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Exchange Rate Dynamics: The Overshooting Model (With Sticky Prices)

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Abstract

The objective of this paper is to test the exchange rate dynamics by measuring the speed of adjustment of prices. In this overshooting model, we assume price stickiness (gradual adjustment). If the prices are adjusted instantaneously, we will have the monetarist view; otherwise, the overshooting one, due to slow adjustment of prices and consequently, it affects all the other variables and slowly the exchange rate. We outline, here, an approach of testing the dynamic models of exchange rate determination. This approach is based upon the idea that it is difficult to measure directly the process by which market participants revise their expectations about current and future money supplies. On the other hand, it is possible to make indirect inferences about these expectations through a time series analysis of related financial and real prices. Empirical tests of the above exchange rate dynamics are taking place for four different exchange rates ($/€, $/£, C$/$, and ¥/$). Theoretical discussion and empirical evidence have emphasized the impact of gradual adjustment and "overshooting" that it is taking place. Only for the $/€ exchange rate the monetarist model is correct.

Keywords: Demand for Money and Exchange Rate Foreign Exchange Forecasting and Simulation Information and Market Efficiency International Financial Markets.

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1. Introduction

The Monetarist model, Bilson (1978), assumes instantaneous adjustment in all markets. An important modification was set forth by Dornbusch (1976), who assumed that asset markets adjust instantaneously, where prices in goods markets adjust slowly (gradually). The resulting exchange rate dynamics model retains all the long run equilibrium or steady state properties of the monetary approach, but in the short run, the real exchange rate and the interest rate can diverge from their long run levels. Then, the monetary policy can have effects on real variables (production) in the system. Thus, exchange rate dynamics or "overshooting" can occur in any model, in which some markets do not adjust instantaneously.

This sticky price version is a Keynesian model of the monetary approach. Purchasing power parity ($p_t = s_t\, p_t^*$) may be a good approximation in the long run, but it does not hold in the short run. There are long term contracts, imperfect information, high cost of acquiring information, inertia in consumer habits, price control in some countries, the uncertainty about the future economy that the effective lower bound (i_{FF}^e) has created,[1] and other restrictions, which do not allow prices to change instantaneously, but adjust gradually. This gives us a model of exchange rate determination, in which changes in the nominal money supply (M^s) are also changes in the real money supply ($\frac{M^s\uparrow}{\overline{P}} = \frac{M^s}{P}\uparrow$) because prices are sticky, so the effect is real, as follows:

$$\frac{M^s\uparrow}{\overline{P}} \Rightarrow \frac{M^s}{P}\uparrow \Rightarrow D_{Bonds}\uparrow \Rightarrow P_{Bonds}\uparrow \Rightarrow i\downarrow \Rightarrow K_{outflow} \Rightarrow S_{S-R}\uparrow\uparrow\uparrow \Rightarrow (\$\downarrow) \Rightarrow X\uparrow \text{ and } M\downarrow$$

In the short run, because prices are sticky ($\overline{P}$), a nominal monetary expansion ($M^s\uparrow$) has an increase in real money (purchasing power, $\frac{M^s}{P}\uparrow$), which increases the demand for bonds ($D_{Bonds}\uparrow$) and the prices of bonds are increasing ($P_{Bonds}\uparrow$) that has a liquidity effect. Thus, the interest rate falls ($i\downarrow$), generating an incipient capital outflow ($K_{outflow}$), which causes the currency to depreciate instantaneously ($S_{S-R}\uparrow\uparrow\uparrow$) more than it will in the long run, which stimulate exports ($X\uparrow$) and discourages imports ($M\downarrow$), as shown in Figure 1. The currency

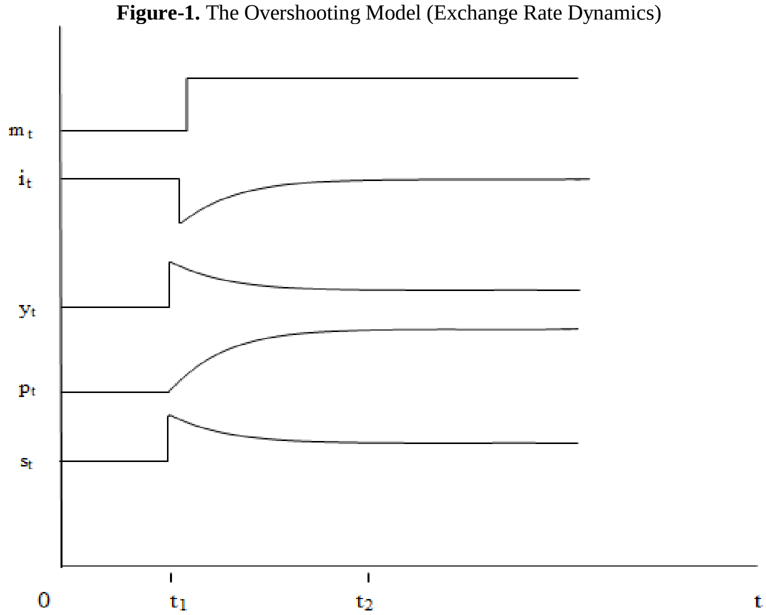
[1] The federal funds rate (i_{FF}) was between 0% and 0.25% for eight years, since December 2008, by the Fed and the effective (i_{FF}^e) closed to zero. Consumers and firms reduced demand and supply of products because the Fed policy had increased their uncertainty for the future outcomes of the economy. This policy had no effect on output and employment, but it has affected prices, due to enormous liquidity and has generated a new bubble. The DJIA from 6,547.05 (3/9/2009) reached 26,616.71 (1/26/2018), a growth of 306.55% in 8.83 years (34.72% p.a.). The last few days, it has lost over 500 points; the bubble is losing air. See, Plante *et al.* (2017). Fed's Effective Lower Bound Constraint on Monetary Policy Created Uncertainty. *Economic Letter, Dallas Fed*, 12(11): 1-4. Also, official inflation rate ($\overline{\pi}$ = 1.6% p.a.) and the SGS one ($\overline{\pi}$ = 6%). See, http://www.usinflationcalculator.com/inflation/current-inflation-rates/ . And http://www.shadowstats.com/alternate_data/inflation-charts

depreciates just enough, so that the rationally expected rate of future appreciation precisely cancels out the interest differential. This is known as "overshooting" of the spot exchange rate.

The overshooting results are consistent with perfect foresight. The assumptions of the model are that goods' prices are sticky (price inertia in the short run), prices of currencies are flexible, arbitrage in asset markets holds [uncovered interest parity (UIP)], and expectations of exchange rate changes are rational. Initial shocks are unanticipated, but when they occur, overshooting clears the way for a time path of the domestic interest rate and the exchange rate that is consistent with perfect foresight on the part of market participants. Given that an unanticipated increase in the domestic money supply in period t_1 would temporarily lower the domestic interest rate (liquidity effect), expectations of currency appreciation are necessary in order to induce individuals to continue to hold domestic securities and money.

When a monetary shock occurs in period t_1 (unanticipated increase in the money supply); the market will adjust to a new equilibrium, which will be between prices and quantities. Due to price stickiness in the goods market, the short run equilibrium will be achieved through shifts in financial market prices. As prices of goods increase gradually toward the new equilibrium in period t_2, the foreign exchange continuous re-pricing approaching its long term equilibrium level. Then, a new long run equilibrium will be attained in the domestic money, currency exchange, and goods markets. As a result, the exchange rate will initially overreact (overshoot), due to a monetary shock. Over time, goods prices will respond, allowing the foreign exchange rate to restrain its overreaction and the economy will reach its new long run equilibrium in all markets in period t_2 (Figure 1).[2]

Figure-1. The Overshooting Model (Exchange Rate Dynamics)



Note: m_t = money supply, i_t = interest rate, y_t = real output (production), p_t = price level, and s_t = spot exchange rate. $M^s \uparrow \Rightarrow (\bar{P}) \Rightarrow \frac{M^s}{P} \uparrow \Rightarrow D_{Bonds} \uparrow \Rightarrow P_{Bonds} \uparrow \Rightarrow i \downarrow \Rightarrow$ capital outflows $\Rightarrow$ currency depreciates instantaneously more than it will in the long-term.

2. The Theoretical Model

The overshooting model can be presented with the following equations:

The money demand function,

$$m_t = \bar{p}_t + \alpha + \beta y_t - \gamma i_t + \varepsilon_t \tag{1}$$

where, m_t = demand for money, $\bar{p}_t$ = the (sticky) price level, α = the constant term, y_t = the real income, and i_t = the short-term interest rate; variables are in natural logarithms ($m_t = \ln M^d = \ln M^s = \ln M$).

The uncovered interest parity,

$$i_t - i_t^* = \Delta s_t^e = s_{t+1}^e - s_t \tag{2}$$

where, i_t = the domestic short-term interest rate, i_t^* = the foreign short-term interest rate, Δs_t^e = expected change of the spot exchange rate, s_{t+1}^e = expected spot rate next period, and s_t = current actual spot rate; and an asterisk (*) means foreign variable.

[2] See, Kallianiotis,(2013a)

The long-run PPP,

$$\bar{s}_t = \bar{p}_t - \bar{p}_t^* \quad (3)$$

The bars (i.e., $\bar{p}$) over the variables mean that the relationship holds in the long run.

The long run monetarist exchange rate equation,

$$\bar{s}_t = (\bar{m}_t - \bar{m}_t^*) - \beta(\bar{y}_t - \bar{y}_t^*) + \gamma(\Delta\bar{p}_t^e - \Delta\bar{p}_t^{*e}) + \varepsilon_t \quad (4)$$

We assume that expectations are rational and the system is stable. Income growth is exogenous [random with $E(g_y) = 0$] and monetary growth follows a random walk. Thus, the relative money supply and, in the long run, the relative price level and exchange rate, are all rationally expected to follow paths that increase at the current rate of relative money growth ($g_{m_t} - g_{m_t^*}$ or $\dot{m}_t - \dot{m}_t^*$).

Then, equation (4) becomes,

$$\bar{s}_t = (m_t - m_t^*) - \beta(y_t - y_t^*) + \gamma(g_{m_t} - g_{m_t^*}) + \varepsilon_t \quad (5)$$

In the short run, when the exchange rate deviates from its equilibrium path, it is expected to close that gap with a speed of adjustment of Θ (theta). In the long run, when the exchange rate lies on its equilibrium path, it is expected to increase at ($g_{m_t} - g_{m_t^*}$).

$$\Delta s_t^e = -\Theta(s_t - \bar{s}_t) + g_{m_t} - g_{m_t^*} \quad (6)$$

By combining (6) with (2), we obtain,

$$i_t - i_t^* = -\Theta(s_t - \bar{s}_t) + g_{m_t} - g_{m_t^*} \quad (7)$$

and putting the growth of money equal to the expected inflation,

$$g_{m_t} - g_{m_t^*} = \pi_t^e - \pi_t^{*e} \quad (8)$$

we have,

$$s_t - \bar{s}_t = -\frac{1}{\Theta}[(i_t - \pi_t^e) - (i_t^* - \pi_t^{*e})] \quad (9)$$

Equation (9) shows that the gap between the exchange rate and its equilibrium value is proportional to the real interest rate differential. When a tight domestic monetary policy causes the interest differential to rise above its equilibrium level, an incipient capital inflow causes the value of the domestic currency to rise (spot rate falls) proportionately above its equilibrium level.

Now, by combining eq. (5), which represents the long run monetary equilibrium path, with eq. (9), representing the short run overshooting effect, we can obtain a general monetary equation of exchange rate determination,

$$s_t = \bar{s}_t - \frac{1}{\Theta}[(i_t - \pi_t^e) - (i_t^* - \pi_t^{*e})] + \varepsilon_t \quad (10)$$

and

$$s_t = (m_t - m_t^*) - \beta(y_t - y_t^*) + \gamma(g_{m_t} - g_{m_t^*}) - \frac{1}{\Theta}[(i_t - \pi_t^e) - (i_t^* - \pi_t^{*e})] + \varepsilon_t \quad (11)$$

Equation (11) is an expansion of the monetarist equation with the addition of the fourth variable, the real interest differential between the two countries. If the monetarist model is correct, the last variable must have a coefficient of zero, which means that the speed of adjustment (Θ) is infinite. By considering that the level of the money supply, rather than the change in the money supply, is a random walk; the expected long run inflation differential ($\pi_t^e - \pi_t^{*e}$) is zero.

Equation (11) becomes,

$$s_t = (m_t - m_t^*) - \beta(y_t - y_t^*) - \frac{1}{\Theta}(i_t - i_t^*) + \varepsilon_t \quad (12)$$

The above equation (12) is the Dornbusch equation, which can be tested econometrically by estimating eq. (11). A question remains, here; whether or not the domestic and foreign bonds are perfect substitutes. The violation of this assumption means that the interest differential will differ from the expected rate of currency depreciation. This difference may arise due to transaction costs, expectation errors or a risk premium, as most financial analysts consider being the case.

Assuming that the real rate of interest is the same in the two countries ($r_t = r_t^*$), eq. (12) becomes,

$$s_t = (m_t - m_t^*) - \beta(y_t - y_t^*) + \frac{1}{\Theta}(\pi_t^e - \pi_t^{*e}) + \varepsilon_t \quad (13)$$

Equation (13) is an equation that can also be tested by using eq. (14), an expansion of the monetarist equation, to determine the speed of adjustment of prices (Θ), which will prove to us what model is correct, the monetarist ($\Theta \cong \infty$) or the overshooting ($\Theta \neq \infty$).

$$s_t = (m_t - m_t^*) - \beta(y_t - y_t^*) + \gamma(g_{m_t} - g_{m_t^*}) + \frac{1}{\Theta}(\pi_t^e - \pi_t^{*e}) + \varepsilon_t \quad (14)$$

Equation (14) is an expansion of the monetarist equation with the addition of the fourth variable, the expected inflation differential between the two countries

3. Data and Empirical Results

The data are monthly and are coming from *Economagic.com*, *Eurostat*, and *Bloomberg*. For the euro (€), the data are from 1999:01 to 2017:01 and for the other four currencies ($, £, C$, and ¥) from 1971:01 to 2017:01. Other data, beyond the four exchange rates ($/€, $/£, C$/$, and ¥/$) used, here, are T-Bill rates, money supplies, incomes, and price levels (CPIs). An empirical test of the overshooting and monetarist model is taking place, which will give the dynamics of exchange rates. Recent tests for the $/€ exchange rate conducted by (Kallianiotis (2013a)) show that the evidence are supporting the overshooting model.[3] The implication of these empirical findings is that the market oriented economies have an instantaneous price adjustment ($\Theta \cong \infty$) and some less market oriented ones have a gradual adjustment of their prices ($\Theta \neq \infty$), as it was expected; thus, prices are not a monetary phenomenon everywhere, but a cost-push (speculation, profit maximization, lack of competition) process (supply side inflation).

We start forecasting the $\hat{\pi}_t^e$ for the five economies and the results are presented in Table 1.

[3] Equation (11) is tested to see whether the monetarist or the overshooting model is correct. First, the equation is running as it is in the theory.

$$s_t = -3.258^{***}(m_t - m_t^*) + 0.397^{***}(y_t - y_t^*) - 0.396(g_{m_t} - g_{m_t^*}) + 0.273^{***}[(i_t - \pi_t^e) - (i_t^* - \pi_t^{*e})]$$
$$(0.337) \qquad (0.036) \qquad (1.401) \qquad (0.044)$$

$$R^2 = 0.559, \quad SSR = 0.826, \quad D-W = 0.242, \quad N = 96$$

The coefficient $\frac{1}{\Theta} \neq 0$, reveals that the speed of adjustment is small ($\Theta = 3.663$). The highest the theta (Θ), the highest the speed of adjustment of prices. But, the statistics show a high serial correlation of the error term ($D-W \neq 2$) and a correction must take place by using some $MA(q)$ processes.

$$s_t = -2.319^{***}(m_t - m_t^*) + 0.225^{***}(y_t - y_t^*) + 1.232^{***}(g_{m_t} - g_{m_t^*}) + 0.043^{**}[(i_t - \pi_t^e) - (i_t^* - \pi_t^{*e})]$$
$$(0.407) \qquad (0.031) \qquad (0.232) \qquad (0.022)$$

$$+1.697^{***}\varepsilon_{t-1} + 1.684^{***}\varepsilon_{t-2} + 1.183^{***}\varepsilon_{t-3} + 0.672^{***}\varepsilon_{t-4}$$
$$(0.079) \qquad (0.154) \qquad (0.156) \qquad (0.081)$$

$$R^2 = 0.956, \quad SSR = 0.082, \quad D-W = 1.857, \quad N = 96$$

The above equation shows that the results are unbiased and the last term (the real interest differential) is statistically significant (at the 5% level) different than zero ($\frac{1}{\Theta} = 0.043 \Rightarrow \Theta = 23.253$). Then, the speed of adjustment ($\Theta \neq \infty$) is finite and the Monetarist model is not correct. The empirical results show that we have gradual adjustment of prices and "overshooting" is taking place. See, Kallianiotis, J. N., *Exchange Rates and International Financial Economics: History, Theories, and Practices*.

Table-1. Forecasting Inflation Rates $\hat{\pi}_t^e$ with an ARMA (p, q) Process

$\hat{\pi}_t^e$ **(U.S.)**	$\hat{\pi}_t^{*e}$ **(EMU)**	$\hat{\pi}_t^{*e}$ **(U.K.)**	$\hat{\pi}_t^{*e}$ **(Canada)**	$\hat{\pi}_t^{*e}$ **(Japan)**	
c	4.651***	4.541***	3.588***	3.962***	4.596***
	(0.697)	(0.099)	(1.037)	(0.491)	0.033)
π_{t-1}	1.995***	0.996***	1.996***	1.998***	1.237***
	(0.001)	(0.011)	(0.001)	(0.001)	(0.067)
π_{t-2}	-0.994***	-	-0.996***	-0.998***	-0.240***
	(0.01)		(0.001)	(0.001)	(0.067)
ε_{t-1}	-0.553***	-	-0.782***	-0.926***	-
	(0.028)		(0.038)	(0.017)	
ε_{t-2}	-0.308***	-	-0.127***	-	-0.202***
	(0.029)		(0.039)		(0.065)
R^2	0.999	0.989	0.999	0.999	0.970
SSR	0.004	0.011	0.011	0.004	0.004
F	3,787,968	11,838.99	1,541,234	2,773,330	2,512.773
$D-W$	1.924	1.935	1.990	1.924	1.985
N	555	267	540	554	312

Note: R^2 = R-squared, SSR = sum of squared residuals, F = F-Statistic, $D-W$ = Durbin-Watson Statistic, N = number of observations, *** = significant at the 1% level, ** = significant at the 5% level, and * = significant at the 10% level.
Source: *Economagic.com*, *Bloomberg*, and *Eurostat*.

Then, we estimate eq. (11) to determine the speed of adjustment (Θ) and it is shown in Table 2a. For the $/€ exchange rate, the $\frac{1}{\Theta} = 0.001 \cong 0$ (statistically insignificant); then, $\Theta \cong \infty$, the monetarist model is correct. The $/£ exchange rate has $\frac{1}{\Theta} = 0.037$ (statistically significant at the 1% level), which gives a $\Theta = 26.816$; there is overshooting, here (the monetarist model is not correct). Then, the C$/$ exchange rate gives $\frac{1}{\Theta} = 0.020$ (significant at the 1% level) and $\Theta = 51.033$, which shows overshooting of exchange rate. Lastly, the ¥/$ exchange rate has a $\frac{1}{\Theta} = 0.025$ (statistically significant at the 1% level) and its $\Theta = 39.390$; thus, the monetarist model is not correct, overshooting takes place.

Table-2a. Estimation of the Overshooting Model, Eq. (11)

$$s_t = \alpha(m_t - m_t^*) - \beta(y_t - y_t^*) + \gamma(g_{m_t} - g_{m_t^*}) - \frac{1}{\Theta}[(i_t - \pi_t^e) - (i_t^* - \pi_t^{*e})] + \varepsilon_t$$

	α	β	γ	$\frac{1}{\Theta}$	R^2	SSR	F	$D-W$	N
$/€	-1.317***	0.182***	0.001	0.001	0.177	4.020	-	0.040	204
	(0.200)	(0.027)	(0.001)	(0.001)					
$/£	0.063***	0.246***	-0.001	-0.037***	0.159	2.118	-	0.077	311
	(0.017)	(0.027)	(0.001)	(0.004)					
C$/$	0.490***	-0.408***	-0.001	0.020***	0.600	2.788	-	0.040	428
	(0.020)	(0.021)	(0.001)	(0.003)					
¥/$	-0.761***	1.059***	-0.001	0.025***	0.320	3.533	-	0.059	258
	(0.015)	(0.060)	(0.001)	(0.006)					

Note: See, Table 1.
Source: See, Table 1.

Now, we run eq. (11) by correcting the serial correlation of the error term and the results are given in Table 2b. For the $/€ exchange rate $\frac{1}{\Theta} = 0.013 \cong 0$ (statistically insignificant); thus, $\Theta \cong \infty$ and we have instantaneous adjustment of prices (no overshooting, but monetarist model is

Table-2b. Estimation of the Overshooting Model, Eq. (11), with Correction of Serial Correlation

$$s_t = \alpha(m_t - m_t^*) - \beta(y_t - y_t^*) + \gamma(g_{m_t} - g_{m_t^*}) - \frac{1}{\Theta}[(i_t - \pi_t^e) - (i_t^* - \pi_t^{*e})] + \varepsilon_t$$

	\$/€	\$/£	C\$/\$	¥/\$
α	-0.873***	0.135***	0.447***	-0.791***
	(0.225)	(0.026)	(0.025)	(0.022)
β	0.143***	0.147***	-0.373***	0.929***
	(0.016)	(0.045)	(0.026)	(0.090)
γ	0.001***	0.001	-0.001***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$\frac{1}{\Theta}$	-0.013	-0.020***	0.004*	0.018**
	(0.008)	(0.004)	(0.002)	(0.008)
ε_{t-1}	1.549***	1.325***	1.448***	1.383***
	(0.063)	(0.059)	(0.035)	(0.065)
ε_{t-2}	1.727***	1.270***	1.715***	1.590***
	(0.109)	(0.084)	(0.066)	(0.096)
ε_{t-3}	1.397***	1.216***	1.462***	1.587***
	(0.092)	(0.077)	(0.110)	
ε_{t-4}	0.826***	1.045***	0.909***	1.396***
	(0.117)	(0.096)	(0.072)	(0.119)
ε_{t-5}	0.240***	0.708***	0.373***	0.886***
	(0.070)	(0.083)	(0.049)	(0.107)
ε_{t-6}	-	0.292***	-	0.409***
		(0.057)		(0.066)
R^2	0.949	0.935	0.976	0.962
SSR	0.247	0.165	0.168	0.195
F	-	-	-	-
$D-W$	1.798	1.817	1.771	1.850
N	204	311	428	258

Note: See, Table 1.
Source: See, Table 1.

correct). For the \$/£, the $\frac{1}{\Theta} = 0.020$ (statistically significant at 1% level) and $\Theta = 50.687$, the monetarist model is not correct, there is overshooting, here. The C\$/\$ exchange rate gives $\frac{1}{\Theta} = 0.004$ (significant at the 10% level) and $\Theta = 268.384$, which shows a relatively high speed of adjustment, but not instantaneous (overshooting still holds). Finally, the ¥/\$ exchange rate shows $\frac{1}{\Theta} = 0.018$ (significant at the 5% level), which gives a $\Theta = 55.658$ and the monetarist model is not correct, there is overshooting.

Further, we estimate eq. (14) to test if there is price inertia and the results are presented in Table 3a. Starting with \$/€ exchange rate, $\frac{1}{\Theta} = 0.001 \cong 0$ (statistically insignificant); then, $\Theta \cong \infty$ and no price inertia takes place. The \$/£ exchange rate has an $\frac{1}{\Theta} = -0.001 \cong 0$ (insignificant); then, $\Theta \cong \infty$ and the monetarist model is correct. The C\$/\$ gives $\frac{1}{\Theta} = 0.013$ (statistically significant at the 1% level); so, $\Theta = 76.923$, which shows that there is overshooting. Lastly, the ¥/\$ exchange rate has $\frac{1}{\Theta} = -0.001 \cong 0$ (statistically insignificant); then, $\Theta \cong \infty$, instantaneous price adjustment.

Table-3a. Estimation of the Overshooting Model, Eq. (14)

$$s_t = \alpha(m_t - m_t^*) - \beta(y_t - y_t^*) + \gamma(g_{m_t} - g_{m_t^*}) + \frac{1}{\Theta}(\pi_t^e - \pi_t^{*e}) + \varepsilon_t$$

	α	β	γ	$\frac{1}{\Theta}$	R^2	SSR	F	$D-W$	N
\$/€	-1.311***	0.181***	0.001	0.001	0.177	4.020	-	0.040	204
	(0.168)	(0.012)	(0.001)	(0.003)					
\$/£	0.194***	0.198	-0.001	-0.001	0.111	2.799	-	0.067	311
	(0.013)	(0.198)	(0.001)	(0.001)					
C\$/\$	.524***	-0.458***	0.001	0.013***	0.600	2.786	-	0.140	429
	(0.022)	(0.023)	(0.001)	(0.002)			-		
¥/\$	-0.840***	0.751***	-0.001	-0.001	0.352	4.501		0.065	309
	(0.007)	(0.031)	(0.001)	(0.003)					

Note: See, Table 1.
Source: See, Table 1.

Finally, we correct eq. (14) for the serial correlation of the error term and the results are shown in Table 3b. The $\frac{1}{\Theta} = 0.001 \cong 0$ (statistically insignificant) for the \$/€, \$/£, and ¥/\$ exchange rates; thus, $\Theta \cong \infty$, which shows that the speed of adjustment of prices is infinite. For C\$/\$ exchange rate, $\frac{1}{\Theta} = 0.001 \neq 0$ (statistically significant at 5% level; then, $\Theta = 1{,}000$, which means overshooting (a small price inertia exists).

Table- 3b. Estimation of the Overshooting Model, Eq. (14), with Correction of Serial Correlation

$$s_t = \alpha(m_t - m_t^*) - \beta(y_t - y_t^*) + \gamma(g_{m_t} - g_{m_t^*}) + \frac{1}{\Theta}(\pi_t^e - \pi_t^{*e}) + \varepsilon_t$$

	\$/€	\$/£	C\$/\$	¥/\$
α	-0.945***	0.205***	0.472***	-0.874***
	(0.217)	(0.024)	(0.024)	(0.009)
β	0.157***	-0.029	-0.402***	0.582***
	(0.017)	(0.141)	(0.026)	(0.043)
γ	0.001**	0.001	-0.001***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$\frac{1}{\Theta}$	0.001	0.001	0.001**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
ε_{t-1}	1.359***	1.416***	1.320***	1.382***
	(0.063)	(0.056)	(0.030)	(0.051)
ε_{t-2}	1.428***	1.397***	1.525***	1.607***
	(0.094)	(0.087)	(0.051)	(0.078)
ε_{t-3}	1.320***	1.300***	1.464***	1.567***
	(0.116)	(0.098)	(0.066)	(0.089)
ε_{t-4}	1.216***	1.145***	1.210***	1.353***
	(0.125)	(0.102)	(0.070)	(0.096)
ε_{t-5}	0.878***	0.759***	0.813***	0.917***
	(0.107)	(0.088)	(0.064)	(0.087)
ε_{t-6}	0.500***	0.312***	0.396***	0.414***
	(0.063)	(0.056)	(0.039)	(0.058)
R^2	0.959	0.931	0.979	0.962
SSR	0.198	0.174	0.145	0.264
F	-	-	-	-
$D-W$	1.687	1.798	1.716	1.842
N	204	311	429	309

Note: See, Table 1.
Source: See, Table 1.

4. Conclusion

The purpose of this research has been to outline an approach to the testing of dynamic models of exchange rate determination. This approach is based upon the idea that it is difficult to measure directly the process by which market participants revise their expectations about current and future money supplies. On the other hand, it is possible to make indirect inferences about these expectations through a time series analysis of related financial and real variables. Dornbusch (1976) assumed that asset markets adjust instantaneously, whereas prices in goods markets adjust gradually (slowly). This exchange rate dynamics model retains all the long run equilibrium or steady state properties of the monetary approach, but in the short run the exchange rate and the interest rate can diverge from their long run levels, so monetary policy can have effects on real variables (production) in the system. Lately, uncertainty has increased because the Fed had reduced the federal funds rate to zero and the economy had not been stabilized; but, prices were expected to change, due to this enormous liquidity.

In an empirical test of the process to the Dornbusch model of exchange rate dynamics by using eq. (11), it was shown that the monetarist model is correct for the dollar/euro ($/€) exchange rate ($\Theta \cong \infty$), which means that prices are adjusted instantaneously in the U.S. and Euro-zone economies. For the other three exchange rates ($/£, C$/$, and ¥/$), the overshooting takes place (gradual adjustment of prices). The speed of adjustment of prices for the C$/$ exchange rate is relatively high ($\Theta = 268.384$). It follows by the ¥/$ exchange rate ($\Theta = 55.658$), which shows relatively price stickiness. Lastly, the $/£ exchange rate has a speed of price adjustment ($\Theta = 50.687$), which shows that prices are adjusted very gradually (there is price inertia). Thus, the monetarist model does not hold for these three exchange rates; these exchange rates are overshooting in the short-run. By using eq. (14), only the C$/$ exchange rate shows price inertia (overshooting); the other three exchange rates show instantaneous price adjustment (monetarist model is correct). Thus, results are mixed, here, so more research is needed to evaluate the two models, monetarist and overshooting.

References

Bilson, J. (1978). Rational expectations and the exchange rate”, in The economics of exchange rates, edited by J. Frenkel and H.G. Johnson, Reading MA: Addison-Wesley.

Dornbusch, R. (1976). Expectations and exchange rate dynamics. *Journal of Political Economy*, 84(6): 1161-76.

Kallianiotis, J. N. (2013a). *Exchange rates and international financial economics: History, theories, and practices.* Palgrave MacMillan: New York.

Plante, M., Alexander, W., Richter and Nathaniel, A. T. (2017). Fed’s effective lower bound constraint on monetary policy created uncertainty. *Economic Letter, Dallas Fed,* 12(11): 1-4.