Advanced Topic 5:
Exchange Rate Determination II

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Our concern here is whether the evidence on forward and spot exchange rate movements is consistent with asset market efficiency. Consider first the historical movements in the spot and 3-month forward prices and forward premium of the Canadian dollar in terms of U.S. dollars, plotted in Figure 1 on the next page. Obviously, the spot and forward rates move very closely together but the period-to-period percent changes in the spot rate vary much more widely than would be predicted by the forward premium.

Covered interest parity is said to hold when the interest rate differential is fully explained by the forward premium, and the country risk can therefore be ignored. Failure of covered interest parity to hold simply reflects the existence of differential country risk. A procedure to minimize the impact of country risk is to compare the interest rates on securities in the two countries' currencies issued by a single firm, or by issuers operating out of a third country. But even in these cases some risk differential could remain because future government intervention could still prevent ultimate repayment in one of the currencies. Interest differentials are plotted along with the corresponding forward premiums for a number of countries in Figure 2 and Figure 3.[1]

The **observed fit is quite good** even in the case of the 3-month commercial paper differential for Canada and much tighter in the case of the off-shore deposit rates. **Nevertheless, there are substantial very short-run deviations from covered interest parity**. It turns out that **these deviations are the result of problems arising in collection of spot and forward exchange rate data, as is illustrated by the case of the Japanese yen with respect to the U.S. dollar in recent years in Figure 4.** Two different monthly estimates of the spot and forward rates were obtained from *Datastream* for 1999 through 2007—the mnemonics for the series are given below the charts in the top two panels. While the spot and forward rates are very similar in each of the two alternative estimates, the resulting 1-month forward premiums on the yen in terms of the dollar implied by the estimates, expressed in annual percentage rates, are strikingly different as shown in the bottom panel.

[1]The sources of all these data are discussed in detail in Appendix F in *Interest Rates, Exchange Rates and World Monetary Policy.*

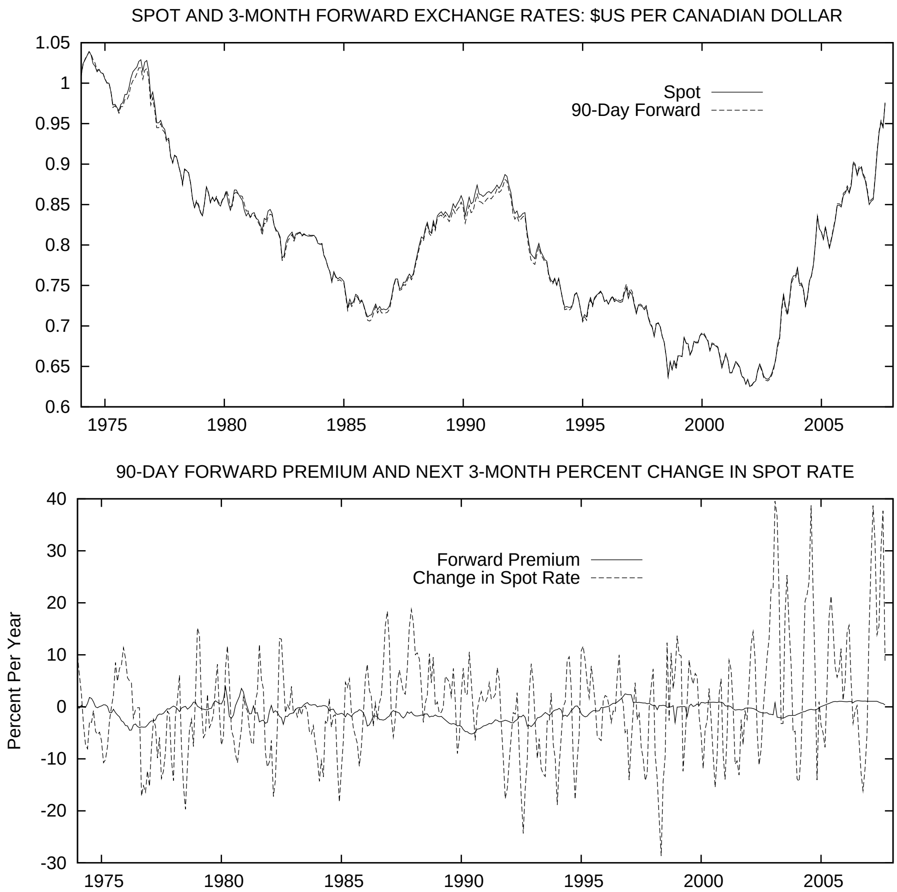


Figure 1: Canada vs. United States: Spot and 90-day forward exchange rates, U.S. dollars per Canadian dollar (top panel) and 90-day forward premium and 3-month ahead percent change in spot rate (bottom panel).

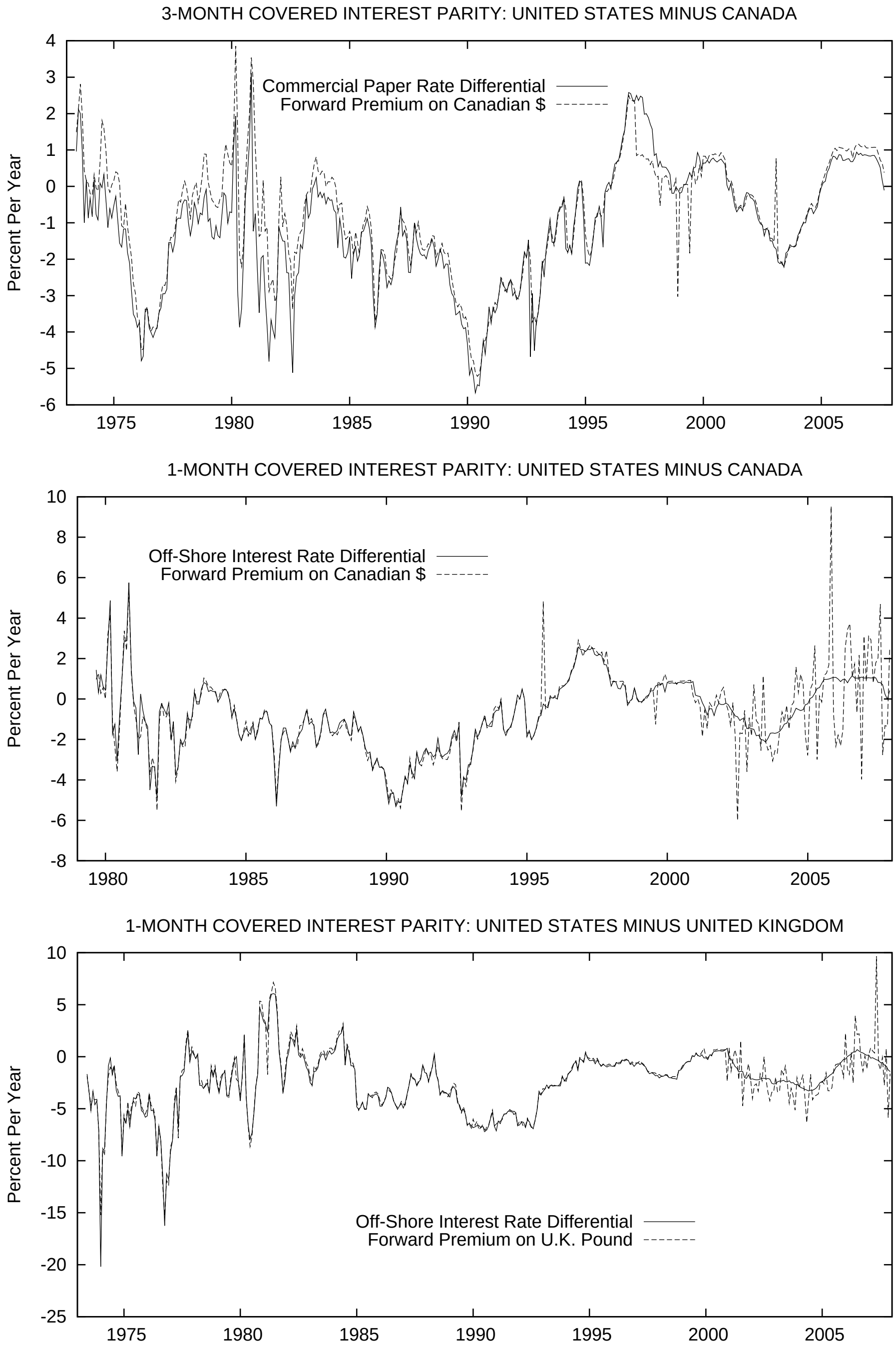


Figure 2: Covered interest parity for Canada and the United Kingdom with respect to the United States.

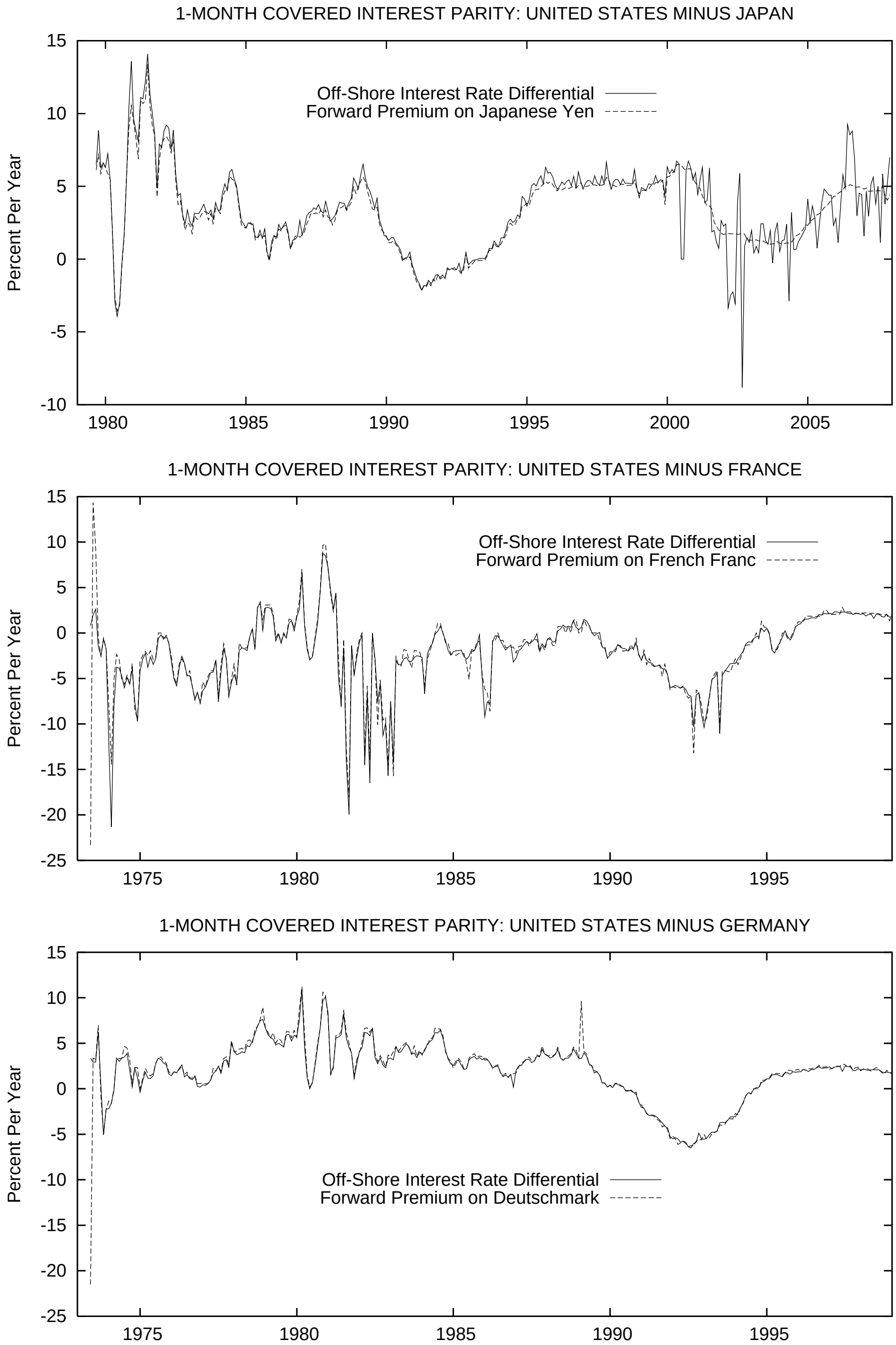


Figure 3: Covered interest parity for Japan, France and Germany with respect to the United States.

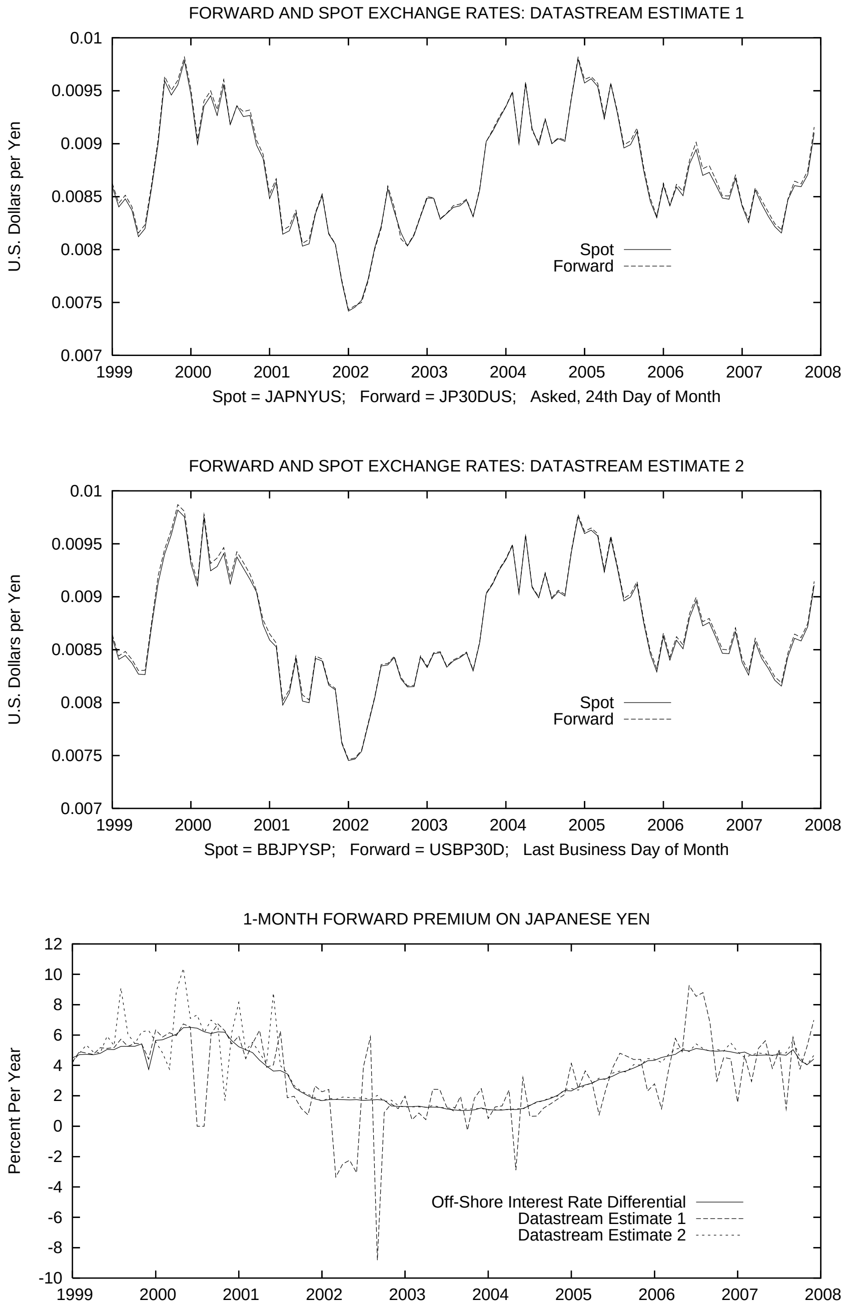


Figure 4: Alternative off-shore interest differential and Datastream estimates of the Japanese spot and 1-month forward exchange rates with respect to the U.S. dollar, and the corresponding forward premia on the Yen.

There are two reasons for this. First, even slight differences between spot and forward rates have big effects on the forward premiums expressed in annual percentage rates. Second, it makes a difference whether the spot and forward exchange rate data pertain to prices asked, prices offered or actual contract prices, and whether the group of transactions that are averaged and the time interval over which they are averaged to obtain noon or closing prices for any given day is large or small. **For these reasons the 'implicit' forward premiums implied by the off-shore interest differentials are used instead of the actual forward premium estimates in all subsequent empirical analysis. Covered interest parity is thus assumed to hold to a reasonable approximation in these data**.

As noted in the previous Topic, **the interest parity condition can be combined with the efficient markets condition** to yield

$$\tilde{i}_t - i_t \;=\; \Phi_t - \rho_c \;=\; E_\Pi - \rho_x - \rho_c \;=\; E_\Pi - \rho\,. \tag{1}$$

If enough people are risk-neutral so that the country and foreign exchange risk premiums disappear, this reduces to

$$\tilde{i}_t - i_t \;=\; \Phi_t \;=\; E_\Pi \tag{2}$$

which is known as a situation of **uncovered interest parity—the foreign-minus-domestic interest rate differential equals the expected rate of appreciation of the domestic currency which, of course, is extremely difficult to measure.**

If expectations are formed rationally in the sense that people take into account all information available to them, if market participants on average correctly anticipate future exchange rate movements, and if a sufficient fraction of those participants are risk neutral, the expected rate of change in the exchange rate will equal the mean of the actual rate of change—prediction errors in the upward and downward directions will be equally likely. Forward exchange rates will then be unbiased predictors of future spot rates. Under these conditions, letting s_t and f_t be the logarithms of the spot and forward exchange rates, the regression

$$s_{t+1} \;=\; \alpha + \beta f_t + \epsilon_t \tag{3}$$

should produce estimates of α equal to zero and β equal to unity. If there is a constant risk premium, the estimate of α will differ from zero but that of β will still be unity. Alternatively, the change in the logarithm of the spot rate can be expressed as

$$s_{t+1} - s_t \;=\; \alpha + \beta\,(f_t - s_t) + \epsilon_t \tag{4}$$

which is identical to (3) when $\beta = 1.0$. The term $(s_{t+1} - s_t)$ is proportional to the percentage rate of change in the spot exchange rate and $(f_t - s_t)$ is proportional to the forward premium. Using (2) it can be seen that $\tilde{i}_t - i_t = f_t - s_t$ if the risk premium is zero and these two magnitudes will be on average proportional if α is a non-zero constant so that β will still be unity. **Equation (3) can be defined as the 'forward rate' version of the 'unbiasedness hypothesis' and equation (4) as the 'forward premium' version. Validity of the unbiasedness hypothesis is usually thought to imply uncovered interest parity**.

Before turning to statistical estimation it is useful to examine what the principles developed thus far and the evidence thus far observed imply about the magnitudes of α and β in the two expressions above. To start, **assume that domestic and foreign inflation rates are zero, and known to be so, and that the real exchange rate is a random walk. If everyone correctly predicts the shocks ϵ_t and behaves rationally, the magnitudes of α and β in both (3) and (4) will be 0 and 1 respectively. Under the more reasonable case where nobody can predict the ϵ_t, β will be zero in (4) because differences between f_t and s_t will only arise as a result of the random timing of individual transactions and those differences will be too small for arbitragers to profit from and will be uncorrelated with the movement of the spot exchange rate from the current to next period. The forward premium, and the excess of the foreign interest rate over the domestic rate, will not predict the future change in the spot rate. Uncovered interest parity holds only in the sense that both Φ and E_Π equal a zero interest rate differential. We would nevertheless expect β to be close to unity in (3) because the forward rate in each period will equal the spot rate in the previous period and the levels of the two series will differ only by the between-period change in the spot rate which, although large in relation to the level of the forward premium, is a tiny percentage of the levels of the forward and spot rates. In the presence of actual and expected inflation differences, the forward rate will do little better in predicting the future movements in the spot rate unless actual and expected inflation differentials move together and very substantially through time**.

The results obtained from running the regressions (3) and (4) are shown in the two pages below.[2] In the regressions of the current spot rate on last period's forward rate, the coefficients of the last period forward rate are very close to unity although, technically, unitary values can be rejected in a number of cases. When the percentage changes of the spot rates to next period are regressed on the corresponding current forward premiums, the coefficients of the forward premiums are everywhere negative, significantly so in the cases of the U.K. pound and Japanese yen with respect to the U.S. dollar. In all five of these cases there is no basis for concluding that the coefficient of the forward premium is unity and the R-Squares are extremely low.

[2]The calculations for these tables are performed in the `Gretl` and `XLispStat` input files `fprempuz.inp` and `fprempuz.lsp` and the results are in the respective output files `fprempuz.got` and `fprempuz.lou`. The montly data files are those previously noted.

Table 1: Regressions of spot exchange rates on lagged 1-month and 3-month forward rates

	Constant	Lagged Forward Rate	No. of Obs. T	R-Sq.	Serial Correlation Chi-Square – Order 1	< 6	$< T/4$
3-Month							
Canada/U.S.	0.015	0.984	414	0.961	631.5	941.6	977.9
1973:6–2007:11	(0.016)	(0.021)			[0.00]	[0.00]	[0.00]
1-Month							
Canada/U.S.	0.003	0.997	339	0.971	0.035	6.983	112.5
1979:9–2007:11	(0.009)	(0.012)			[0.85]	[0.22]	[0.02]
U.K./U.S.	0.043**	0.977***	414	0.964	3.859	5.606	87.51
1973:6–2007:11	(0.020)	(0.012)			[0.05]	[0.47]	[0.88]
Japan/U.S.	0.00009*	0.986**	339	0.982	0.748	6.049	57.68
1979:9–2007:11	(0.00006)	(0.007)			[0.39]	[0.30]	[0.99]
France/U.S.	0.004**	0.981**	319	0.970	0.012	5.507	66.97
1973:6–1999:12	(0.002)	(0.010)			[0.91]	[0.36]	[0.85]
Germany/U.S.	0.006	0.988*	319	0.973	1.303	4.743	71.11
1973:6–1999:12	(0.005)	(0.009)			[0.25]	[0.45]	[0.75]

Note: The test for serial correlation is a Lagrange Multiplier test. It involves regressing the residuals on lagged residuals together with the the matrix of independent variables and testing for significance of the lagged residuals. The figures in square brackets are P-values. When the residuals are serially correlated at the 10% level or worse, the coefficient standard errors, shown in the curved brackets, are adjusted for heteroscedasticity and autocorrelation with truncation lags equal to $.75\, T^{1/3}$ rounded to the nearest integer. The superscripts ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively of the null-hypotheses of zero values for the constant and unit values for coefficients of the forward rate.

Table 2: Regressions of percentage changes in spot exchange rates to next period on 1-month and 3-month forward premia

	Constant	Forward Premium	No. of Obs. T	R-Sq.	Serial Correlation Chi-Square – Order 1	< 6	$< T/4$
3-Month							
Canada/U.S. 1973:9–2007:9	0.210 (0.980)	-0.032 (0.437)	409	0.000	528.0 [0.00]	806.2 [0.00]	986.4 [0.00]
1-Month							
Canada/U.S. 1979:9–2007:11	-0.045 (1.162)	-0.900 (0.622)	339	0.006	0.138 [0.71]	4.038 [0.54]	96.35 [0.19]
U.K./U.S. 1973:6–2007:11	-3.118 (2.273)	-1.248** (0.604)	414	0.010	0.638 [0.42]	1.576 [0.95]	89.84 [0.84]
Japan/U.S. 1979:9–2007:11	11.49*** (3.611)	-2.528*** (0.869)	339	0.024	0.033 [0.85]	2.399 [0.79]	67.73 [0.91]
France/U.S. 1973:6–1999:12	-2.392 (2.338)	-0.656 (0.537)	319	0.005	0.022 [0.88]	5.609 [0.35]	54.63 [0.99]
Germany/U.S. 1973:6–1999:12	2.763 (2.579)	-0.673 (0.712)	319	0.003	0.190 [0.66]	4.615 [0.46]	61.23 [0.94]

Note: The forward premia are based on off-shore interest rate differentials in the 1-month cases and on the corporate paper interest rate differential in the 3-month case. The percentage changes in the spot rates and the forward premia are expressed as annual rates. The superscripts *** and ** indicate signicance of the relevant coefficients at the 1% and 5% levels respectively. The test for serial correlation is the Lagrange Multiplier test discussed in the notes to the previous table. The figures in square brackets are the P-values and in those in curved brackets are the coefficient standard errors. In the Canadian 3-month case where the residuals are clearly serially correlated, the coefficient standard errors are adjusted for heteroscedasticity and autocorrelation with truncation lag equal to $.75\,T^{1/3}$ rounded to the nearest integer.

Table 3: Regressions of the 1-month forward premium on the past year's U.S. minus domestic inflation rate difference, the current real exchange rate and averages of percentage changes in real exchange rates during the past 1 to 3, 4 to 6 and 7 to 12 months

	Const.	Previous Years' Inflation	Real Exch. Rate	Average of Past Real Exch. Rate Changes 1-3	4-6	7-12	No. of Obs. R-Sq.
Canada/U.S.	5.417***	0.312***	-0.069***	0.012	0.017	0.021	340
1979:9–2007:12	(1.701)	(0.087)	(0.019)	(0.014)	(0.013)	(0.021)	0.238
U.K./U.S.	-4.665**	0.281***	0.024	-0.020	-0.000	-0.016	415
1973:6–2007:12	(2.340)	(0.081)	(0.020)	(0.013)	(0.009)	(0.017)	0.185
Japan/U.S.	2.053**	0.633**	-0.002	-0.026***	-0.009	-0.002	340
1979:9–2007:12	(1.021)	(0.249)	(0.005)	(0.010)	(0.007)	(0.014)	0.267
France/U.S.	-0.686	0.734***	-0.006	-0.021	0.012	-0.007	319
1973:6–1999:12	(2.868)	(0.149)	(0.025)	(0.019)	(0.013)	(0.023)	0.195
Germany/U.S.	7.542***	0.946***	-0.055***	0.003	0.005	-0.022**	319
1973:6–1999:12	(1.533)	(0.130)	(0.012)	(0.010)	(0.007)	(0.010)	0.544

Note: The forward premia are based on off-shore interest rate differentials and they and the percentage changes in the spot exchange rates are expressed as annual rates. The superscripts *** and ** indicate statistical significance at the 1% and 5% levels respectively. All coefficient standard errors, shown in the brackets below the coefficients, are adjusted for heterscedasticity and autocorrelation using the Gretl statistical program which chose a bandwidth of 5 and a bartlett kernel.

Regressions of the forward premiums on previous inflation rates are presented in the Table above. Those results clearly indicate that the lower the domestic relative to U.S. inflation rate over the previous year, the higher will be the forward premium on the domestic currency. Also, to the extent that the current and past real exchange rate movements significantly affect the forward premium they do so negatively, indicating some mean reversion.

Clearly, there is no reason to be puzzled about the fact that the estimates of β in both the forward rate and forward premium equations are less than unity—**there is no bases for the so-called "forward premium puzzle" as to why the coefficients of the forward premiums in regressions determining future changes in spot rates are not unity. And, it should not be surprising that in three out of the five cases the null-hypothesis that $\beta = 0$ cannot be rejected. That the estimated β coefficients in all the forward premium equations are negative is somewhat of a surprise** although negative values in half of the cases is extremely likely. This surprise is augmented by the fact that, as shown in the Table below, negative signs also occur in estimated forward premium equations for eight of the nine country-combinations not involving the United States. The possible reasons for this predominance of negative signs is discussed on pages 138 through 151 of *Interest Rates, Exchange Rates and World Monetary Policy.* Although the analysis there is inconclusive, **it is not hard to imagine situations in which negative signs could occur as a result of changes in inflation rates happening to move in the opposite directions to changes in real exchange rates. To argue that there is fundamental irrationality in financial markets makes little sense when we note that the R-squares in these regressions are tiny. Indeed, scatter plots of the percent changes in exchange rates to next month against the forward premiums in the two Figures further below suggest little in the way of an important relationship between the variables that could be exploited for profit.**

Kernel-density plots of the forecast errors resulting from naively using the current spot rate as the predictor of next-month's spot rate and, alternatively, using the current forward rate as the predictor are shown in two Figures further below. It is clear from these plots that there is little to choose between the two forecasting methods—indeed, this is consistent with the view that market participants have based their exchange-rate predictions largely on a naive assumption that over the next period the spot rate is equally likely to move in either direction. As shown in Table 5, the root-mean-square-errors of the two approaches are practically identical, with the forward rate forecast doing trivially worse than the naive spot projection.

Table 4: Regressions of percentage changes in spot exchange rates to next period on 1-month forward premia: Canadian, British, Japanese, French and German currencies with respect to each other

	Constant	Forward Premium	No. of Obs. T	R-Sq.	Serial Correlation Chi-Square – Order 1	< 6	$< T/4$
Canada/U.K.	5.936***	-3.936***	339	0.044	0.567	2.152	72.83
1979:9–2007:11	(2.296)	(1.002)			[0.45]	[0.83]	[0.82]
Japan/U.K.	21.15***	-3.403***	339	0.017	0.401	1.691	58.93
1979:9–2007:11	(7.708)	(1.418)			[0.53]	[0.89]	[0.99]
France/U.K.	0.921	-0.712**	319	0.009	3.400	5.451	69.80
1973:6–1999:12	(1.951)	(0.534)			[0.06]	[0.36]	[0.78]
Germany/U.K.	-3.242	-0.064	319	.00003	3.791	5.619	73.78
1973:6–1999:12	(3.508)	(0.637)			[0.05]	[0.34]	[0.67]
Canada/Japan	-12.68	-2.844***	319	0.022	0.621	1.446	84.51
1973:6–1999:12	(4.778)	(1.038)			[0.43]	[0.92]	[0.49]
France/Japan	-3.630	0.349	244	0.001	0.002	5.944	39.58
1979:9–1999:12	(3.919)	(0.626)			[0.96]	[0.31]	[0.98]
Germany/Japan	-5.854*	-1.501	244	0.007	0.189	3.847	38.97
1979:9–1999:12	(3.011)	(1.122)			[0.66]	[0.57]	[0.99]
Canada/Germany	-2.590	-0.993	244	0.005	0.075	2.190	47.64
1979:9–1999:12	(3.601)	(0.899)			[0.78]	[0.82]	[0.89]
France/Germany	1.852	1.032***	319	0.149	2.907	6.082	57.80
1973:6–1999:12	(0.945)	(0.283)			[0.09]	[0.29]	[0.48]

Note: The forward premia, based on off-shore interest rate differentials, and the percentage changes in the spot rates are expressed as annual rates. The superscripts ***, ** and * indicate significance of the relevant coefficients at the 1%, 5% and 10% levels respectively. The test for serial correlation is the Lagrange Multiplier test discussed in the notes to Table 1. The figures in square brackets are the P-values and those in curved brackets are the coefficient standard errors. Where the residuals are serially correlated at the 10% level or worse, the coefficient standard errors are adjusted for heteroscedasticity and autocorrelation in the same fashion as in Table 1.

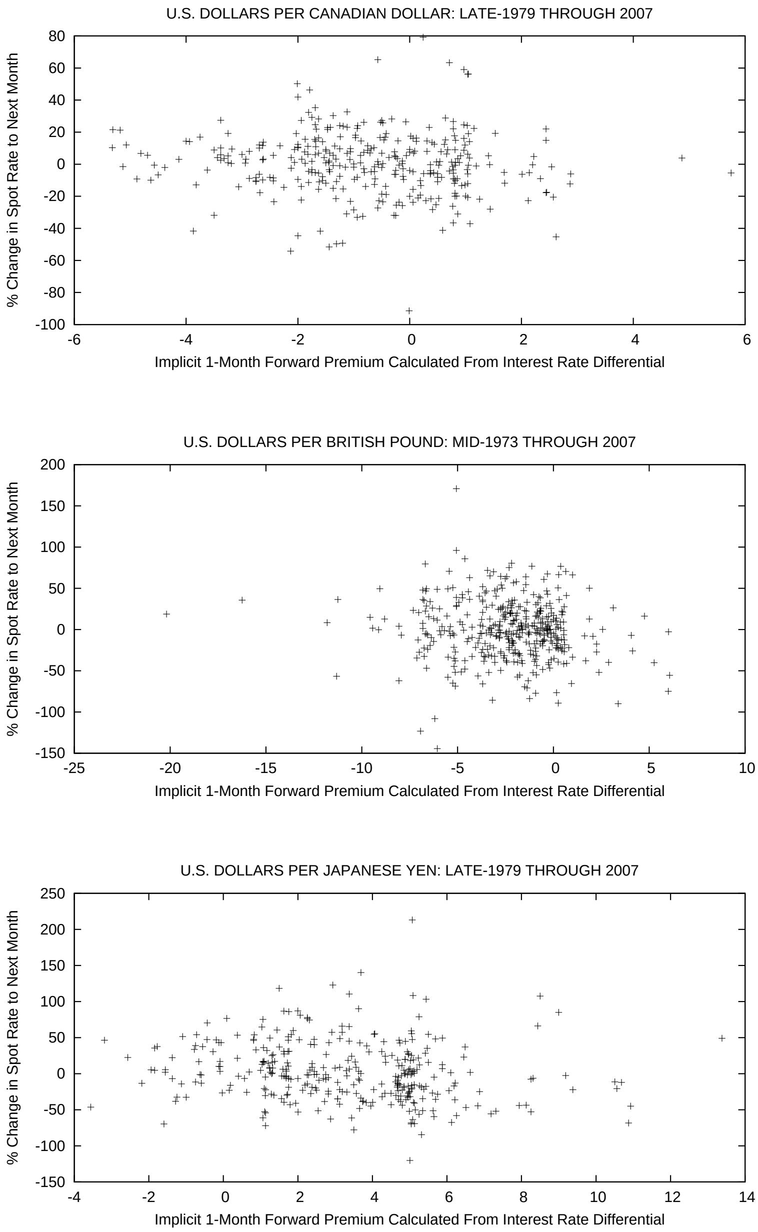
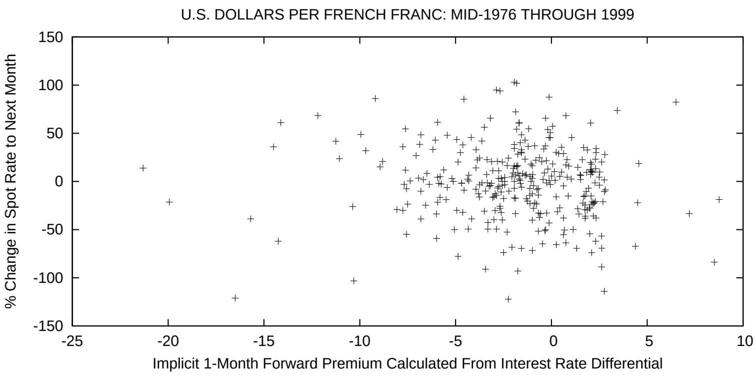


Figure 5: 1-Month forward discounts based on interest rate differentials and percentage changes of spot rates to next month – all interest rates and percentage changes are at annual rates



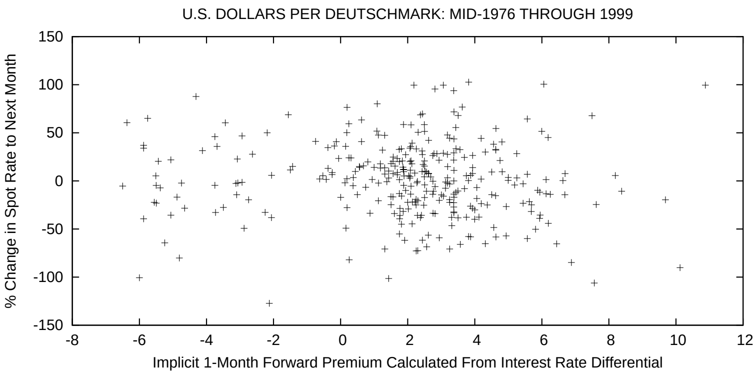


Figure 6: 1-Month forward discounts based on interest rate differentials and percentage changes of spot rates to next month – all interest rates and percentage changes are at annual rates

Table 5: Root-mean-square forecast errors of forward and naive current spot rate forecasts of next-period exchange rates expressed as U.S. dollars per unit of domestic currency

			Naive Spot Rate	Forward Rate
Canadian Dollar	1979:10	2007:11	1.574	1.594
U.K. Pound	1973:07	2007:11	2.999	3.025
Japanese Yen	1979:10	2007:11	3.381	3.434
French Franc	1973:07	2000:11	3.215	3.245
Deutschmark	1973:07	2000:11	3.243	3.279

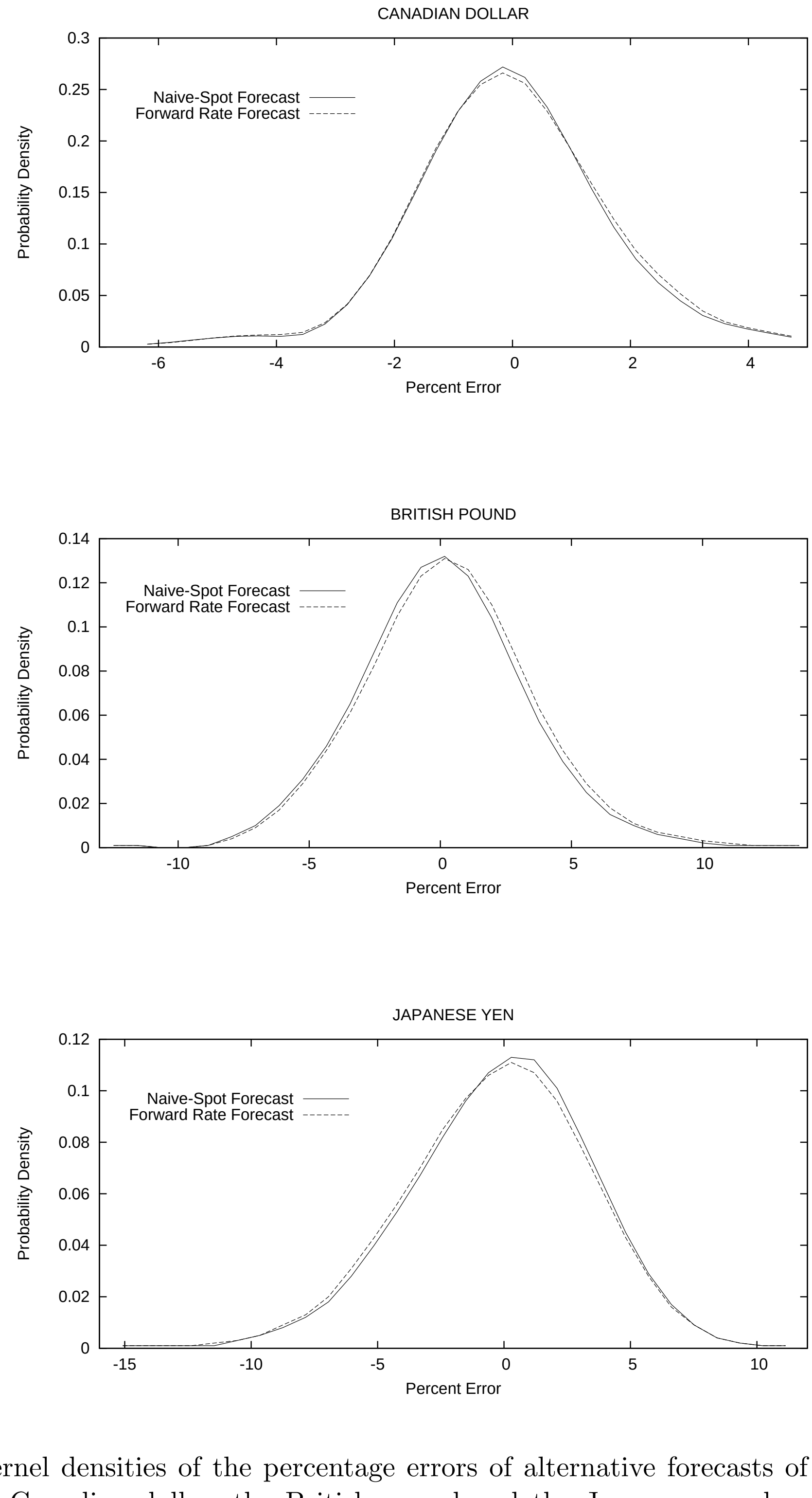


Figure 7: Kernel densities of the percentage errors of alternative forecasts of the U.S. dollar prices of the Canadian dollar, the British pound and the Japanese yen based on the naive assumption of constancy of the current spot rate and on the prediction implied by the current 1-month forward rate.

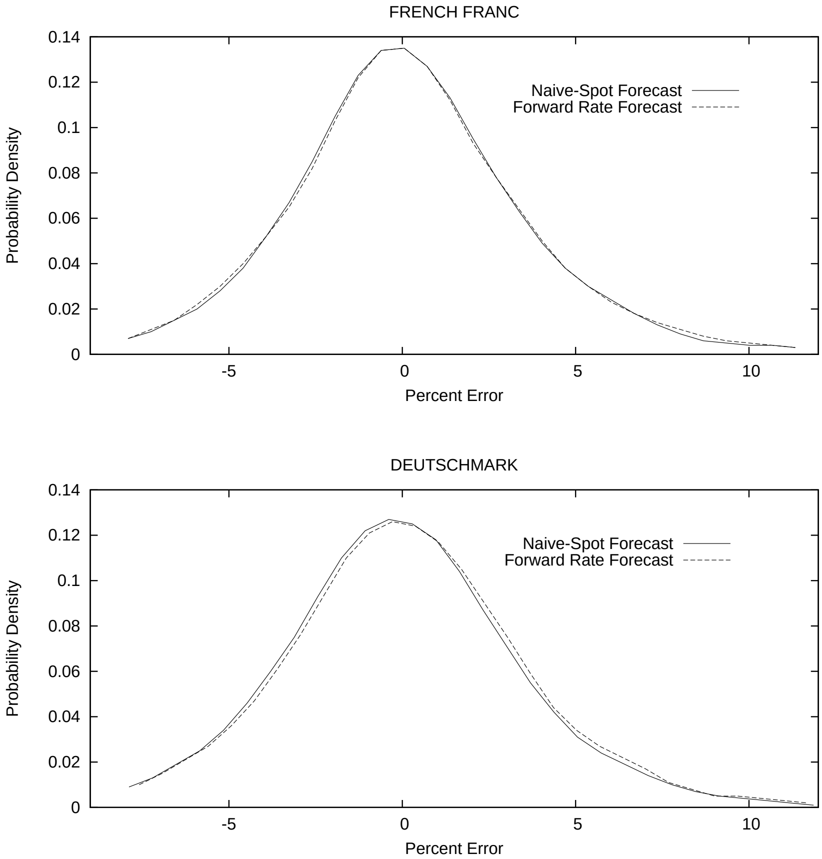


Figure 8: Kernel densities of the percentage errors of alternative forecasts of the U.S. dollar price of the French franc and German mark based on the naive assumption of constancy of the current spot rate and on the prediction implied by the current 1-month forward rate.

The final issue to be discussed here is exchange rate overshooting. Under a flexible exchange rate the process of portfolio adjustment to excess liquidity involves an attempted purchase of assets abroad that leads to a devaluation of the real and nominal exchange rates which increases exports relative to imports, causing the levels of output and income to increase until domestic residents become willing to hold this greater liquidity. It is inevitable that the process of adjustment of the current account balance and output in response to a devaluation will take time. In the very short run—say, a day or week—very little adjustment, if any, can occur.

The nature of these issues can be seen from log linear representations of the equation of stock equilibrium, in its demand for liquidity form, and a modified expression of equation (1.8) from the previous Topic on exchange-rate determination.

$$l_t = \phi_t + p_t + \epsilon\, y_t + \eta\, r_t + \eta\, (E\{p_{t+1}\} - p_t) \tag{5}$$

$$r_t = \tilde{r_t} + \rho - (E\{q_{t+1}\} - q_t) \tag{6}$$

where y_t is the logarithm of domestic income, ρ is the risk premium on domestic assets, q_t is the logarithm of the real exchange rate, l_t is the logarithm of the nominal stock of liquidity and p_t is the logarithm of the domestic price level so that $l_t - p_t$ is the logarithm of the real stock of liquidity, and ϵ (> 0) and η (< 0) are, respectively, the income elasticity and the interest semi-elasticity of demand for liquidity. **Note that r_t and $\tilde{r_t}$ are the levels, not the logarithms**, of domestic and rest-of-world interest rates and that changes in ϕ_t represent logarithmic shocks to the demand for liquidity. Assuming that **the price level in the rest of the world is normalized at unity**, the logarithm of the real exchange rate can be expressed

$$q_t = p_t + \pi_t \tag{7}$$

where π_t is the logarithm of the nominal exchange rate Π_t, defined as the price of the small country's currency in rest-of-world currency.

It can be easily seen that **if price level adjustment is instantaneous, a positive monetary shock—that is, a one-time increase in l_t or decline in ϕ_t —will result in an immediate increase in p_t and fall in π_t in the same proportion as the monetary shock**. Since the shock is a one-off occurrence, the expected inflation rate and rate of change of the real exchange rate will be unaffected. The real interest rate will remain unchanged and price level flexibility will guarantee that y_t stays constant at its full employment level. As a result, from equations (5) and (7),

$$\Delta p_t = -\Delta \pi_t = \Delta(l_t - \phi_t)$$

and

$$\Delta q_t = 0\,,$$

where Δ here simply denotes a change in the logarithm of the level of the variable.

Now suppose a length of run sufficiently short for changes in q_t to have no effect on the trade balance and y_t as well as for p_t and $E\{p_{t+1}\}$ to remain unchanged. Assume also that the risk premium on domestic assets does not change and that everyone regards the real exchange rate as an approximate random walk in the

short run, implying that $E\{q_{t+1}\} = q_t$. This will imply an unchanged level of r_t in (6) and the left side of equation (5) will exceed the right side. Because of the attempt of domestic residents to dispose of their excess liquidity by purchasing claims on real capital from abroad, π_t and q_t will fall, both in the same proportion. Since neither r_t or y_t are affected, there is no mechanism to bring the right and left sides of equation (5) together and the small country's currency will devalue without limit. There will be no short-run equilibrium!

As noted in the previous Topic dealing with exchange rate determination, a part of each country's output, the non-tradeable component, will be available only for home consumption and investment, and the remaining part, the tradeable component, will available for consumption and investment both at home and abroad. The tradeable component can be thought of as having the same price, measured in either currency, in both countries while the output components restricted to consumption and investment in the country in which they are produced will, of course, have different prices. One need not equate traded and non-traded output components with traded and non-traded goods, as **every good will have embedded in it both traded and non-traded components**.

The small country's price level can therefore be expressed as a weighted average of the domestic-currency prices of the traded and non-traded components of domestic output.

$$p_t \quad = \quad \theta \, p_t^n - (1-\theta)\, \pi_t \tag{8}$$

where θ is the share of output that is non-traded, p_t^n is the domestic-currency price of the non-traded output component, and **the price of the traded output component in rest-of-world currency units is normalized at unity.**[3] It is obvious from this equation that **a devaluation of the small country's currency will increase its price level even if the home-currency price of domestic non-traded component of output and price of the traded component in rest-of-world currency are fixed**. It follows from (5) that the short-term equilibrium change in the logarithm of the nominal exchange rate will be

$$\Delta\pi_t = -\frac{1}{1-\theta}\,\Delta(l_t - \phi_t) = -\frac{1}{1-\theta}\,\Delta p_t. \tag{9}$$

Since none of the other variables in (5) are affected, **the increase in the price level will be proportional to the increase in the stock of liquidity, while the nominal exchange rate will decrease by some multiple of the increase in liquidity—the exchange rate overshoots its long-run equilibrium value, which will be below its initial value by an amount proportional to the increase in the money stock**. The short-run change in the real exchange rate will be

$$\begin{aligned}
\Delta q_t &= \Delta p_t + \Delta \pi_t \\
&= \left[1 - \frac{1}{1-\theta}\right] \Delta(l_t - \phi_t) \\
&= -\frac{\theta}{1-\theta}\,\Delta(l_t - \phi_t).
\end{aligned} \tag{10}$$

[3]Since Π_t is the price of domestic currency in terms of foreign currency, - π_t is the logarithm of the domestic currency price of foreign currency, which the rest-of-world price of the traded output component must be multiplied by to express it in units of domestic currency.

and will be negative as long as the nominal exchange rate overshoots its final equilibrium value, which will happen whenever $\theta > 0$ and the non-traded component of output is therefore positive.

It has been argued that even traded goods prices may not respond to exchange rate movements because of local-currency-pricing by firms that have monopsony power in international markets. This is called pricing to market. Letting υ represent the fraction of the small country's traded component of output that is *not* priced in local currency independently of the nominal exchange rate, the change in p_t in response to a change in π_t becomes, from (8),

$$\Delta p_t = -\upsilon\,(1-\theta)\,\Delta\pi_t. \tag{11}$$

and equation (9) becomes

$$\Delta\pi_t = \frac{-1}{\upsilon\,(1-\theta)}\,\Delta(l_t - \phi_t). \tag{12}$$

If the price of the traded component is set entirely in the small country's currency and does not respond to movements in the exchange rate, $\upsilon = 0$ and Δp_t will therefore also be zero. The **nominal and real exchange rates will fall without limit in response to a positive monetary shock even if the traded component represents a substantial fraction of output**.

It seems **reasonable to assume that the expected future rate of change in the real exchange rate will unaffected by this short-run overshooting movement in the nominal exchange rate, given that there is a lot of noise in the nominal and real exchange rates and everyone acts as though the real exchange rate is a random walk. Occasions may arise, however, where people know when the real exchange rate has fallen below its long-run equilibrium level and expect it to rise back to that level.**[4] **The term** $(E\{q_{t+1}\} - q_t)$ **in equation (6) will become positive, causing the domestic interest rate to fall. The quantity of liquidity demanded will thus increase in equation (5), offsetting some of the shock to the excess supply of money and moderating, and possibly even eliminating, the overshooting of the nominal exchange rate**. This will be the case whenever the real exchange rate falls in response to a monetary shock as long as people understand that the fall is temporary, although it is hard to imagine situations in which this will happen.[5] **It must be kept in mind that no forecasting approach has been able to consistently outperform the simple prediction that tomorrow's real exchange rate will, on average, equal today's**.

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[4]If this is the case, it can no longer be assumed that the prices of non-traded output components are fixed on account of agents' unawareness that a shock of aggregate demand has occurred. The only basis for price level rigidity becomes menu and other costs of initiating price change.

[5]For a full discussion of all these issues regarding exchange rate overshooting as well as important references to the literature, read Chapter 6 of *Interest Rates, Exchange Rates and World Monetary Policy.*