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Monetary Policy, Money Market, and Exchange Rate Determination

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Abstract[1]

The money market approach to exchange rate determination is part of the Asset Market Models and is largely attributed to economists after 1973 when the exchange rate became flexible (market determined). This article, first, introduces, the setting of the model embedded in the money market equilibrium equation with the use of the spot exchange rate as an independent variable in the money demand equations for the two countries. Then, the spot rate is determined from these money market functions. Consequently, the exchange rate is determined through the classical equation of exchange. These models deviate a little from the models and approaches used for the monetary approach to the balance of payment, the overshooting model, and from the associated market equilibria. The effects of monetary policy (federal funds rate, monetary base, and money supply), of wealth (income), and of the price level (real money supply) under the money market approach are examined, here, theoretically and empirically. The current econometric results show that the exchange rate is determined by the monetary policy in the two countries (domestic and foreign money supply, income, interest rate, and velocity of money). The new monetary policy has questionable and ethical implications for our economy and society.

Keywords: Foreign Exchange, Forecasting and Simulation, Monetary Policy, Demand for Money, Model Evaluation and Testing, Consumption and Saving, Interest Rates

JEL (Classification): F31, F47, E52, E41, C52, E21, E43

I. Introduction

Exchange rate determination and forecasting is very important for financial economists, financial institutions, foreign currency traders, multinational firms, and all professionals in the foreign currency market. This paper is based on discussions of exchange rate determination on a school of thought, using the asset market approach to solve complex problems, but it uses an alternate representation of the money demands and monetary policies in the two countries. We will explore the different determinants of exchange rate and the current theory that deal with its determination. This theory is a variation the Monetary Approach by testing it with the classical equation of exchange for Flexible Prices and Sticky Prices, which will support the Money Market and Exchange Rate approach.

During our discussion, we look at some of the macroeconomic variables (fundamentals) and monetary policy that influence and are influenced by the exchange rate. We can envision a "true" model of the two economies (domestic and foreign) that include all of these variables, incorporate full information, and expectations and in the context of economic optimization and random events generates the time path of foreign exchange rate between two currencies. Then, by utilizing all these information, we can deal with the determination and in extension with the forecasting of the exchange rate. Forecasting can be thought of as the formal process of generating expectations by using the current economic theory, mathematics, statistics, and econometric analysis. When expectations for future economic variables are derived, we have an implicit forecast of the variable in question, the exchange rate.

The theoretical literature on the Asset Market view of Exchange Rate Determination has been expanding voluminously since the middle 1970s. The popularity of this view continues for more than forty five years and generations of economists and practitioners are learning and applying them to their theoretical research and to their trade practices. The assumption that these models share is the absence of substantial transaction cost, capital control, and other impediments to the flow of capital between nations. Thus, we assume that there is perfect capital mobility among countries. In this case, the exchange rate will adjust instantly to equilibrate the international demand for

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stocks of national assets. The more traditional view was that the exchange rate adjusts to equilibrate the international demand for flows of national goods (international trade and investment). The empirical implication is that floating exchange rates exhibit high variability, which goes beyond the variability of their underlying determinants. Central banks with their monetary policies play a major role in exchange rate fluctuation.

II. The Money Market Approach

The most frequently used theoretical approach to exchange rate determination is the one involving the supply and demand for currencies in the foreign exchange market. These exchange rate flows reflect current account and financial account transactions recorded in a nation's balance of payments. The basic *balance of payments approach* argues that the equilibrium exchange rate is found when the net inflow (outflow) of foreign exchange arising from current account activities matches the net outflow (inflow) of foreign exchange arising from financial account activities. Also, the role of the central banks is important because their money supply is affecting the value of their currencies and the entire business cycle. The demand for and supply of foreign currency indicates that there is demand for imports and supply of exports. Then, any time that trade or capital flows are taking place the demand and supply schedules shift up or down, as shown in Figure 1 and affect the exchange rate (the relative price of the two currencies).

Many researchers have used the spot exchange rate as an independent variable in the money market equilibrium equation (real demand for money)[2] for the domestic country, as follows,

$$\frac{M_t}{P_t} = L(Q_t, i_t, S_t) \qquad (1)$$
$$L_Q > 0, L_i < 0, L_S > 0$$

The demand for money for the foreign country is,

$$\frac{M_t^*}{P_t^*} = L(Q_t^*, i_t^*, S_t) \qquad (2)$$
$$L_{Q^*} > 0, L_{i^*} < 0, L_S < 0$$

where, M_t = the stock of money = the money demand (M_t^d) ≡ the money supply (M_t^s), P_t = the price level, Q_t = real income, i_t = nominal rate of interest, S_t = the spot exchange rate (\$/FC), and an asterisk (*) on a variable represents the foreign country.

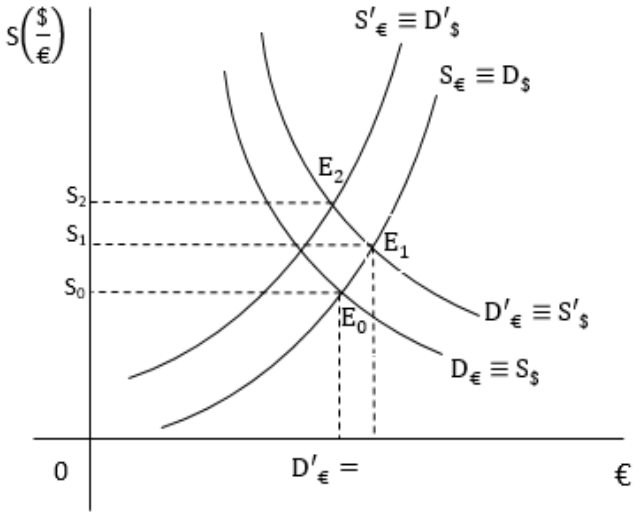


Figure 1. Exchange Rate Determination after March 1973

Note: An increase in the demand for euros (€) shifts the demand schedule from $D_€$ to $D'_€$ and the original equilibrium exchange rate S_0 (at the intersection of the demand and supply schedules) increases to S_1. The euro is appreciated and the U.S. dollar is depreciated. A reduction in supply or a contractionary monetary policy from the ECB is a shift to the left from $S_€$ to $S'_€$ (from E_1 to E_2). This is another appreciation of the euro (€), due to monetary policy.

An increase in the spot exchange rate (dollar is depreciated) reduces the demand for U.S. dollar (investors and speculators do not want to hold a weak currency). This depreciated dollar will put pressure on the U.S. interest rate to increase to attract foreign investment (covering the forward discount of the dollar) and bringing back the interest rate parity (IRP) between the two countries, eq. (3). The U.S. central bank will in all likelihood, increase the money supply to keep the interest rate at a moderate level.

[2] See, Kallianiotis (2010).

$$i_t - i_t^* = fd_{\$} \text{ or } fp_{€} = (f_t - s_t)\frac{12}{n}100 \quad (3)$$

Solving eq. (1) for the spot exchange rate and taking the natural logarithm of the variables, we have eq. (4):[3]

$$s_t = \beta_0 - \beta_1 q_t - \beta_2 i_t + \beta_3 (m_t - p_t) + \varepsilon_t \quad (4)$$

and for the foreign country,

$$s_t = \gamma_0 + \gamma_1 q_t^* + \gamma_2 i_t^* - \gamma_3 (m_t^* - p_t^*) + \varepsilon_t^* \quad (5)$$

The bilateral value of money in the two countries (not only the money supply in a single economy) plays a significant role in the determination of the exchange rate in many theories. The efficient markets approach emphasizes the efficiency of markets reacting to information, rather than market structure. The rational expectations approach, in contrast, emphasizes the structure of the model that explains fundamental market reactions. But, there is also substitutability of currencies across countries.

Thus, currency portfolio substitution or diversification does in fact take place. Money demand, money supply, and exchange rates should be analyzed from an international rather than a country-specific perspective. Starting from a simple closed-economy monetary model with rational expectations, a second currency can be introduced. The two monies are assumed to be substitutes in demand, and an exchange rate exists between them. This model permits the description of the behavior of the exchange rate in terms of anticipated and unanticipated changes in money supplies, money demands, income, and interest rate (money market rate).

$$m_t^d - p_t = \beta_0 + \beta_1 q_t - \beta_2 i_t + \varepsilon_t \quad (6)$$

$$m_t^s - p_t = exogenous \quad (7)$$

and

$$m_t^{*d} - p_t^* = \gamma_0 + \gamma_1 q_t^* - \gamma_2 i_t^* + \varepsilon_t^* \quad (8)$$

$$m_t^{*s} - p_t^* = exogenous \quad (9)$$

where, m_t^d = the ln of money demand, p_t = the ln of price level, m_t^s = the ln of money supply, β_1 and γ_1 = the income elasticities of demand for real balances, β_2 and γ_2 = the interest rate semi-elasticities of demand for real balances, i_t = the opportunity cost of holding money, q_t = the ln of a measure of real economic activity (income), and an asterisk (*) on a variable denotes the foreign country.

Thus, a similar system of equations exists for the foreign country. Fluctuations in real incomes lead to aggregate disturbances in the money markets. Given current available information, participants in each market use the structure of the economy, which is known to everyone, to form rational operational forecasts of the general price level. From the above equations (4) and (5) and equations (6) and (8), we can get the spot exchange rate as follows,

$$s_t = f\left[(m_t - m_t^*), (m_t^d - p_t) - (m_t^{*d} - p_t^*), s_{t+1}^e \middle| I_t\right] \quad (10)[4]$$

where, $m_t - m_t^*$ = the nominal stock of money differential in the two countries, $(m_t^d - p_t) - (m_t^{*d} - p_t^*)$ = the real demand for money differential, and $s_{t+1}^e \middle| I_t$ = the expected spot rate conditional on current information (I_t), in the two countries.

One result for s_t in eq. (10) is that, since any real disturbance leads to an equiproportionate change in the demand for the two currencies (given the assumption of strict money neutrality), real disturbances have no effect on

[3] An OLS regression [S ($/€)] shows the following results:

$$s_t = -4.624^{**} + 0.640^{***} q_t - 0.020^{*} i_t - 0.365^{*} (m_t - p_t) + 0.972^{***} AR(1) + 0.166^{***} MA(1)$$
$$(2.286) \quad (0.237) \quad (0.011) \quad (0.205) \quad (0.015) \quad (0.060)$$

$R^2 = 0.973$, $SER = 0.024$, $F = 1{,}390.246$, $D-W = 1.968$, $N = 240$

[4] The s_{t+1}^e is forecasting as follows:

$$s_t = 0.005 + 0.521^{***} s_{t-1} + 0.190\, s_{t-2} + 0.645^{***} f_{t-1} - 0.386^{***} f_{t-2} + 0.015 (i_t - i_t^*) - 0.019^{**} (i_{t-1} - i_{t-1}^*)$$
$$(0.006)\,(0.162) \quad (0.124) \quad (0.125) \quad (0.139) \quad (0.009) \quad (0.009)$$

$R^2 = 0.945$, $SER = 0.023$, $F = 377.886$, $D-W = 1.994$, $N = 140$, $RMSE = 0.021942$

By using a GARCH (1,1) specification with respect the EU, eq. (10) gives the following results:

$$s_t = -0.059^{***} + 0.063^{***} (m_t - m_t^*) - 0.069^{***} [(m_t^d - p_t) - (m_t^{*d} - p_t^*)] + 1.031^{***} s_{t+1}^e + 0.150\, \varepsilon_{t-1}^2 + 0.600^{*} \sigma_{t-1}^2$$
$$(0.004) \quad (0.005) \quad (0.005) \quad (0.004) \quad (0.118) \quad (0.322)$$

$R^2 = 0.999$, $SER = 0.003$, $F = 30{,}732.57$, $D-W = 1.772$, $N = 138$, $RMSE = 0.004218$

Where, ε_{t-j}^2 = lag of Residual (ARCH), σ_{t-j}^2 = lag of Variance (GARCH).

the determination of the exchange rate. In this model, the exchange rate is truly a monetary phenomenon. The exchange rate in this model is also affected by concurrent events, which the market has not anticipated.[5]

Another money market model can be developed by taking into consideration the equation of exchange, eq. (11) and in natural logarithm (ln) terms, eq. (12),

$$MV = QP \tag{11}$$

$$m_t + v_t = q_t + p_t \tag{12}$$

or

$$p_t = v_t + m_t - q_t \tag{13}$$

and the Purchasing Power Parity (PPP), eq. (14) or in natural logarithms, eq. (15),

$$S = \frac{P}{P^*} \tag{14}$$

$$s_t = p_t - p_t^* \tag{15}$$

From eq. (15), by substituting p_t and p_t^* with their values from eq. (13) and a similar one for the foreign country, we get,

$$s_t = (v_t - v_t^*) + (m_t - m_t^*) - (q_t - q_t^*) \tag{16}$$

This model can also be tested in first differences:

$$s_t - s_{t-1} = [(v_t - v_t^*) - (v_{t-1} - v_{t-1}^*)] + [(m_t - m_t^*) - (m_{t-1} - m_{t-1}^*)] - [(q_t - q_t^*) - (q_{t-1} - q_{t-1}^*)] \tag{17}$$

where, v_t = the ln of velocity of money, m_t = the ln of stock of money, q_t = the ln of the real output (income), and p_t = the ln of the price level.

III. Empirical Results

The data are monthly and are coming from *Economagic.com*, *Eurostat*, and *Bloomberg*. For the Euro-zone (€), the data are from 2004:12 to 2020:12; for Mexico (MP), they are from 1994:08 to 2021:02; for Canada (C$), they are from 1981:03 to 2020:12; for U.K. (£), the data are from 1990:01 to 2018:05; for Australia (A$), the data are from 1986:10 to 2021:02; and lastly, for Japan (¥), they are from 1990:01 to 2021:02. The variables for the U.S. are the ln of velocity of money (v_t), the ln of stock of money (m_t), the ln of the real output or income (q_t), the ln of the price level (p_t), the nominal rate of interest (i_t), the ln of the spot exchange rate (s_t) quoted in American terms ($/FC), and an asterisk (*) on a variable denotes similar variables for the foreign countries.

Tables 1a and 1b show the results of eqs. (4) and (5). The U.S. real income (q_t), interest rate (i_t), and real money ($m_t - p_t$) have significant effect (at 1% level) on *eus*, but two signs are wrong. In EU the real income has significant positive effect (at 1% level) on *eus*. The U.S. real income and the real money have negative significant effects (at 1% level) on *ms* and the Mexican interest rate and real money have negative significant effect (at 1% level) on *ms*. The U.S. real income and interest rate have significant negative effects (at 1% and 5% level) on *cs* and its real money a positive significant effect (at 5% level) on *cs*. The Canadian real income and real money have significant effect on *cs*, but wrong signs.

Table 1b continues with eqs. (4) and (5) giving results for other countries. The U.S. real income, interest rate, and real money have significant negative effects (at 1% level) on *uks*. The real money in U.K. has a significant negative effect (at 5% level) on *uks*. The U.S. real money has a significant positive effect and the real income a significant negative one (at 1% level) on *as*. The Australian real income and interest rate have a positive significant effect (at 1% level) on *as*. The U.S. variables (q_t , i_t , and $m_t - p_t$) have significant effects on *js*, but two with wrong signs. The Japanese real income and real money have significant effects on *js*, but wrong signs.

The results of eq. (16) are presented in Table 2. The velocity differential is statistically significant for *eus*, *ms*, *uks*, *as*, and *js*, but not for Canada (*cs*). The money differential is statistically significant for *eus*, *ms*, *cs* (wrong sign), *uks*, *as*, and *js*. The real income differential is statistically significant for *ms*, *uks*, *as*, and *js*, but insignificant fir *eus* and *cs*. Thus, the empirical results support the money market approach to exchange rate determination.

[5] See, Canto and Miles (1984).

Table 1a

Estimation of Exchange Rate (s_t): Money Market, Eqs. (4) and (5)

$$s_t = \beta_0 - \beta_1 q_t - \beta_2 i_t + \beta_3 (m_t - p_t) + \varepsilon_t$$

$$s_t = \gamma_0 + \gamma_1 q_t^* + \gamma_2 i_t^* - \gamma_3 (m_t^* - p_t^*) + \varepsilon_t^*$$

	U.S.(*EUS*)	*EMU*(*EUS*)	*U.S.* (*ms*)	*MX* (*ms*)	*U.S.* (*cs*)	*C* (*cs*)
C	-5.364***	-1.447***	8.101***	-0.401	1.661***	0.042
	(1.346)	(0.295)	(1.508)	(1.388)	(0.342)	(0.063)
q_t	0.703***	0.206***	-0.797***	-0.010	-0.246***	-0.074***
	(0.165)	(0.037)	(0.208)	(0.096)	(0.050)	(0.008)
i_t	-0.028***	0.005	-0.011	-0.026***	-0.006**	0.001
	(0.007)	(0.006)	(0.009)	(0.005)	(0.002)	(0.002)
$(m_t - p_t)$	-0.327***	0.001	-0.791***	-0.607***	0.136**	0.153***
	(0.087)	(0.007)	(0.152)	(0.033)	(0.053)	(0.009)
MA(1)	1.557***	1.589***	1,387***	1.091***	1.606***	1.408***
	(0.058)	(0.057)	(0.028)	(0.079)	(0.022)	(0.028)
MA(2)	1.624***	1.670***	1.458***	0.867***	1.895***	1.537***
	(0.095)	(0.092)	(0.049)	(0.087)	(0.045)	(0.051)
MA(3)	1.169***	1.227***	1.260***	0.386***	1.767***	1.409***
	(0.103)	(0.100)	(0.064)	(0.070)	(0.059)	(0.070)
MA(4)	0.482***	0.535***	0.855***	-	1.403***	1.173***
	(0.074)	(0.073)	(0.064)		(0.063)	(0.076)
MA(5)	-0.122***	-0.114***	0.404***	-	0.871***	0.830***
	(0.032)	(0.032)	(0.047)		(0.053)	(0.063)
MA(6)	-0.168***	-0.176***	-	-	0.357***	0.393***
	(0.018)	(0.017)			(0.030)	(0.036)
R^2	0.944	0.943	0.988	0.978	0.974	0.969
SER	0.034	0.034	0.044	0.034	0.022	0.022
F	479.598	465.705	2,923.506	1,219.544	2,171.380	1,436.203
$D-W$	1.809	1.852	1.766	1.765	1.745	1.708
N	266	264	328	198	602	478
RMSE	0.116071	0.033339	0.055086	0.034065	0.022055	0.021808

Note: $U.S.(eus)$ = ln of U.S. Spot Exchange Rate (\$/€) with EU (from U.S. point of view), $EMU(eus)$ = ln of EMU Spot Exchange Rate (\$/€) with U.S. (from EMU point of view), $U.S.(ms)$ = ln of U.S./Mexico Spot (\$/MP), $MX(ms)$ = ln of Mexico/U.S. Spot Rate (\$/MP), $U.S.(cs)$ = ln of U.S./Canadian Spot rate (\$/C\$), $C(cs)$ = ln of Canadian/U.S. (\$/C\$), q_t = ln of U.S. Real Income, i_t = U.S. Short-term Interest Rate (Money-market Rate), ($m_t - p_t$) = ln of U.S. Real Money Supply, An asterisk on a variable (*) shows the foreign country's one, MA(q) = Moving Average Process, R^2 = R-squared, SER = S.E. of regression, $D-W$ = Durbin-Watson statistic, F = F statistic, N = number of observations, $RMSE$ = Root Mean Squared Error, *** significant at the 1% level, ** significant at the 5% level, and * significant at the 10% level.

Source: *Economagic.com*, *Bloomberg*, and *Eurostat.*

Table 1b

Estimation of Exchange Rate (s_t): Money Market, Eqs. (4) and (5)

$$s_t = \beta_0 - \beta_1 q_t - \beta_2 i_t + \beta_3 (m_t - p_t) + \varepsilon_t$$

$$s_t = \gamma_0 + \gamma_1 q_t^* + \gamma_2 i_t^* - \gamma_3 (m_t^* - p_t^*) + \varepsilon_t^*$$

	U.S.(*uks*)	*UK* (*uks*)	*U.S.* (*as*)	*A* (*as*)	*U.S.* (*js*)	*J* (*js*)
C	2.873***	-0.345	4.463***	-3.749***	-14.158***	1.171
	(0.366)	(1.199)	(0.458)	(0.670)	(0.349)	(2.082)
q_t	-0.182***	0.077	-0.605***	0.280***	1.142***	-0.514***
	(0.057)	(0.100)	(0.066)	(0.062)	(0.050)	(0.145)
i_t	-0.011***	0.010***	-0.002	0.022***	-0.013***	-0.003
	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.017)
$(m_t - p_t)$	-0.183***	-0.100**	0.295***	-0.047	-0.401***	0.104*
	(0.064)	(0.047)	(0.069)	(0.058)	(0.050)	(0.063)
MA(1)	1.601***	1.349***	1.672***	1.592***	1.528***	1.396***
	(0.036)	(0.054)	(0.033)	(0.045)	(0.039)	(0.054)
MA(2)	1.764***	1.366***	1.941***	1.649***	1.737***	1.577***
	(0.062)	(0.077)	(0.062)	(0.079)	(0.067)	(0.083)
MA(3)	1.719***	1.327***	1.871***	1.500***	1.716***	1.503***
	(0.073)	(0.086)	(0.079)	(0.097)	(0.083)	(0.097)
MA(4)	1.395***	1.112***	1.426***	1.234***	1.391***	1.221***
	(0.073)	(0.088)	(0.083)	(0.103)	(0.085)	(0.103)
MA(5)	0.866***	0.750***	0.850***	0.868***	0.934***	0.787***
	(0.061)	(0.075)	(0.067)	(0.092)	(0.071)	(0.087)
MA(6)	0.345***	0.348***	0.328***	0.363***	0.397***	0.313***
	(0.035)	(0.050)	(0.038)	(0.051)	(0.041)	(0.059)
R^2	0.977	0.958	0.982	0.969	0.994	0.956
SER	0.027	0.025	0.034	0.029	0.032	0.028
F	2,556.377	832.856	3,150.884	1,185.613	9,962.202	664.809
$D-W$	1.753	1.777	1.754	1.769	1.733	1.838
N	602	372	602	393	602	318
RMSE	0.027262	0.024837	0.033330	0.029585	0.033576	0.027730

Note: See, Table 1a. $U.S.(uks)$ = ln of U.S./U.K Spot Exchange Rate ($/£), $UK\ (uks)$ = ln of UK/U.S. Spot rate ($/£), $U.S.(as)$ = ln of U.S./Australian Spot rate ($/A$), $A(as)$ = ln of Australia/U.S. Spot rate ($/A$), $U.S.(js)$ = ln of U.S./Japanese Spot rate ($/¥), $J(js)$ = ln of Japanese/U.S Spot Exchange Rate ($/¥).

Source: See, Table 1a.

Table 2
Estimation of Exchange Rate (s_t): Equation of Exchange, Eq. (16)

$$s_t = (v_t - v_t^*) + (m_t - m_t^*) - (q_t - q_t^*)$$

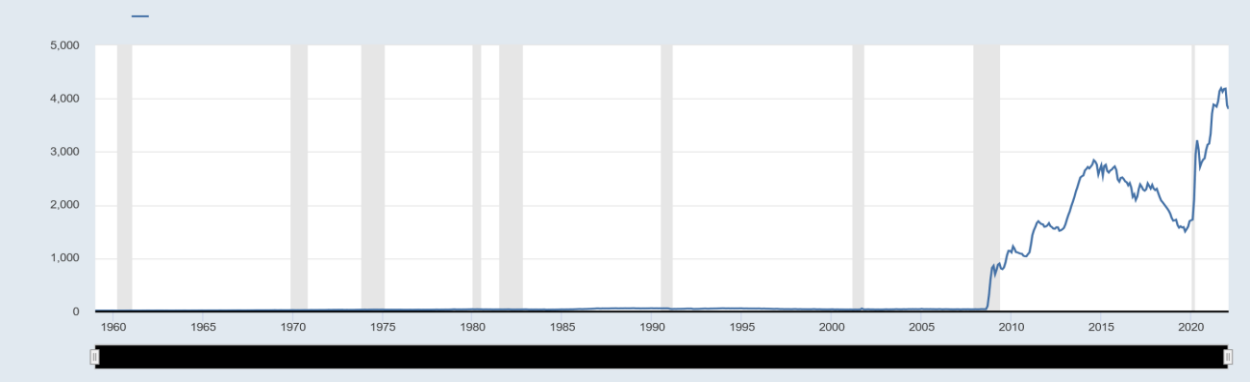
	eus	*ms*	*cs*	*uks*	*as*	*js*
C	0.247*	-1.749	1.841***	2.101	1.929	-1.254**
	(0.133)	(1.561)	(0.681)	(1.458)	(1.243)	(1.522)
$(v_t - v_t^*)$	1.040***	0.942***	0.167	0.709***	0.830***	0.743***
	(0.303)	(0.105)	(0.134)	(0.192)	(0.263)	(0.262)
$(m_t - m_t^*)$	0.751**	0.848***	-0.394***	0.471**	0.887***	0.885***
	(0.373)	(0.060)	(0.131)	(0.209)	(0.264)	(0.214)
$(q_t - q_t^*)$	-0.979	-1.606***	-0.110	-1.379***	-1.366***	-0.972***
	(0.288)	(0.178)	(0.149)	(0.339)	(0.309)	(0.369)
AR(1)	0.942***	0.912***	0.988***	-	-	-
	(0.027)	(0.028)	(0.009)			
MA(1)	0.204***	0.202***	-0.303***	1.388***	1.571***	1.380***
	(0.077)	(0.047)	(0.035)	(0.060)	(0.048)	(0.054)
MA(2)	-	-	-	1.251***	1.626***	1.355***
				(0.095)	(0.081)	(0.088)
MA(3)	-	-	-	0.830***	1.494***	1.216***
				(0.092)	(0.099)	(0.096)
MA(4)	-	-	-	0.398***	1.248***	0.917***
				(0.056)	(0.106)	(0.088)
MA(5)	-	-	-	-	0.886***	0.365***
					(0.098)	(0.059)
R^2	0.975	0.989	0.990	0.919	0.971	0.962
SER	0.026	0.035	0.013	0.027	0.030	0.031
F	1,359.532	3,534.912	6,275.298	399.274	1,080.982	798.690
D−W	1.959	1.957	2.016	1.721	1.776	1.704
N	182	245	397	291	330	291
RMSE	0.025568	0.034192	0.013214	0.026194	0.02962	0.031479

Note: See, Tables 1a and 1b. $(v_t - v_t^*)$ = ln of Velocity of Money Differential, $(m_t - m_t^*)$ = ln of Money Differential, $(q_t - q_t^*)$ = ln of Real Income Differential, AR(p) = Auto-Regressive p Process, MA(q) = Moving Average q Process.
Source: See, Table 1a.

IV. Monetary Policy Implications

We saw that money supply and interest rate have significant effects on the spot exchange rate, the money market effect. Then, the monetary policy has important implications. When there is a large quantity of reserves in the banking system,[6] as it is lately with the ample reserves, Figure 2, the Fed can no longer influence the federal funds

[6] Banks' Reserves:



Graph 1. Reserves of Depository Institutions: Total (TOTRESNS)

rate (i_{FF}) by making small changes in the supply of reserves (R^s).[7] Why we need all these non-borrowing reserves (R^*)? What is the reason of this enormous liquidity with the economy lockdown for more than two years and a very anemic AD? How we will control the bubble in the financial market and the creeping high (30%) inflation? The interest on reserves[8] increases the national debt,[9] too. The market manipulators and the oligopolists-monopolists will start taking advantage of this situation.[10] The trade deficit[11] is going up and the dollar was depreciated[12]due to an enormous money supply since 2008,[13] as it can

be seen from the stock market bubble with an average growth of 35.09% p.a.[14] and the gold price from $696.43/oz (2007) to $2,043.30/oz (2022);[15] an average growth of 12.89% p.a. of the price of gold or a depreciation of the dollar by 12.89% p.a.

Note: March 22, 2022: R = 3,804.5 billion.
Source: https://fred.stlouisfed.org/series/TOTRESNS

[7] See, Kallianiotis (2021b).

[8] It is 0.40% since 3/17/2022. See, "Interest on Reserve Balances". https://www.federalreserve.gov/monetarypolicy/reserve-balances.htm

[9] The U.S. National Debt was with April 18, 2022, $30.392 trillion. https://usdebtclock.org/

[10] See, "GameStop day traders shook markets and hit hedge funds for billions. What has Wall Street learned?", https://markets.businessinsider.com/news/stocks/gamestop-saga-triggers-rethink-wall-street-short-seller-losses-2021-1-1030021995 . See also," Reddit Jolts Activist-Short Hedge Funds Into 'Adapt or Die' Mode", https://www.bloomberg.com/news/articles/2021-01-27/reddit-jolts-activist-short-hedge-funds-into-adapt-or-die-mode

[11] The U.S. trade deficit increased from $676.7 billion in 2020 to $859.1 billion in 2021. https://www.thebalance.com/u-s-trade-deficit-causes-effects-trade-partners-3306276 . The trade deficit in the US remained near-record levels of $89.18 billion in February of 2022. See, https://tradingeconomics.com/united-states/balance-of-trade . See also, The Trade deficit for 2021 was -$1,078.566 billion. https://www.census.gov/foreign-trade/balance/c0004.html

[12] See, Real Broad Effective Exchange Rate for United States (RBUSBIS), where it is quoted (FC/$). https://fred.stlouisfed.org/series/RBUSBIS

Graph 2. Real Broad Effective Exchange Rate for United States (RBUSBIS)
Source: https://fred.stlouisfed.org/series/RBUSBIS

[13] The money supply in December 2007 was $7,469.4 billion and on March 22, 2022, the M2 reached: $21,811.8 billion. https://fred.stlouisfed.org/series/M2SL . Its growth is 13.72% p.a.

Graph 3. Money Supply (M2)
Note: M2 = $21,768.8 Billions (2/28/2022)
Source: https://fred.stlouisfed.org/series/WM2NS

[14] The DJIA was in 3/9/2009 (6,547.57) and in 1/4/2022 reached (36,799.65); a growth of 30,252.57 points or 35.09% per annum. See, *Yahoo/Finance*.

The Fed is using, now, its administered rates (i_{IOR} and $i_{ON\ RRP}$) to influence the i_{FF} . The demand curve (R^d) turns flat between the new administered rates at point E_1, Figure 2, which helps to keep the i_{FF} into the *FOMC* 's target range ($0.00\% - 0.25\%$) for over 13 years and now, between ($0.25\% - 0.50\%$). With these enormous "ample" reserves, the Fed does not need to make daily *OMO* (*OMP* or *OMS*), as it did before with the limited reserves to hit the i_{FF} target. But, now, small shifts of the supply curve (R^s) have no effect on the i_{FF} .

The main tool for keeping the i_{FF} on its target and driving the demand curve flat is the i_{IOR} . Banks invest their money short-term based on the interest rate and the risk.[16] They could

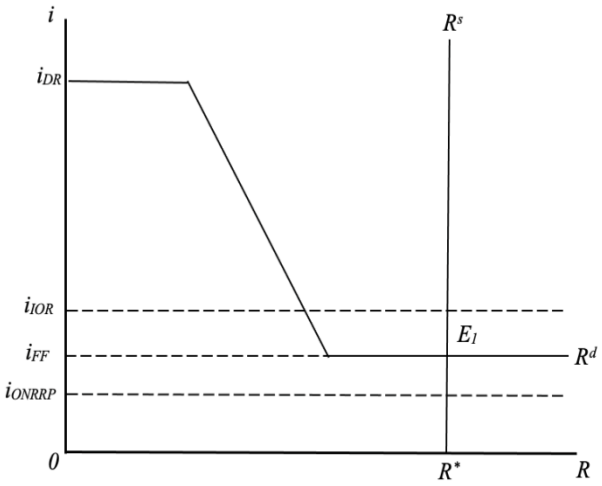


Figure 2. Monetary Policy with Ample Reserves

Note: i = interest rates, i_{FF} = federal funds rate, i_{DR} = discount rate, i_{IOR} = interest rate on reserves, i_{ONRRP} = interest rate on overnight reverse repurchase agreements, R = reserves, R^d = demand for reserves, R^s = supply of reserves, R^* = non-borrowed reserves, E = equilibrium ($R^s = R^d$).

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invest in Treasury Bills ($i_{RF} = 0.04\%$), by offering loans to banks ($i_{FF} = 0.06\%$), or by depositing to the Fed ($i_{IOR} = 0.15\%$).[17] Banks prefer to deposit their money to the Fed because i_{IOR} is higher compared to the alternative S-T investments and it is also a safe overnight investment. (*Sic*). If the i_{FF} were to fall very far below the i_{IOR} , banks would borrow in the federal funds market and deposit those reserves at the Fed, earning a profit (arbitrage, π_A) on the difference ($\pi_A = i_{IOR} - i_{FF}$). This arbitrage ensures that the i_{FF} does not fall much below i_{IOR} .

$$EX\ D_{FF} \Rightarrow i_{FF} \uparrow \ and \quad EX\ S_{\text{Re}serves} \Rightarrow i_{IOR} \downarrow$$

On March 16, 2022 (effective on March 17, 2022), the Fed changes the federal funds target rate to ($0.25\% \le \bar{i}_{FF} \le 0.50\%$) and the other interest rates,[18] as follows: $i_{IOR} = 0.40\%$, $i_{ONRRP} = 0.30\%$, and the effective federal funds rate became, $i_{FF}^{eff} = 0.33\%$.[19] Thus, when the Fed raises or lowers the i_{IOR} , the i_{FF} moves up or down, too. Consequently, the Fed can keep the i_{FF} into the target range set by the *FOMC* through adjustment of the i_{IOR} .

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[15] See, Gold Prices - 100 Year Historical Chart. https://www.macrotrends.net/1333/historical-gold-prices-100-year-chart

[16] The short-term interest rates were closed to zero and the long-term ones very low since 2008. $i_{FF} = 0.00\% - 0.25\%$, $i_{FF}^{eff} = 0.09\%$, $i_{RF} = 0.08\%$, $i_{MM} = 0.10\%$, $i_D = 0.05\%$, $i_{DR} = 0.25\%$, $i_{5YCD} = 0.48\%$, $i_{CM} = 2\%$, $i_P = 3.25\%$, $i_{15YM} = 2.21\%$, $i_{30YM} = 2.77\%$, $i_{2YGB} = 0.12\%$, $i_{5YGB} = 0.42\%$, $i_{10YGB} = 1.03\%$, $i_{30YGB} = 1.79\%$. See, *Wall Street Journal*, January 27, 2021.

[17] These rates are with June 30, 2021. The T-Bill rate in the secondary market was, $i_{RF} = 0.02\%$.

[18] See, "Implementation Note issued March 16, 2022". https://www.federalreserve.gov/newsevents/pressreleases/monetary20220316a1.htm . See also, "Federal Funds Target Rate History: From 1990 to The Present." http://www.fedprimerate.com/fedfundsrate/federal_funds_rate_history.htm . Since May 5, 2022, the federal funds rate is between (0.75% -1.00%).

[19] See, "Effective Federal Funds Rate". https://www.newyorkfed.org/markets/reference-rates/effr

The Fed sets the i_{IOR} directly, so this interest rate serves as an effective monetary policy tool. Now, this i_{IOR} [20] is the *primary tool* used by the Fed for influencing the i_{FF}, Figure 2. The old tools were satisfying the same objective without charging citizens (taxpayers) with any enormous cost,[21] as they have to pay, now, the IOR (bail out cost to taxpayers).[22] Depositors have a bail in cost; they are paying the banks to hold their deposits:[23]

$$r_D = i_D - \pi^e \quad (18)$$

where, r_D = real deposit rate, i_D = nominal deposit rate, and π^e = expected inflation.

This official real deposit rate is now (April 2022):[24] $r_D = 0.05\% - 8.5\% = -8.45\%$. Then the bail in cost to depositors is: $18,067.3334 billion x (-8.45%) = -$1,526.690 billion per annum. With this enormous inflation, the wealth of individuals is declining daily (inflation tax). They have lost more than 30% of their wealth. With a wrong monetary policy for 14 years and a wrong fiscal policy for more than 2 years, the economy will deteriorate further and people will be in big trouble (due to Fedflation, Fednomics and Bidenflation, Bidennomics). Crises must be prevented;[25] this is the role and the obligation of true leaders.

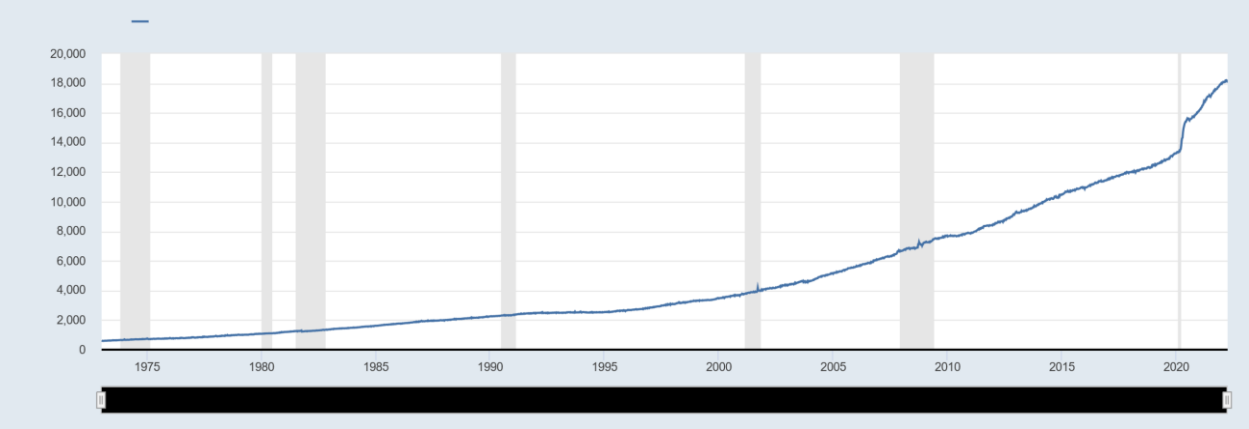
In 2014, the *FOMC* announced that it will use the Overnight Reverse Repurchase Agreement Facility (*ON RRP*)[26] to help control the i_{FF}. This facility is a form of *OMO*, where the Fed interacts with many nonbank financial institutions (large money market funds and government-sponsored enterprises).[27] When one nonbank financial institution uses the *ON RRP* facility, it deposits reserves at the Fed overnight receiving securities as collateral. The next day the transaction is "unwound";[28] the Fed buys back the securities and the institution earns the $i_{ON\ RRP}$, which the Fed sets, on the cash it deposited at the Fed, Figure 2. This investment facility is a risk-free option

[20] See, Board of Governors of the Federal Reserve System. "Interest on Required Reserve Balances and Excess Balances". https://www.federalreserve.gov/monetarypolicy/reqresbalances.htm

[21] The bail out cost is: $R\,x\,i_{IOR}$ = $3,804.5 billion x 0.40% = $15.218 billion. Graph 1. See, https://fred.stlouisfed.org/series/TOTRESNS .

[22] See, Kallianiotis (2021b, pp. 53-57).

[23] See, Deposits, All Commercial Banks (DPSACBM027NBOG)



Graph 4. Deposits, All Commercial Banks (DPSACBW027SBOG)
Note: April 8, 2022, Deposits: $18,111.9123 billion.
Source: https://fred.stlouisfed.org/series/DPSACBW027SBOG

[24] The SGS inflation rate is $\pi = 17\%$ and $r_D = -16.95\%$ (bail in cost = -$3,062.413 billion), but the true inflation is $\pi = 30\%$ and $r_D = -29.95\%$ (bail in cost = -$5,411.166 billion).

[25] See, Kallianiotis (2020). The worst of all it was that they did not prevent the Ukrainian crisis (the war), but they encourage it with money, weapons, propaganda, and the fake news. See also, John J. Mearsheimer, "Why the Ukraine Crisis Is the West's Fault: The Liberal Delusions That Provoked Putin". https://www.google.com/url?esrc=s&q=&rct=j&sa=U&url=https://www.mearsheimer.com/wp-content/uploads/2019/06/Why-the-Ukraine-Crisis-Is.pdf&ved=2ahUKEwijnNrFupb3AhUShHIEHU_pAK8QFnoECAoQAg&usg=AOvVaw0zcwZxmmW4J4Y8gK6M_OQX . Leadership incompetence or completely controlled, due to corruption? The unreasonable sanctions, embargoes, and Russia's cut off from the SWIFT system will deteriorate the global economy and hurt mostly the EU countries.

[26] See, Board of Governors of the Federal Reserve System. "Overnight Reverse Repurchase Agreement Facility". https://www.federalreserve.gov/monetarypolicy/overnight-reverse-repurchase-agreements.htm.

[27] See, "What Is a Money Market Fund?", https://www.investopedia.com/investing/do-money-market-funds-pay/ and "Government-Sponsored Enterprise (GSE)", https://www.investopedia.com/terms/g/gse.asp . See also, Federal Reserve Bank of New York, "Reverse Repo Counterparties". https://www.newyorkfed.org/markets/rrp_counterparties.

[28] Unwind: To close out a relatively complicated investment position.

and these institutions are willing to lend funds to this low rate, the $i_{ON\ RRP}$, but not lower. For this reason, the $i_{ON\ RRP}$ acts as a reservation rate and institutions can use it to arbitrage other short-term rates. Thus, the interest rate paid on *ON RRP*[29] transactions and it is below the i_{IOR}, acts like a floor for the i_{FF} and serves as a *supplementary policy tool* by the Fed, Figure 2. All these questionable "innovations" in monetary policy, the unnecessary liquidity of $22 trillion and the uncontrolled fiscal stimulus, unemployment compensation, "infrastructure" bill (over $5 trillion); and unfortunately, the huge wastes have caused enormous social cost, debts, uncertainty, divisions, and the future generations will face all these deficiencies. Thus, there is a serious ethical question, here. Why our policy makers (monetary, central bank and fiscal, government) are acting against their own people? Who is in control and dictates these anti-social policies? With all these strange policies, exchange rates are difficult to be determined and also to be forecasted.

V. Conclusion

The paper is using a money market approach to determine the exchange rate. The important variables are the real money supply, the real income (production of the nation), and the interest rate. The empirical results show that these variables (actually, monetary policy) have a significant effect on the spot exchange rate. Fiscal policy and of course, trade policy are important for the wellbeing of the citizens for a democratic, sovereign, and advanced nation. Trade policies have become "obsolete" by the WTO for the advanced industrial nations. Currencies show the prosperity of a nation and their comparative advantage and competitiveness.

Further, it is used, here, another money market model of exchange rate determination, which is utilizing the classical equation of exchange. The results show that the velocity of money differentials, the money supply differentials, and the real production differentials have significant effects on the spot exchange rate. Then, public policies and economic growth affect the value of the currencies, especially after 1973, when exchange rates became flexible (market determined) through trade, investment, production, competitiveness, speculation, and economic prosperity of the independent nations.

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[29] This $i_{ON\ RRP} = 0.05\%$ (July 2, 2021) and now, it is 0.30%. See, https://fred.stlouisfed.org/series/RRPONTSYAWARD

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