Application of Monetary Models of Exchange Rate Determination for Poland

Yu Hsing*

Abstract:

The zloty/USD exchange rate is examined based on the Dornbusch model, the Bilson model, the Frenkel model, and the Frankel model. Empirical results show that the coefficient of the relative money supply is positive and significant, that the coefficient of the relative output is negative and significant, and that the Bilson model or the Frenkel model applies to Poland. Hence, the nominal exchange rate is positively affected by the relative interest rate and the relative expected inflation rate. The Balassa-Samuelson effect is confirmed in both models. The Bilson model has a smaller root mean squared error or mean absolute percent error than the Frenkel model.

Keywords: Dornbusch model, Bilson model, Frenkel model, Frankel model, Balassa-Samuelson effect

JEL: F31

DOI: 10.2478/v10033-008-0011-y

1. Introduction

Since April 2000, Poland has pursued a floating exchange rate regime without setting any restrictions against other foreign currencies. However, the National Bank of Poland, which is the central bank of Poland, reserves the right to take necessary measures to intervene in the foreign exchange market in order to achieve the stated inflation target of 2.5% decided by the Monetary Policy Council, with an allowed deviation of 1 percentage point from either side and to meet the criterion of exchange rate stability in order to join the Eurozone.

According to International Financial Statistics, the zloty/USD exchange rate fluctuated in the short run and exhibited trends in the long run, rising from 1.12 in 1992.M1 to a high of 4.64 in 2000.M10, and then declining to 3.09 in 2006.M10. These statistics suggest that the zloty has become stronger against the U.S. dollar in recent years. The study of the behavior of the zloty/USD exchange rate is significant for several reasons. Exchange rate stability is essential to the growth of international trade. Rapid appreciation of the zloty is expected to hurt exports and help imports, whereas rapid depreciation would help exports and hurt imports. Although depreciation would help exports, depreciation is expected to cause import prices and domestic inflation rates to rise. Currency depreciation may lead to a decrease in real wealth or assets, capital outflows,

less foreign investments, potential problems of repayment of foreign debt, etc. Hence, the study of the behavior of the nominal exchange rate is significant.

Several recent articles studied the exchange rates for Poland and other countries in the region. Dibooglu and Kutun (2001) revealed that real exchange rate fluctuations in Poland and Hungary can be significantly explained by nominal shocks and that real shocks exerted more effect on the exchange rates in Hungary than in Poland. Smidkova, Barrell and Holland (2003) found evidence of overvaluation for Poland and the other three pre-accession countries in 2001 and that economic fundamentals may not necessarily lead to the stability of the real exchange rate. Karfakis and Moschos (2004) showed that macroeconomic fundamentals largely contributed to currency crises in Poland and the Czech Republic. Creel and Levasseur (2004) indicated that that government actions and measures were more credible in Poland than the other two countries

*Hsing:
Southeastern Louisiana University
Hammond, LA 70402, USA
e-mail: yhsing@selu.edu

under study. Barlow (2004) found that the purchasing power parity hypothesis was rejected in Poland, the Czech Republic, and other selected developed countries. Crespo-Cuaresma, Fidrmuc, and MacDonald (2005) found that the monetary model combined with the Balassa-Samuelson effect worked well in explaining exchange rate behaviors for six CEECs. Stavarek (2005) reported that stock prices Granger-caused the exchange rates in Poland, the Czech Republic, Hungary, and Slovakia.

This paper attempts to examine the nominal exchange rate for Poland based on several well-known monetary models (Frenkel and Koske, 2004) including the Dornbusch model (1976), the Bilson model (1978), the Frenkel model (1976), and the Frankel model (1979). Monetary models of exchange rate determination are based on purchasing power parity, interest parity, and the money demand function. The purchasing power parity hypothesis assumes that the nominal exchange rate is a function of the relative price in the two countries under study. The interest parity concept postulates that the nominal exchange rate is determined by the interest rate differential between the two countries. Stable money demand functions for the two countries are expected in deriving a stable exchange rate equation. There are several versions of monetary models of exchange rate determination, partly depending upon whether a sticky price (Dornbusch, 1976; Frankel, 1979) or a flexible price (Frenkel, 1976; Bilson, 1978) is assumed.

Monetary models of the exchange rate have been studied extensively. MacDonald and Taylor (1991, 1993, 1994a, 1994b), Kouretas (1997), Diamandis, Georgoutos and Kouretas (1998), Makrydakis (1998), Husted and MacDonald (1998), Reinton and Ongena (1999), Chinn (1999, 2000), Miyakoshi (2000), Hwang (2001), Tawadros (2001), Civcir (2003), Sarno, Valente, and Wohar (2004), Lee, Azali and Matthews (2007), Bitzenis and Marangos (2007), and others have found evidence in support of the monetary models for some currencies. To measure the potential impact of the productivity differential in the tradable and non-tradable sectors on the nominal exchange rate, the Balassa-Samuelson effect (Balassa, 1964; Samuelson, 1964; Chinn, 1999, 2000; Drine and Rault, 2005; Crespo-Cuaresma, Fidrmuc, and MacDonald, 2005; Lothian and Taylor, 2006) will be tested.

2. The Model

Supposing that the purchasing power parity hypothesis holds, that is, that money demand functions are stable for both countries, and/or that the uncovered interest parity condition is valid, the four different monetary models of the nominal exchange rate can be described by the following equation with different assumptions on the parameters:

$$\varepsilon = \alpha_0 + \alpha_1(M - M^*) - \alpha_2(Y - Y^*) + \alpha_3(R - R^*) + \alpha_4(\pi^e - \pi^{e*}) + v \quad (1)$$

where

- ε = the nominal exchange rate in terms of the zloty per U.S. dollar,
- M = the money supply for Poland,
- Y = real output for Poland
- R = the short-term nominal interest rate for Poland
- π^e = the expected inflation rate for Poland
- M^* = the money supply for the U.S.
- Y^* = real output for the U.S.
- R^* = the short-term nominal interest rate for the U.S.
- π^{e*} = the expected inflation rate for the U.S.
- v = error terms.

The coefficient of the relative money supply is expected to be positive and equal to one, and the coefficient of the relative output is expected to be negative. Different assumptions of these four models are as follows:

The Dornbusch model:

$$\alpha_3 < 0, \alpha_4 = 0$$

The Bilson model:

$$\alpha_3 > 0, \alpha_4 = 0$$

The Frenkel model:

$$\alpha_3 = 0, \alpha_4 > 0$$

The Frankel model:

$$\alpha_3 < 0, \alpha_4 > 0$$

Therefore, the Dornbusch model assumes that an increase in the relative interest rate would cause the zloty to appreciate because a higher domestic interest rate relative to the foreign interest rate would lead to capital inflows and higher demand for the zloty. The Bilson model postulates that an increase in the relative interest rate would cause the zloty to depreciate because the demand for domestic currency would decline in response to a higher domestic interest rate relative to the foreign interest rate. The Frenkel model maintains that an increase in the relative expected inflation rate would lead to the depreciation of the zloty. The Frankel model combines the assumptions of the Dornbusch model and the Frenkel model.

Note that the Dornbusch and Frankel models assume that uncovered interest parity holds and that purchasing power parity holds in the long run. The expected exchange rate change is a function of the interest rate differential or is the deviation of the spot rate from its long-term rate plus the deviation of the actual inflation rate from the expected inflation rate. In other words, the long-term exchange

rate is equal to the short-term exchange rate plus the real interest rate differential.

The Balassa-Samuelson effect can be tested by adding another variable to the first equation:

$$\varepsilon = \beta_0 + \beta_1(M - M^*) - \beta_2(Y - Y^*) + \beta_3(R - R^*) + \beta_4(\pi^e - \pi^{e*}) + \beta_5(P^{TN} - P^{TN*}) + \mu \quad (2)$$

where P^{TN} is the log difference between the tradable sector price and non-tradable sector price in Poland and P^{TN*} is the log difference between the tradable sector price and non-tradable sector price in the U.S.

3. Empirical Results

Monthly data were collected from International Financial Statistics, which is published by the International Monetary Fund. The sample ranges from 1992.M1 to 2005.M12 for the Dornbusch or Bilson model and from 1992.M6 to 2005.M12 for the Frenkel or Frankel model to account for lags in constructing the expected inflation rate. The data for the money supply beyond 2005.M12 had not been published at the time of writing. The exchange rate is expressed as zlotys per U.S. dollar.¹ M2 money is used for the money supply and is expressed in millions for Poland and billions for the U.S. Industrial production is selected to represent output as data for real GDP are not available on a monthly basis.² The money market rate in Poland and the federal funds rate in the U.S. are chosen to represent the interest rates. The average inflation rate of the past four months is used to represent the expected inflation rate.³ The tradable sector price is represented by the producer price index, and the non-tradable sector price is represented by the consumer price index.⁴ Except for the interest rates and expected inflation rates, all other variables are measured in the logarithmic scale.

In the unit root test, the critical values are -3.468, -2.878, and -2.576 at the 1%, 5%, and 10% levels. All the variables have unit roots in levels and are stationary in first difference at the 5% level. According to the Johansen test, in equation (1), because the value of the trace statistic is estimated to be 125.563 compared with the critical value of 69.819, the null hypothesis that the exchange rate and other variables in equation (1) are not cointegrated cannot be rejected at the 5% level. In a similar manner, in equation (2), because the trace statistic of 159.091 is greater than the critical

value of 95.754, the null hypothesis of no cointegration cannot be rejected at the 5% level.

According to the Granger causality test, ε and $Y - Y^*$ Granger cause each other, and $P^{TN} - P^{TN*}$ and $Y - Y^*$ Granger cause each other. ε Granger causes $\pi^e - \pi^{e*}$ or $P^{TN} - P^{TN*}$ but not vice versa. $M - M^*$ Granger causes $Y - Y^*$, $\pi^e - \pi^{e*}$, or $P^{TN} - P^{TN*}$ but not vice versa. $R - R^*$ Granger causes $Y - Y^*$ but not vice versa. $\pi^e - \pi^{e*}$ Granger causes $Y - Y^*$ but not vice versa. $R - R^*$ Granger causes $\pi^e - \pi^{e*}$ but not vice versa. $\pi^e - \pi^{e*}$ Granger causes $P^{TN} - P^{TN*}$ but not vice versa.

Test of the Dornbusch and Bilson Models:			
(A)	$\varepsilon = -1.457 + 0.690(M - M^*) - 0.384(Y - Y^*) + 0.006(R - R^*)$	$R^2 = 0.956$	
	(-0.693) (20.779) (-3.344) (+2.384)		
Test of the Frenkel Model:			
(B)	$\varepsilon = -1.399 + 0.688(M - M^*) - 0.470(Y - Y^*) + 0.028(\pi^e - \pi^{e*})$	$R^2 = 0.945$	
	(-9.419) (18.692) (-3.309) (1.825)		
Test of the Frankel Model:			
(C)	$\varepsilon = -1.502 + 0.699(M - M^*) - 0.344(Y - Y^*) + 0.006(R - R^*) + 0.016(\pi^e - \pi^{e*})$	$R^2 = 0.949$	
	(-8.834) (18.237) (-3.023) (2.417) (0.999)		
Test of the Balassa-Samuelson Effect:			
(D)	$\varepsilon = -1.878 + 0.794(M - M^*) - 0.243(Y - Y^*) + 0.004(R - R^*) + 1.481(P^{TN} - P^{TN*})$	$R^2 = 0.966$	
	(-10.352) (18.341) (-2.482) (1.869) (3.842)		
(E)	$\varepsilon = -1.954 + 0.820(M - M^*) - 0.265(Y - Y^*) + 0.038(\pi^e - \pi^{e*}) + 1.593(P^{TN} - P^{TN*})$	$R^2 = 0.959$	
	(-11.385) (19.390) (-2.399) (2.734) (4.183)		

Notes:

Figures in the parenthesis are t-ratios.

The critical values at the 1%, 2.5%, 5%, and 10% significance levels are 2.364, 1.984, 1.660, and 1.290, respectively.

P^{TN} is the log difference between the tradable sector price and non-tradable sector price in Poland.

P^{TN*} is the log difference between the tradable sector price and non-tradable sector price in the U.S.

Table 1. Estimated Regressions of the Nominal Exchange Rate for Poland

Table 1 presents estimated regressions for different models and related statistics. The level form is employed in empirical work because the use of first-difference may obscure the outcome (Greene, 2003). The Newey-West (1987) method is applied to yield consistent estimates for the standard error and covariance when the forms of autocorrelation and heteroskedasticity are uncertain. In version (A), the positive coefficient of the relative money supply and the negative coefficient of the relative output are as expected and are significant at the 1% level. The positive and significant coefficient of the relative interest rate suggests that the behavior of the exchange rate in Poland can be characterized by the Bilson model better

1. The EUR/PLN exchange rate may be considered due to its increasing significance after joining the EU. However, the earliest data for the EUR/PLN exchange rate begin in 1999. The sample size may not be large enough to test monetary models.

2. Ideally, real GDP instead of industrial production should be used in empirical work. However, real GDP is reported on a quarterly basis, whereas industrial production is reported on a monthly basis. If real GDP is used in empirical work, the sample size will reduce by 75%, making the test of hypotheses more unreliable.

3. Consumer inflation expectations published by the NBP may be employed. However, numerical values were not readily available. Furthermore, the series ended in 2002.M12, which would reduce 36 observations in the sample.

4. The selection of the PPI and CPI to represent the price levels for the tradable and non-tradable goods may not reflect the changing composition of the service sector.

than the Dornbusch model. It implies that an increase in the relative interest rate is expected to cause the zloty to depreciate.

In version (B), the Frenkel model is tested. The coefficients of the relative money supply and the relative output have the expected signs and are significant. The positive and significant coefficient of the relative expected inflation rate indicates that an increase in the relative expected inflation rate would cause the zloty to depreciate.

In version (C), the Frankel model is tested. The coefficients of the relative money supply and the relative output have the expected signs and are significant. The positive and significant coefficient of the relative interest rate is opposite to the assumption of the Frankel model. The coefficient of the relative expected inflation rate is positive but insignificant.

In every version the null hypothesis that $\alpha_1 = 1$ can be rejected at the 5% level. The root mean squared error is used to determine which model would perform better in forecasting. The root mean squared error is 0.229 in the Bilson model and 0.241 in the Frenkel model. The mean absolute percent error is 5.673% in the Bilson model and 5.760% in the Frenkel model. Hence, the Bilson model has smaller forecast errors than the Frenkel model.

To measure the effect of the productivity differential in the tradable and non-tradable sectors on the exchange rate, the Balassa-Samuelson (1964) effect is tested. The coefficient of the relative price of the tradable to non-tradable goods is positive and significant at the 1% level in the Bilson model in version (D) and in the Frenkel model in version (E) in Table 1. The Balassa-Samuelson effect is not tested in the Frankel model because of an incorrect sign for the coefficient of the relative interest rate.

The error correction model with a lag length of two is considered. In versions (B), (C), and (E), the coefficient of the error correction term is insignificant at the 10% level. In version (A), the coefficient of the error correction term is negative and significant, $\Delta(\varepsilon_{t-1})$ has a significant coefficient with a positive value, and all other coefficients are insignificant. In version (D), $\Delta(\varepsilon_{t-1})$ and $\Delta(\varepsilon_{t-2})$ have significant coefficients, and all other coefficients are insignificant. To save space, details of the results are not printed here and will be available upon request.

To account for a possible impact of the adoption of a floating exchange rate policy since April 2000, a dummy variable with a value of zero before April 2000 and one since April 2000 has been considered. The coefficient of the dummy variable is positive but insignificant at the 10% level in the Dornbusch model, the Bilson model, the Frenkel model, and the Frankel models, and it is positive and significant at the 2.5% level in the regressions with the Balassa-Samuelson effect. These results suggest that the pursuit of a floating exchange rate may lead to a depreciation of the zloty, holding other factors constant.

Several different measurements or versions are considered. Treasury bill rates in Poland and the U.S. may be considered to represent the relative interest rate. However, the data of the Treasury bill rate in Poland are not complete. Real GDP may substitute industrial production in empirical work. However, the sample size based on quarterly data will decrease 75%, causing hypothesis tests to become less reliable. Attempts were made to include the relative stock price in the models without success due to the lack of complete data for the stock price in Poland during the sample period. To save space, these results are not presented and will be available upon request.

4. Summary and Conclusions

This paper has examined the exchange rate behavior for Poland based on four well-known models. Empirical results show that the Bilson model and the Frenkel model characterize the behavior of the nominal exchange rate for Poland better than the Dornbusch model and the Frankel model. The positive and significant coefficient of the relative interest rate in the Bilson model indicates that raising the domestic interest rate relative to the foreign interest rate would cause the zloty/USD exchange rate to rise or the zloty to depreciate. The positive and significant coefficient of the relative expected inflation rate in the Frenkel model suggests that a higher expected domestic inflation rate relative to the expected foreign inflation rate would cause the zloty to depreciate or the zloty/USD exchange rate to rise. The monetary models can explain the behavior of the zloty/USD exchange rate reasonably well in view of a relatively high value of R^2 and a relatively small value of the root mean squared error or the mean absolute percent error.

There are several policy implications. The Bank of Poland needs to monitor its money supply. Increased money supply in Poland relative to the money supply in the U.S. would cause the zloty to depreciate. Contrary to what many countries have been practicing, raising the domestic interest rate relative to the U.S. interest rate would not help to appreciate the zloty against the U.S. dollar. A higher interest rate hurts consumption and investment spending and would cause the zloty to depreciate even though it would cause international capital inflows and increase the demand for the zloty. Maintaining price stability and a low inflation rate would help protect the value of the zloty. The positive and significant coefficient of the relative tradable to non-tradable prices may suggest that productivity differential is important in the determination of the nominal exchange rate.

There may be potential areas for future research. The monetary models are based on the assumptions of a stable money demand function and the validity of purchasing power parity and uncovered interest parity. It may be interesting to study whether the money demand functions

for Poland and the U.S. would be stable. The monetary models may be compared with other exchange rate models such as the one based on an open economy IS, the monetary policy function, and an augmented Phillips curve (Romer, 2006). In this exchange rate model, the central bank determines the short-term interest rate based on the inflation rate gap, the output gap, and other related variables such as the exchange rate and the world interest rate. If currency depreciation leads to a higher inflation rate, the central bank would raise the interest rate, which, in turn, is expected to reduce aggregate spending and output. $\square$

References

- Barlow, D. 2004. Purchasing power parity in three transition economies, *Economics of Planning*, 36, 201-21.
- Bilson, J. F. O. 1978. Rational expectations and the exchange rate, in: J. Frenkel and H. Johnson, eds., *The Economics of Exchange Rates*, Addison-Wesley Press, Reading.
- Bitzenis, A. and Marangos, J. 2007. The monetary model of exchange rate determination: the case of Greece (1974-1994), *International Journal of Monetary Economics and Finance*, 1, 57-88.
- Cheung, Y.-W., Chinn, M. D. and Pascual, A. G. 2005. Empirical exchange rate models of the nineties: are any fit to survive? *Journal of International Money and Finance*, 24, 1150-75.
- Chinn, M. D. 1999. On the won and other East Asian currencies, *International Journal of Finance and Economics*, 4, 113-27.
- Chinn, M. D. 2000. Before the fall: were East Asian currencies overvalued? *Emerging Markets Review*, 1, 101-26.
- Civcir, I. 2003. The monetary models of the Turkish Lira/dollar exchange rate: long-run relationships, short-run dynamics and forecasting, *Eastern European Economics*, 41, 43-69.
- Crespo-Cuaresma, J., Fidrmuc, J., and MacDonald, R. 2005. The monetary approach to exchange rates in the CEECs, *Economics of Transition*, 13, 395-416.
- Diamandis, P. F., Georgoutos, D. A. and Kouretas, G. P. 1998. The monetary approach to the exchange rate: long-run relationships, identification and temporal stability, *Journal of Macroeconomics*, 20, 441-66.
- Dibooglu, S., and Kutan, A. M. 2001. Sources of real exchange rate fluctuations in transition economies: the case of Poland and Hungary, *Journal of Comparative Economics*, 29, 257-75.
- Dornbusch, R. 1976. Expectations and exchange rate dynamics, *Journal of Political Economy*, 84, 1161-76.
- Drine, I. and Rault, C. 2005. Can the Balassa-Samuelson theory explain long-run real exchange rate movements in OECD countries? *Applied Financial Economics*, 15, 519-30.
- Frankel, J. A. 1979. On the mark: a theory of floating exchange rates based on real interest differentials, *American Economic Review*, 69, 610-22.
- Frenkel, M. and Koske, I. 2004. How well can monetary factors explain the exchange rate of the euro?, *Atlantic Economic Journal*, 32, 232-43.
- Frenkel, J. A. 1976. A monetary approach to the exchange rate: doctrinal aspects and empirical evidence, *Scandinavian Journal of Economics*, 78, 200-24.
- Fuhrer, J. C. and Weiller, K. J. 1991. Multivariate posterior odds approach to assessing competing exchange rate models, *Review of Economics & Statistics*, 73, 113-24.
- Greene, 2003. *Econometric Analysis*, 5th edition, Upper Saddle River, New Jersey.
- Hooper, P. and Morton, J. E. 1982. Fluctuations in the dollar: a model of nominal and real exchange rate determination, *Journal of International Money and Finance*, 1, 39-56.
- Husted, S. and MacDonald, R. 1998. Monetary-based models of the exchange rate: a panel perspective, *Journal of International Financial Markets, Institutions and Money*, 8, 1-19.
- Hwang, J. K. 2001. Dynamic forecasting of monetary exchange rate models: evidence from cointegration, *International Advances in Economic Research*, 7, 51-64.
- Karfakis, C., and D. Moschos 2004. Predicting currency crises: evidence from two transition Economies, *Emerging Markets Finance and Trade*, 40, 95-103.
- Kouretas, G. P. 1997. Identifying linear restrictions on the monetary exchange rate model and the uncovered interest parity: cointegration evidence from the Canadian US dollar, *Canadian Journal of Economics*, 30, 875-90.
- Lobo, B. J. 2002. Large changes in major exchange rates: a chronicle of the 1990s, *Applied Financial Economics*, 12, 805-11.
- Lothian, J. R. and Taylor, M. P. 2006. Real exchange rates over the past two centuries: how important is the Harrod-Balassa-Samuelson effect? University of Warwick, Department of Economics, Warwick Economics Research Paper Series (TWERPS).

- MacDonald, R. and Taylor, M. P. 1991. The monetary approach to the exchange rate: long-run relationships and coefficient restrictions, *Economics Letters*, 37, 179-85.
- MacDonald, R. and Taylor, M. P. 1992. Exchange rate economics, *IMF Staff Paper*, 39, 437-89.
- MacDonald, R. and Taylor, M. P. 1993. The monetary approach to the exchange rate: rational expectations, long-run equilibrium, and forecasting, *IMF Staff Papers*, 40, 89-107.
- MacDonald, R. and Taylor, M. P. 1994a. The monetary model of the exchange rate: long-run relationships, short-run dynamics and how to beat a random walk, *Journal of International Money and Finance*, 13, 276-90.
- MacDonald, R. and Taylor, M. P. 1994b. Re-examining the monetary approach to the exchange rate: the dollar-franc, 1976-90, *Applied Financial Economics*, 4, 423-9.
- Meese, R. A. and Rogoff, K. 1983. Empirical exchange rate models of the seventies: do they fit out of sample? *Journal of International Economics*, 14, 3-24.
- Makrydakis, S. 1998. Testing the long-run validity of the monetary approach to the exchange rate: the won-US dollar case, *Applied Economics Letters*, 5, 507-11.
- Miyagawa, T., Toya, H., and Makino, T. 2004. Equilibrium exchange rates in Asian currencies, *Seoul Journal of Economics*, 17, 483-509.
- Miyakoshi, T. 2000. The Monetary Approach to the Exchange Rate: Empirical Observations from Korea, *Applied Economics Letters*, 7, 791-94.
- Newey, W. K. and West, K. D. 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica*, 55, 703-8.
- Reinton, H. and Ongena, S. 1999. Out-of-sample forecasting performance of single equation monetary exchange rate models in Norwegian currency markets, *Applied Financial Economics*, 9, 545-50.
- Romer, D. 2006. *Advanced Macroeconomics*, 3rd edition. Boston: McGraw-Hill/Irwin.
- Sarno, L., Valente, G., and Wohar, M. E. 2004. Monetary fundamentals and exchange rate dynamics under different nominal regimes, *Economic Inquiry*, 42, 179-93.
- Schroder, M. and Dornau, R. 2002. Do forecasters use monetary models? an empirical analysis of exchange rate expectations, *Applied Financial Economics*, 12, 535-43.
- Smidkova, K., R. Barrell, and D. Holland 2003. Estimates of fundamental real exchange rates for the five EU pre-accession countries, *Prague Economic Papers*, 12, 291-16.
- Tawadros, G. B. 2001. The predictive power of the monetary model of exchange rate determination, *Applied Financial Economics*, 11, 279-86.
- Taylor, M. P. 1995. The economics of exchange rates, *Journal of Economic Literature*, 33, 13-47.
- Taylor, A. M. and Taylor, M. P. 2004. The purchasing power parity debate, *Journal of Economic Perspectives*, 18, 135-58.