$	1.758	3.822**	3.678**	2.540*
Panel B: changes in fundamentals can't Granger-cause Δs_t				
$\Delta(m_t - m_t^f) \nrightarrow \Delta s_t$	1.053	1.545	1.029	0.202
$\Delta(y_t - y_t^f) \nrightarrow \Delta s_t$	0.040	0.602	3.646**	3.346**
$\Delta i_t^f \nrightarrow \Delta s_t$	0.273	1.010	1.807	2.536
$\Delta(p_t - p_t^f) \nrightarrow \Delta s_t$	0.247	0.074	0.002	0.669

Optimal lags in the bivariate VAR system were determined in accordance with the Schwarz Criterion (maximum lags = 12). ***, **, and * indicate that the null hypothesis is rejected at 1%, 5%, and 10% significance levels.

5 Conclusion

Experts in the financial sector have long been puzzled by the lack of an identifiable relationship between exchange rates and macroeconomic fundamentals. Previous studies have indicated that bilateral exchange rates may be affected by other inexplicable factors, causing volatile and unpredictable changes in exchange rates. This study utilized monthly

data on multilateral exchange rates to increase the number of samples. Bilateral trade ratios between Taiwan and its major trade rivals were used to measure the extent of mutual dependence between Taiwan and each of these nations. We then established NEER to explore the relationship between multilateral exchange rates and market fundamentals. This empirical study determined that relationships between bilateral exchange rates and fundamentals are not readily identifiable. However, as more nations were added to the currency basket and a more comprehensive multilateral exchange rate was developed, the cointegration relationships between multilateral exchange rates and fundamentals were found, thereby verifying the theoretical equilibrium relationship of the exchange rate models. According to the asset pricing exchange rate models, short-run fluctuations in multilateral exchange rates contribute to forecast changes in fundamentals, thereby strengthening the short-run relationship between exchange rates and fundamentals. We surmise that the reason for this is that multilateral exchange rates provide more comprehensive empirical information, which can enhance the explanatory power of conventional exchange rate models in empirical applications.

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