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Determinants of the Hungarian forint/ US dollar exchange rate

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Abstract. *Applying the EGARCH model and using demand and supply analysis, this paper finds that the HUF/USD exchange rate (units of the Hungarian forint per U.S. dollar) is positively associated with the U.S. Treasury bill rate, U.S. real GDP, the U.S. stock index, the Hungarian inflation rate and the expected exchange rate and negatively influenced by the Hungarian Treasury bill rate, Hungarian real GDP, the Hungarian stock index, and the U.S. inflation rate. The HUF/USD exchange rate has a long-term equilibrium relationship with these time series variables.*

Keywords: Exchange rates, Interest rates, Real GDP, Stock indexes, Inflation rates, EGARCH.

JEL Classification: F31, F41.

1. Introduction

The Hungary forint/U.S. dollar exchange rate has experienced fluctuations and volatile movements. The HUF/USD exchange rate was relatively stable up to the 1980s. In the 1990s, the forint continued to depreciate due to high inflation rates and difficulties in transition to a market economy. Relative political stability, low inflation rates and the joining of the EU led to a stronger forint during 2000-2007. The global financial crisis and other related factors caused the forint to depreciate as much as 58.8% from 147.0600 in 2008.M7 to 233.5400 in 2009.M3. It was settled at 275.23 on January 30, 2015.

This paper examines the HUF/USD exchange rate and has several focuses. First, a simultaneous-equation model consisting of demand and supply in the foreign exchange market is used to determine the exchange rate. This approach is justified as the central bank in Hungary had adopted a free floating exchange rate regime with the exchange rate to be determined by market forces. Second, international capital flows are considered by incorporating the interest rate and the stock market index in the U.S. in the model. Third, an advanced econometric method is applied in empirical estimation.

2. Literature review

Several recent studies have examined the determinants of exchange rates for Hungary or related countries. Frait, Komarek and Melecký (2006) study exchange rate misalignments for five central European countries. For Hungary, the EG method shows that the real exchange rate is significantly determined by the productivity differential, net foreign assets, openness and foreign direct investment. The ARDL method reveals similar outcomes except that the coefficient of net foreign direct investment is insignificant. According to the ECM, the coefficient of the error correction term is high, suggesting a fast adjustment to the equilibrium value. The forint was undervalued by about 2.5% by the end of 2004.Q1.

Ardic, Ergin and Senol (2008) compare six different exchange rate models for six CEE countries including Hungary based on three forecast error criteria. These six models are monetary models, the random walk model, uncovered interest parity, VAR(2), and ARIMA(2,1,0). They reveal that all the models have smaller forecast errors than the random walk model.

Uz and Ketenci (2010) investigate monetary models of exchange rate determination for 10 new EU countries. For Hungary, based on the OLS, DOLS, the ARDL or JOH method, the exchange rate, the relative money supply and the relatively output are cointegrated and have a long-term stable relationship, and the coefficients of the

relative money supply and relative output are significant. The hypothesis that exchange rates are unpredictable can be rejected significantly.

Giannellis and Papadopoulos (2011) consider the real, monetary and financial variables in examining exchange rate volatility for 8 EMU members and candidate nations. Monetary shocks affect exchange rate volatility in Hungary and Poland. Real shocks influence exchange rate volatility in Ireland. Both monetary and real shocks affect exchange rate volatility in France, Italy and Spain.

Kebłowski (2011) investigate exchange rate changes for the Czech Republic, Hungary, Poland and Romania. He shows that the long-term relationship between the Romanian leu and the euro can be rejected and that real exchange rates of the forint, the zloty, and the koruna versus the euro have long-term relationships and can be captured by real interest rate parities and the spreads of credit default risk premiums. Some common patterns are found among these four currencies as they were undervalued between 2003 and 2004 and overvalued between 2007 and 2009. The zloty and the forint were near their steady-state values after the global financial crisis whereas the leu and the koruna were overvalued.

Shevchuk (2014) finds that less domestic output, stronger growth abroad or more money supply leads to currency depreciation for the Czech Republic, Hungary and Poland. The money supply and the interest rate can explain 10%-14% of exchange rate changes in Hungary. The result for the interest rate differential in Poland is consistent with the monetary model.

To the author's best knowledge, few of the previous studies have applied demand and supply to analyze the determinants of the HUF/USD exchange rate. Monetary models depend on the validity of purchasing power parity, which may not hold in the short run. The assumption of the same coefficient for the interest rate, income or inflation rate differential may need to be tested.

3. The model

We can express the demand for and supply of the U.S. dollar versus the Hungarian forint in the foreign exchange market as:

$$\underset{\;-\;?\;\;\;?\;\;+\;\;+\;-}{D = X(E, Y^{HU}, R^{US}, S^{US}, E^{e}, \pi^{US})} \tag{1}$$

$$\underset{\;+\;?\;\;\;?\;\;+\;\;-}{S = Z(E, Y^{US}, R^{HU}, S^{HU}, \pi^{HU})} \tag{2}$$

where

D = demand for the U.S. dollar,

S = supply of the U.S. dollar,
E = the HUF/USD (units of the Hungarian forint per U.S. dollar) exchange rate,
Y^{US} = U.S. real GDP,
R^{US} = the interest rate in the U.S.,
S^{US} = the stock price in the U.S.,
E^{e} = the expected HUF/USD exchange rate,
π^{US} = the inflation rate in the U.S.,
Y^{HU} = real GDP in Hungary,
R^{HU} = the interest rate in Hungary,
S^{HU} = the stock price in Hungary, and
π^{HU} = the inflation rate in Hungary.

We expect that the demand for the U.S. dollar has a negative relationship with the HUF/USD exchange rate and the U.S. inflation rate and a positive relationship with the U.S. stock price and the expected HUF/USD exchange rate. The supply of the U.S. dollar is expected to be positively associated with the HUF/USD exchange rate and the stock price in Hungary and negatively affected by the Hungarian inflation rate.

A higher U.S. real GDP may increase U.S. imports from Hungary. However, if some of the increase in real GDP are due to an increase in import-substitute goods, U.S. imports from Hungary may decline. Hence, the sign of Y^{US} is unclear. A higher real GDP in Hungary is expected to increase imports from the U.S. and increase the demand for the U.S. dollar. However, if some of the increase in real GDP is due to import-substitute goods, Hungarian imports from the U.S. may decline. Hence, the sign of Y^{HU} is unclear.

According to the traditional view, a higher U.S. interest rate tends to attract Hungarian investors to purchase U.S. financial assets, resulting in an increase in the demand for the U.S. dollar and a higher HUF/USD exchange rate. On the other hand, the revisionist view maintains that a high U.S. interest rate may reduce the demand for the U.S. dollar and cause the U.S. dollar to depreciate because of a weaker economy and a higher default risk (Dekle et al., 2002; Huang et al., 2010). The analysis applies to Hungary as well.

Solving for the equilibrium values of the two endogenous variables simultaneously, we can express the equilibrium exchange rate as a function of all the exogenous variables:

$$\overline{E} = \overline{E}(R^{US}, R^{HU}, Y^{US}, Y^{HU}, S^{US}, S^{HU}, \pi^{US}, \pi^{HU}, E^{e}) \qquad (3)$$
$$\quad ? \quad ? \quad ? \quad ? \quad + \quad - \quad - \quad + \quad +$$

According to comparative static analysis, the sign beneath an exogenous variable shows the impact of a change in the exogenous variable on the equilibrium HUF/USD exchange rate.

4. Empirical results

The data were collected from the *International Financial Statistics* of the International Monetary Fund. The HUF/USD exchange rate is expressed as units of the Forint per U.S. dollar. Hence, an increase in the HUF/USD exchange rate means depreciation of the forint and appreciation of the U.S. dollar. Real GDP is measured in billions. The share price in Hungary is selected to represent the stock index in Hungary, and the Wilshire 500 index is chosen to represent the U.S. stock index. The inflation rate is derived from the percent change in the consumer price index in both countries. The expected exchange rate is derived from the weighted average exchange rate of the past four quarters. The exchange rate, Real GDP, stock indexes and the expected exchange rate are measured on the log scale in order to reduce collinearity among right-hand side variables. The sample ranges from 2000.Q1 to 2014.Q2 and has a total of 58 observations. Earlier data for the share price in Hungary are unavailable.

The ADF test on the residuals shows that the value of the test statistic is estimated to be -4.3349, which is greater than the critical value of -4.1305 in absolute values at the 1% level. Thus, these time series variables are cointegrated and have a long-term stable relationship.

Table 1 presents the estimated regression and relevant statistics. The exponential GARCH (EGARCH) model is applied in estimating the parameters. The value of R-squared is 0.8067, suggesting that 80.67% of the variation in the HUF/USD exchange rate can be explained by the nine right-hand side variables. All the coefficients are significant at the 1% level. The HUF/USD exchange rate has a positive relationship with the U.S. Treasury bill rate, U.S. real GDP, U.S. Wilshire 5000 stock index, the Hungarian inflation rate and the expected HUF/USD exchange rate and a negative relationship with the Hungarian Treasury bill rate, Hungarian real GDP, Hungarian share price and the U.S. inflation rate. Except for the stock market index, the coefficient of the U.S. Treasury bill rate, real GDP or inflation rate is greater than the coefficient of a corresponding Hungarian variable in absolute values.

Table 1. *Estimated Regression of the HUF/USD Exchange Rate*

Variable	Coefficient	z-Statistic
Constant	0.756979	9.537934
U.S. Treasury bill rate	0.033721	84.30461
Hungarian Treasury bill rate	-0.019292	-11.02706
LOG(U.S. real GDP)	0.543851	40.15660
LOG(Hungarian real GDP)	-0.136299	-6.268773
LOG(U.S. Wilshire 5000 index)	0.134486	19.04455
LOG(Hungarian stock index)	-0.316863	-39.35076
U.S. inflation rate	-0.018508	-9.016306
Hungarian inflation rate	0.007702	5.848172
LOG(expected exchange rate)	0.282907	15.55974
R-squared	0.8067	
F-statistic	17.4510	
Sample	2000.Q1-2014.Q2	
Sample size	58	
MAPE	5.1825%	

Notes: The dependent variable is the log of the HUF/USD exchange rate. All the coefficients are significant at the 1% level. MAPE is the mean absolute percent error.

Several comments can be made. The traditional view prevails as a higher Hungarian Treasury bill rate would cause the Hungarian Forint to appreciate whereas a higher U.S. Treasury bill rate would cause the U.S. dollar to appreciate. Capital flows to the country with a higher rate of return on financial assets because a higher stock market index in Hungary would cause the Hungarian forint to appreciate, and a higher stock market index in the U.S. would make the U.S. dollar stronger. Inflation plays an important role in the determination of the value of a currency since a higher inflation rate in Hungary would cause the forint to depreciate whereas a higher inflation rate in the U.S. would cause the U.S. dollar to depreciate. An investors expect the HUF/USD to increase or the U.S. dollar to appreciate, the demand for the U.S. would shift to the right, leading to a stronger U.S. dollar.

Several different versions were considered. The Wald test is applied to determine whether the differential form should be used. In all four cases, the hypothesis that the coefficients are the same with the opposite signs can be rejected at the 1% level. Hence, separating each of the variables and assuming different coefficients are the correct approach. If the discount rate in Hungary and the federal funds rate in the U.S. replace the Treasury bill rates, the coefficient of the discount rate is -0.0336 and significant at the 1% level, and the coefficient of the federal funds rate is 0.0182 and significant at the 1% level. The value of R-squared is 0.7956. Other results are similar. When the simple average exchange rate of the past four quarters is used to represent the expected exchange rate, the estimated coefficient is positive but insignificant at the 10% level, the value of R-squared is 0.7638, and other results are similar.

5. Conclusions

This paper has examined the determinants of the Hungarian forint/U.S. dollar exchange rate based on demand and supply analysis. A higher interest rate, more real GDP, a higher stock market index or a lower inflation rate in Hungary would cause the forint to appreciate. A higher interest rate, more real GDP, a higher stock price index and a lower inflation rate in the U.S. would cause the U.S. dollar to appreciate. A higher expected exchange rate would lead to a higher exchange rate.

There are several policy implications. Interest rates, real GDP, stock prices, inflation rates and the expected exchange rate play important roles in exchange rate determination. Monetary easing or tightening leading to a lower or higher interest rate would affect the HUF/USD exchange rate. A stronger economy is essential to a stronger currency. Stock market performance is expected to cause international capital flows into or out of Hungary and the U.S. and affect the exchange rate. It is desirable to maintain a low inflation rate in order to protect the value of a currency.

References

Ardic, O.P., Ergin, O. and Senol, G.B. (2008). Exchange Rate Forecasting: Evidence from the Emerging Central and Eastern European Economies. *Working paper*.

Bilson, J.F.O. (1978). Rational Expectations and the Exchange Rate. In: J.A. Frenkel and H. Johnson (Eds.). *The Economics of Exchange Rates*, Addison-Wesley Press, Reading.

Dekle, R., Hsiao, C. and Wang, S. (2002). High Interest Rates and Exchange Rate Stabilization in Korea, Malaysia, and Thailand: An Empirical Investigation of the Traditional and Revisionist Views. *Review of International Economics.* Vol. 10, pp. 64-78.

Dornbusch, R. (1976). Expectations and Exchange Rate Dynamics. *Journal of Political Economy.* Vol. 84, pp. 1161-1176.

Engel, C. (2010). Exchange Rate Policies. *A Federal Reserve Bank of Dallas Staff Paper*. DIANE Publishing.

Frait, J., Komarek, L. and Melecký, M. (2006). The Real Exchange Rate Misalignment in the Five Central European countries. No 739, Warwick Economic Research Papers, pp. 1-33.

Frankel, J.A. (1979). On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials. *American Economic Review*. Vol. 69, No. 4, pp. 610-622.

Frenkel, J.A. (1976). A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence. *Scandinavian Journal of Economics*. Vol. 78, No. 2, pp. 200-224.

Giannellis, N. and Papadopoulos, A.P. (2011). What Causes Exchange Rate Volatility? Evidence from Selected EMU Members and Candidates for EMU Membership Countries. *Journal of International Money and Finance*. Vol. 30, pp. 39-61.

Huang, P., Hueng, J.C. and Yau, R. (2010). Traditional View or Revisionist View? The Effects of Monetary Policy on Exchange Rates in Asia. *Applied Financial Economics*. Vol. 20, pp. 753-760.

Kębłowski, P. (2011). The Behavior of Exchange Rates in the Central European countries and Credit Default Risk Premiums. *Central European Journal of Economic Modelling and Econometrics.* Vol. 3, pp. 221-236.

Shevchuk, V. (2014). Monetary Model of Exchange Rate Determination: Evidence from the Czech Republic, Hungary and Poland. *Journal of Modern Accounting and Auditing*. Vol. 10, pp. 97-103.

Uz, I. and Ketenci, N. (2010). Exchange Rate Determination: Monetary Approach in the New EU Members and Turkey. *Applied Economics Letters*. Vol. 17, No. 10, pp. 963-967.