Deviations from Uncovered Interest Rate Parity: A Post Keynesian Explanation

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Uncovered interest rate parity (UIRP) makes a seemingly innocuous claim: expected rates of return on interest-bearing assets (taking into account exchange rate movements) across countries must be equal. If not, this sets into motion forces that restore the equality. But, despite the simplicity and elegance of this theory, empirical tests have shown little support for this pillar of the Neoclassical approach to global capital flows.

This suggests that one or more of the premises underlying the argument is unwarranted. Supporters of UIRP realize this and usually offer some form of risk as the culprit. However, subsequent efforts to explain the source of risk premiums have been unsatisfactory.[2] I will argue that the introduction of uncertainty, non-ergodicity, and endogenous money solves the mystery and allows for a comprehensive explanation of deviations from UIRP. This argument will be supported by both theory and empirical evidence. By the end of the paper it will be clear to the reader that there are so many factors interfering with the textbook operation of UIRP that it is exceedingly unlikely that it would ever hold in the real world. Deviations are common and they are not necessarily related to risk.

The paper is organized as follows. The next section will review traditional UIRP theory and a Post Keynesian modification thereof. Following that, an empirical test of the latter is presented. The results are reported and interpreted in section 3.0. Concluding remarks finish the paper.

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[1]I would like to thank, without implicating, Stephen Quinn for his helpful suggestions in writing this paper.

[2]In particular, the deviations from UIRP have varied in ways that could not be explained using standard measures of risk.

1.0 Theory

Uncovered interest rate parity argues that the rate of return from holding interest-denominated assets must tend toward equality across countries. Taking the example of the U.S. and Japan, this can be expressed as show in (1):

(1) $(\$/¥)^e/(\$/¥) = (1+r_\$)/(1+r_¥)$

where $(\$/¥)^e$ is the expected future spot exchange rate, $(\$/¥)$ is the current spot exchange rate, $r_\$$ is the rate of interest available on dollars, and $r_¥$ is the rate of interest available on yen.[3] Rearranging the equation as shown in (1') gives a view of the situation from the US perspective: the left-hand side is the rate of return one could earn domestically, and the right-hand side is what one might expect to earn were the money invested in Japan:

(1') $(1+r_\$) = (¥/\$)(1+r_¥)(\$/¥)^e$.

If for some reason the equality does not hold, then forces are set into motion that restore equilibrium. For example, were the left-hand side of (1') larger than the right, this would mean that agents expected the rate of return to be higher in the United States. This would attract capital into the U.S., driving $r_\$$ down, moving $r_¥$ up, and causing a dollar appreciation (a rise in ¥/\$). This process continues until (1') holds again. This is the essence of UIRP.

Strictly speaking, there is only one thing that can prevent UIRP from prevailing: lack of compensating capital flows. Returning to the example where agents expect the rate of return to be higher in the US than in Japan, if US interest-bearing assets are not purchased (and Japanese ones

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[3]Note that the time horizon of the expectations and the term of each interest rate must be the same.

sold) then this situation will continue indefinitely. Without flows of capital resulting from the differential, $r_{\$}$, $r_{¥}$, and ¥/$ will not move (ceteris paribus) and the right- and left-hand sides of (1) (and (1')) will remain unequal. **Changes in the pattern of international portfolio investment are thus key to the operation of UIRP.**

As Neoclassical economists readily admit, however empirical studies typically find that UIRP as shown above does not hold. On the face of it, they are not terribly surprised by this as equation (1) makes some untenable assumptions. To begin, it is held that capital is perfectly mobile. Were there to exist official restrictions of capital flows or significant transactions costs then it would be possible for one side of the equation to exceed the other in equilibrium, with flows only triggered when the potential for profit exceeded the costs (in the same way that gold points operate in a gold standard). Among developed countries one would expect this factor to be small and fairly constant. Unfortunately, studies have shown that deviations from UIRP can be quite large and vary considerably over time. Thus, this does not appear to be an adequate explanation of deviations from UIRP.

But Neoclassicists are also aware that they have made the unlikely assumption that all interest-bearing assets are homogenous. This is done to ensure that agents' attention to assets is limited to the rates of interest paid and the expected rate of appreciation of the currency in question. In that way there can be no other attribute that might make an asset attractive other than those explicitly modeled in equation (1). Otherwise, there may be factors not evident in (1) that would allow an apparent inequality to actually be an equilibrium position. Neoclassical economists suspect that this is actually the case and that in reality assets are viewed as heterogeneous with respect to risk. If so, risky investments will be forced to offer higher rates of return to compete with the safe ones. This has not proved to be

an adequate explanation either, however, as no accepted measure of risk has properly tracked the direction or magnitude of observed deviations from UIRP.

One last possibility is that agents may wish to diversify their portfolios. Rather than put all their eggs into one basket agents may be willing to hold some volume of the low-return asset. However, as this desire for diversification is unlikely to vary considerably over time it is not considered as a potential explanation for the difficulties described above. Neoclassicals have yet to find an answer to the riddle of time-varying risk premia. Apparently, it is necessary to dig deeper than the suspension of perfect capital mobility and heterogeneity of assets to find the answer.

Post Keynesian economists approach monetary economics from a different perspective, one that assumes (in direct contrast to the Orthodox position) uncertainty, non-ergodicity, and endogenous money.[4] By starting with the Neoclassical version of UIRP (with imperfect mobility of capital and heterogeneous assets) and adding the factors implied by these three assumptions one can derive a comprehensive explanation of interest rate parity. The first two impact agents' expectations (an area almost completely neglected by researchers of every persuasion). In a world marked by non-ergodicity and uncertainty, the level of confidence with which agents' hold their forecasts becomes important. Investors will be unable to rely on the past as an even probabilistic guide to the future, and they will be well aware of the fact that the volume and quality of information that they do have is inadequate (sometimes woefully so). In this world, not all market expectations of return are created equal.

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[4]Please see Marc Lavoie (2000, 2001, 2002-2003) and John Smithin (1994, 1999, 2002-2003) for an excellent body of work on interest rate parity (covered, uncovered, and real) from the Post Keynesian perspective.

Assuming for a moment no other sources of deviation from UIRP, when agents are confident of forecasts then capital will move and UIRP will tend to hold; when they are not, however, then one can have a situation in which investors in aggregate believe the return that can be earned in one nation exceeds that in the other, but they lack the conviction to act. Capital will not flow in sufficient volume and UIRP will not hold.[5]

When money is exogenous, only conscious acts of policy from the central monetary authority will affect the money supply. One of those conscious acts can be *sterilization*. Sterilization involves the dampening of the capital flows created by UIRP deviations such that inflows of capital in the high-return country are met by policy-initiated reductions in the domestic money supply (and vice versa in the low-return country). Hence, while the flows are not actually prevented in a strict sense, the financial market is nevertheless insulated from their effect. Were the monetary authority to choose to do so, interest rates could be held in place and the entire burden of adjustment in UIRP would be thrown onto the exchange rate. Note, however, that this means that in a flexible exchange rate system where there were no other impediments to UIRP this alone would not prevent it from holding.[6] Rather, it shifts the entire burden of adjustment onto variables other than the interest rates in the countries where sterilization is occurring.

Of course, this describes what can happen (if authorities so choose) in a world of exogenous

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[5]Note that this is not identical to currency risk. Currency risk is simply the concern that investment positions may be adversely affected by exchange rate movements. That is not the same thing as the fear that one's forecast of future currency movements is faulty.

[6]This is so because the capital flows would still enter the high-return country and even though their interest rates would not rise, their currency would appreciate and thus restore equality in equation (1).

money. Things become much more interesting when money is endogenous. Consider the following. If money supply is demand driven and banks loan to credit-worthy agents first and find the reserves later, then in the event of capital inflows it is quite possible that the *private market* sterilize the inflow (see Lavoie 2001 for an explanation of this process). They would do this in a asset-based economy (like the United States, wherein the central monetary authority adjusts supplies of liquidity by buying and selling government securities) by purchasing securities with the unwanted funds and in an overdraft style one (like Germany and Japan, where the monetary authority operates by making loans to private banks) by reducing outstanding liabilities to the central bank.[7] In either event, private financial institutions, because they had already made all the loans they desired, freely choose to adjust their portfolios in a manner that sterilizes the capital flow.[8]

This yields a total of six factors that may prevent UIRP from holding: government restrictions on the flow of capital, transactions costs, risk, portfolio diversification, forecast confidence, and sterilization (either private and public). In addition, risk is often broken down into three categories: country risk (the risk that political or financial events in the country issuing the asset may adversely affect its value), default risk (the risk that the asset issuer will default), and currency risk (the risk that unfavorable changes in the exchange rate may take place). The eight determinants may be expressed as in equation (2):

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[7]In the outflow economy securities would be sold by private banks to compensate in a US style and new liabilities to the central bank incurred in a German style.

[8]Just as with policy-driven sterilization, they may choose **not** to do this as well. The point here is that when money is endogenous, it is possible and perhaps even likely that sterilization occur without there being a conscious policy choice.

(2) $Z = f(g, \hat{o}, \tilde{n}_c, \tilde{n}_d, \tilde{n}_{fx}, \ddot{a}, \ddot{e}, G)$,

where Z is the deviation from UIRP, g represents government restrictions on the flow of capital, $\hat{o}$ is transactions costs, $\tilde{n}_c$ is country risk, $\tilde{n}_d$ is default risk, $\tilde{n}_{fx}$ is foreign exchange risk, $\ddot{a}$ exists because agents wish to diversify their portfolios, $\ddot{e}$ is forecast confidence, and G is the effect of sterilization (either public or private). All but the last act as a hindrance to capital flow; G negates its impact (except on spot currency prices). An increase in any of the determinants except confidence (which works in the opposite direction) will increase Z.

Z can be placed directly into the UIRP relationship:

(3) $(1+r_{\$}) = (¥/\$)(1+r_{¥})(\$/¥)^e + Z.$

The idea here is to create an equation wherein it is possible to have an equilibrium when the US return exceeds that in Japan (Z>0), or vice versa (Z<0). Z is the specific amount by which the US return is expected to exceed that in Japan.

Consider again the impact of each of the independent variables in (2). Risk will affect both the sign and size of Z. If Japan is considered riskier (in any of the three senses), Z will be negative; if the US is considered riskier, Z will be positive. Several of the explanatory variables act only to change the absolute value of Z, those being g, $\hat{o}$, $\ddot{a}$, $\ddot{e}$, and G. These restrict capital flows without causing one country's assets to be preferred over the other's. For example, a government can limit the flow of capital and this may serve to allow them to maintain either a higher or lower rate of return than abroad. Transactions costs have a similar effect. A rise in the desire for diversification will also increase the spread between the US and Japanese expected rates of return but will not tend to favor either. And when confidence in agents' forecasts decline the spread likewise increases, but with no bias toward a

particular direction. Finally, sterilization (privately or publicly initiated) allows deviations in UIRP to continue, but does not create them (or their sign).

It would not be correct to read the above paragraph as arguing that only risk affects the sign of Z. For example, say we begin in a situation where Z is zero, but significant transactions costs (or government restrictions, or low levels of confidence, or whatever) exist. Were there to be a rise in the Japanese interest rates, Z would become negative because the capital flows necessary to eliminate the imbalance would not occur. Hence, *even though Japanese assets are not more risky,* the rate of return available on them rises and UIRP does not hold. This situation could continue indefinitely so long as Z does not rise to the point that flows are triggered. Thus, there is no reason to assume, a priori, that Z is a risk premium. In fact, among developed countries where relative risk factors could be expected to be less pronounced this might well be the major factor explaining deviations from UIRP. Note further that this means that *any* factor capable of moving $r_{\$}$, $r_{¥}$, (¥/$), or ($/¥)^{e} can therefore affect Z.

In summary, for UIRP to hold, Z must be equal to zero, which means that the impact of each of its determinants–g, ô, $ñ_c$, $ñ_d$, $ñ_{fx}$, ä, ë, G–must net to zero. This requires a very strange coincidence of events, one that, realistically speaking, is exceedingly unlikely.

2.0 Empirical Test

Much of what has been suggested above has been said elsewhere. Whether or not these factors are truly important in explaining deviations from UIRP is an empirical question. This paper will therefore conduct a test of this theory for the two most widely traded exchange rates in the world: the dollar-Deutsche Mark and the dollar-yen (the study is quarterly for the period 1989-1998; data

availability dictated both the frequency of the observations and time period selected). The dependent variable used is derived by solving for Z in equation (3) and is best understood as the excess return (annualized) agents expect to earn on US interest-bearing assets:

(3') $Z_t = (1+r_{\$t}) - (FX/\$)_t(1+r_{FXt})(\$/FX)^e_t$

The variables are measured as follows: $r_\$$ is the one-month London interbank rate paid on dollars, (FX/$) is the spot price of the dollar in units of foreign currency (DM or ¥), r_{FX} is the one-month London interbank rate paid on the foreign currency in question, and $(\$/FX)^e_t$ is agents' expectation in period t of the spot exchange rate one month hence.[9] The last number is the result of surveys collected by Money Market Services. In light of some economists' mistrust of observations created in this manner it should be noted that these data were shown to have significant explanatory power in Harvey (1998-99) and Harvey and Quinn (1997).

Unfortunately, very few of the independent variables listed in equation (2) are available and thus proxies had to be designed. Following convention no attempt was made to approximate the effect of official capital controls, transactions costs, or diversification. Given that the countries under study were Germany, Japan, and the United States, the first would be very minor factor and the last two constant, at worst (and probably small), and therefore captured by the intercept. Confidence, sterilization, and risk, however, are likely to vary significantly over time. In the end the following equation (4) was estimated (for both the dollar-Deutsche Mark and the dollar-yen) to capture their effect:

(4) $Z_t = \hat{a}_0 + \hat{a}_1 Err_t + \hat{a}_2 CV_t + \hat{a}_3 Money_t + \hat{a}_4 Share_t + \hat{a}_5 Risk_t + e_t$.

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[9]These data were collected from the Economagic website, except the exchange rate expectations which were purchased from Money Market Services.

The first two variables, Err_t, or past forecast errors, and CV_t,, or spot exchange rate volatility, are included to capture the effect of forecast confidence. As either increases, so one would expect agents' confidence to fall. Past forecast errors are measured as the quarterly averages of each week's realized error from forecasts made the month before (spot exchange rates used were from Economagic and forecasts from Money Market Services). Exchange rate volatility is a quarterly average of monthly observations of the coefficient of variation of the currency price over the previous six months (not including the current month; monthly average exchange rate data from International Financial Statistics). As these variables are expected to make Z larger but not affect *which* currency earns the higher return, both forecast error and currency volatility are assigned the same sign as Z for each observation. In that way, they cannot change the direction of the deviation from UIRP, but they can make it larger or smaller. On the assumption that the reaction to a doubly-large error is more than double, forecast error and exchange rate volatility were also squared (while retaining the designated sign, positive or negative).

Sterilization, per se, cannot be tested directly in equation (4). Instead, the effect of changes in the money supply on Z will be first be examined, and following that it will be determined if there was a tendency for liquidity to remain constant in the face of variations in the flow of capital (the process by which this will be accomplished is explained later). $Money_t$ is an index of US real M2 (M2 divided by the consumer price index) minus an index of the foreign (German or Japanese) real M2 (M2 divided by the consumer price index; all data from International Financial Statistics, except for Japanese M2, which is actually M2 + CD's, where data is from the Econstats web page). This variable is meant to represent the effect on interest rates in each country of changing levels of liquidity. Ceteris paribus, as the supply of money rises in the US relative to that in Germany or Japan, the excess return one can

expect to earn on US interest-bearing assets should decline since US interest rates would fall relative to those in Germany or Japan.

$Share_t$ is a measure of securities prices in the US relative to those in Germany or Japan. It is calculated as the three-quarter moving average of the cpi deflated index of share prices in the US minus the same measure of share prices in Germany or Japan (share price data and cpi from International Financial Statistics). This variable was not discussed above but was included because if it is the case that factors like confidence, transactions costs, official restrictions, and diversification are creating impediments to the flow of capital, then, as suggested in the previous section, **any** factor that could alter either interest rates or currency prices can cause a deviation from UIRP. Since Post Keynesians argue that capital flows are far and away the strongest factor moving exchange rates (CITES), it seems reasonable that the demand for non-interest bearing assets, i.e., securities, might also be relevant. In particular, when US securities' prices are rising faster than those in Germany or Japan, one might expect this to be correlated with an increased expectation of profits from investing in the US (in terms of the expected exchange rate movement), which would then lead to a rise in Z.

Finally, $Risk_t$ is a measure of relative risk. Two different variables were used for each set of countries, one a reflection of the government debt position and one that of the private sector.[10] The former, called $Risk1_t$, was calculated by subtracting the ratio of publicly held government debt to gross domestic product in either Germany or Japan from that in the US (all data from International Financial

[10]Smithin 2002-2003 suggests such proxies for risk (pp.232-233). Note that these basically represent default risk, Risk1 for public and Risk2 for private. Currency and country risk are relatively more difficult to capture, though it could be argued that the CV variable proxies both forecast confidence (or a lack thereof) and currency risk.

Statistics, expect Japanese government debt which is from the Bank of Japan). As this number rises, so the indebtedness of the US government increases relative to that of the other country and we should expect a risk premium on US interest-bearing assets (i.e., Z should get larger). $Risk2_t$ was calculated the same way except that the numerator was the foreign liabilities of private banks rather than government debt (new data from International Financial Statistics). These two variables are tried separately and together in the regressions for Germany and Japan. There is also a regression in which neither is included in case risk is not a terribly important factor in the particular markets studied (though it may well be when developing countries are examined).

3.0 Results and Discussion

The estimations are shown in Table 1. The results were remarkably good for a time series study of a financial phenomenon, and the support for the Post Keynesian view–and in particular the role of confidence–is very strong. On the order of two-thirds to three-quarters of the deviation from UIRP is explained. For Germany, Err proved to be significant in each and every equation, as did CV and Share. This suggests the importance of both Keynes' confidence and equity capital markets in driving Z. Neither of the risk variables were successful, however, and Money was only significant when Risk1 was excluded from the equation. In all, the most successful equation was that excluding risk variables. This may be a consequence of the fact that default risk is not a serious factor in the US-German asset market, or it could be that

Table 1. Excess Return on US Interest Bearing Assets.

Country	Err_t	CV_t	$Money_t$	$Share_t$	$Risk1_t$	$Risk2_t$	adj-R^2	D-W
Germany	**2523**	**2521**	-0.055	**27.9**	11.5		0.66	1.66
	(2.03)	**(2.81)**	(0.64)	**(3.33)**	(1.07)			
	2100	**2467**	**-0.133**	**28.0**		-0.009	0.65	1.66
	(1.78)	**(2.71)**	**(1.40)**	**(2.59)**		(0.49)		
	2676	**2550**	0.026	**23.8**	18.7	0.016	0.65	1.66
	(2.08)	**(2.80)**	(0.15)	**(2.07)**	(1.08)	(0.24)		
	2000	**2462**	**-0.103**	**24.3**			0.66	1.64
	(1.74)	**(2.74)**	**(1.43)**	**(3.16)**				
Japan	**0.229**	**2183**	**-0.833**	**7.87**	-41.8		0.72	2.00
	(1.62)	**(2.48)**	**(2.31)**	**(3.49)**	(1.03)			
	0.131	**2501**	**-0.534**	3.61		**673**	0.73	1.97
	(0.85)	**(2.98)**	**(2.50)**	(1.18)		**(1.45)**		
	0.138	**2282**	**-0.810**	**4.58**	-40	-658	0.73	2.00
	(0.90)	**(2.63)**	**(2.28)**	**(1.43)**	(1.00)	(1.42)		
	0.223	**2410**	**-0.534**	**6.93**			0.72	1.97
	(1.58)	**(2.83)**	**(2.51)**	**(3.36)**				

Parenthetical numbers are absolute values of t-statistics.

Boldface entries of parameter estimates indicate rejection of the null hypothesis at the 10% level or better. A positive sign was expected for every variable except Money.

n = 38

multicollinearity among Money, Risk1, and Risk2 obscured the true role of risk.[11]

In the Japanese equations, Err was successful only when there were no risk variables or only Risk1, but CV and Money were significant in every regression run. Of the risk variables, only Risk2 (when used alone) passed the t-test; this occurred in the one equation where Share failed.[12] As was the case with Germany, the only equation in which every variable was found significant was that containing no risk variables. Again, this could be because risk plays only a minor role when the subject is advanced capitalist economies. On the other hand, if one treats risk as a variable that must be included in the regressions on theoretical grounds then I would select the German estimation using only Risk1 and the Japanese using only Risk2 as the most successful.

Coefficients of determination and t-scores fall well short of telling the whole story in terms of empirical relationships. Also interesting, for example, are the descriptive statistics offered in Table 2. Note first that the average deviations from UIRP over the period selected for the study were 4.18 for Germany-US and 5.19 for Japan-US. And consistent with earlier findings, it is evident that the size and sign of Z varied considerably. Yet, as much as unstable as Z was, this was still well below the volatility displayed by the forecast errors and the coefficient of variation of the past currency prices. Money and Share are relatively calm variables given the company in both data sets.

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[11]In the German-US regressions, Risk2 is highly correlated (negatively) with Money, as is Risk1 (especially through 1994, when the partial correlation coefficient is -0.984); in the Japanese-US regression, Risk1 and Money are highly correlated (again negatively).

[12]As with Money and Risk1 in the German regressions, it appears that Share and Risk2 are highly correlated.

Table 2. Descriptive Statistics, Dependent and Independent Variables.

	average	maximum	minimum	standard deviation	coefficient of variation
Germany					
Excess	4.18	17.18	-12.87	8.688	208%
Err	-0.000137	0.001491	-0.00253	0.000802	585%
CV	0.000165	0.000315	-0.003178	0.001099	666%
Money	-43	-1.37E-07	-65	18.2335	42%
Share	-0.132647	0.081131	-0.454312	0.150146	113%
Japan					
Excess	5.19	28.52	-14.25	11.16	224%
Err	1.109817	44.42389	-20.15711	9.157401	825%
CV	0.000342	0.005156	-0.00311	0.001517	444%
Money	-4.612265	3.150533	-12.59704	5.14653	112%
Share	1.230936	2.096713	0.0815122	0.345892	28%

Even more interesting, however, are the measures of impact in Table 3. Assume for a moment that the most accurate specifications of the determinants of Z were those excluding both risk factors. In that case, Table 3 shows how much the dependent variable changes given a one standard deviation increase in the independent variable. For example, a one standard deviation rise in the forecast error leads, ceteris paribus, to a 1.6 percentage point rise in the deviation from UIRP for the US and Germany and a 2.04 points rise for the US and Japan. Note the relative importance of the variables designed to proxy the impact of confidence levels. If one sums the absolute values of the changes caused across each row and then calculates the percentage of that total caused by Err and CV alone, those figures are 44% for the dollar-Deutsche Mark and 53% for the dollar-yen. This suggests that agents' lack of conviction regarding their forecasts plays a much larger role than anyone had heretofore imagined. It also lends credence to the contention that UIRP can only be properly understood when assuming uncertainty and non-ergodicity and that risk might not be the culprit it is made out to be.[13]

The numbers are similar when the best regressions containing risk are examined. Table 4 is a repeat of Table 3, but using the Risk1-only regression for Germany and the Risk2-only

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[13]I worried that my decision to give Err and CV the same sign as that period's Error might have biased my equation unfairly toward the conclusion that I expected. Because of this, I also ran the regressions with only the Money and Share variables to make sure that they were driving the direction of the deviation from UIRP (and not Err and CV, which were bound to have the same sign). While these were obviously mis-specified if the theory in section 1.0 is correct, I felt it necessary to do this to allay any fears the reader might have. In fact, the results were excellent. For Germany, the adjusted R2 was 59% and both variables were significant (highly so); the results were almost identical for Japan (with a coefficient of determination of 61%). It **does** appear to be the case that Money and Share are determining the sign (and part of the size) of Z, while confidence (through Err and CV) affects only the size.

Table 3. Effect on Deviations from UIRP (Germany and Japan) of Changes in Explanatory Variables.

	Err	CV	Money	Share
Germany	1.60	2.71	-1.88	3.65
	18.46%	*31.14%*	*-21.62%*	*42.00%*
Japan	2.04	3.66	-2.75	2.40
	18.30%	*32.76%*	*-24.63%*	*21.48%*

Normal script values on the table show how much the dependent variable changes given a one standard-deviation increase in the independent variable (rates of return are annualized). The italicized values below show that same change as a percentage of the dependent variable's standard deviation. Hence, for example, when for the dollar-Deutsche Mark equation, CV in increased by one standard deviation (0.001099), this will cause the deviation from UIRP to increase by 31.14% of its standard deviation (a raw increase of 2.71 divided by the standard deviation of 8.688). These calculations are based on the regressions excluding both risk factors.

Table 4. Effect on Deviations from UIRP (Germany and Japan) of Changes in Explanatory Variables, Risk Included.

	Err	CV	Money	Share	Risk
Germany	2.02	2.77	-1.00	4.19	1.09
	23.29%	*31.89%*	*-11.54%*	*48.22%*	*12.56%*
Japan	1.20	3.79	-2.75	1.25	2.83
	10.75%	*34.00%*	*-24.63%*	*11.19%*	*25.38%*

Normal script values on the table show how much the dependent variable changes given a one standard-deviation increase in the independent variable (rates of return are annualized). The italicized values below show that same change as a percentage of the dependent variable's standard deviation. These calculations are based on the Risk1-only regression for Germany and the Risk2-only regression for Japan.

regression for Japan.[14] Though the change is more significant for the US and Japan, it is still the case that the confidence-related variables are responsible for the largest percentage of the deviation from UIRP.

Still left unanswered at this stage, however, is whether or not sterilization occurred. Though money supplies appeared to play a role in driving Z (through Money), is it the case that inflows of capital are being offset by declines in the domestic money supply (and vice versa)? To determine the level to which sterilization took place, the data for bank assets and liabilities were examined for each of the three countries. Lavoie (2001) suggests that in asset-based economies like the US, sterilization might be detected by comparing the change in foreign assets of the central bank with compensating changes in the monetary authority's claims on the central government. Capital inflows would mean, for example, that domestic banks would find themselves holding foreign currency which they would then sell to the central bank for domestic money (in the process creating a rise in foreign assets at the latter). Under the traditional exogenous money story, the new domestic currency assets would then lead to new loans and a further expansion of the money supply. If money is demand driven, however, private banks would instead find themselves with reserves that (ceteris paribus) they really do not want. Hence, they might well, Lavoie reasons, spend these to purchase domestic assets (presumably treasury bills). If they purchased these from the central bank, then the latter would find themselves with fewer claims on the government.[15] There would thus tend to be a negative relationship between foreign assets

[14]These were selected on the assumption that, of the regressions including at least one risk variable these were the best in terms of t-score (bearing in mind that the coefficient signs must be positive).

[15]In the event of a capital outflow one would reverse all the directions of change.

and claims on the central government in the Federal Reserve's balance sheet.

Meanwhile, in overdraft banking systems like Germany and Japan, capital inflows in an endogenous money framework would lead first, as above, to a rise in central bank foreign assets (as banks sell foreign currency to them) and, second, to private banks to reducing outstanding liabilities to the central bank. Here, the evidence of sterilization would be a negative relationship between foreign assets and claims on commercial banks in the Bundesbank's and Bank of Japan's balance sheets.

The problem with detecting these changes in balance sheets is that, first, there are obviously more things that affect money supplies than just capital inflows and outflows; second, there may be occasions when banks are more than happy to accept the changes in reserves created by the flows of foreign capital; third, there are additional, less transparent, avenues available to those wishing to sterilize; and fourth, it is impossible to tell whether sterilization, if it does occur, was a function of public policy or private market activities. Nevertheless, Table 5 offers some data that might give some idea of how the structure of financial assets vary.

Table 5 shows the partial correlation coefficients between changes in foreign assets held by the respective country's central bank and changes in either claims on the central government (for the US) or claims on commercial banks (for Germany and Japan). These are expected to be negative in the event that sterilization occurs. Note that while the data set for Germany and the US is the same as in the regression analysis (i.e., quarterly from 1989:1 through 1998:4), sufficiently disaggregated data were not available from the Bank of Japan until 1998:3. It obviously would have been preferable had numbers for the time period under study been available.

The first column of data show the results for the entire time period available. For all three

Table 5. Evidence of Sterilization: Partial Correlation Coefficients between Capital Flows and Domestic Monetary Assets.

	overall	**>0.5 sd**	**>1 sd**	**>1.5 sd**
US	-0.163 40 obs	-0.171 20 obs	-0.233 10 obs	-0.316 6 obs
Germany	-0.668 40 obs	-0.936 8 obs	-0.956 4 obs	-0.956 4 obs
Japan	-0.279 14 obs	-0.315 10 obs	+0.026 6 obs	NA 2 obs

Values show the partial correlation coefficient between changes in foreign assets held by the respective country's central bank and changes in either claims on the central government (for the US) or claims on commercial banks (for Germany and Japan). Overall is for all observations (1989 first quarter through 1998 fourth quarter for US and Germany and 1998 third quarter through 2001 fourth quarter for Japan), >0.5 sd is for only those observations where the absolute value of changes in foreign reserves exceeded 0.5 standard deviations (from zero rather than their mean), >1 sd is for greater than one standard deviation, and >1.5 is for greater than 1.5 standard deviations. Numbers below each correlation coefficient show the total number of observations. NA indicates that there were too few observations to generate a meaningful statistic.

there appears to be a negative relationship, though it is strongest in Germany. On the assumption that sterilization might be a more important issue in the event of large flows of capital the subsequent columns show only the results when the changes in foreign assets exceed their standard deviation by some fraction or multiple. Indeed, for both the US and Germany, the evidence became stronger and stronger as more substantial cases of flows were considered (especially in Germany). However, that was not the case for Japan. In fact, when changes in foreign assets exceeded one standard deviation, their correlation with changes in claims on domestic banks became positive. The evidence of sterilization is therefore mixed. Recall, however, that in a flexible exchange rate regime it could never have been the sole reason for deviations from UIRP since exchange rates were still free to adjust. It creates a friction, but not a block.

4.0 Conclusions

Once more realistic assumptions are substituted for those offered in the textbook presentations of UIRP it soon becomes obvious that the latter would only hold by coincidence. Furthermore, it appears that risk is neither necessary in order to cause deviations from UIRP nor even the largest factor if considered. Rather, it appears that Keynes' confidence variable, along with changes in money and share prices, are capable of explaining the majority of deviations from UIRP. The empirical support for these contentions is substantial.

I would argue that this does not mean that UIRP is a useless concept, especially in the classroom. Using it to frame discussions of international capital flows is a very useful first step. The fact that such an simple and intuitive theory does not hold in the real world is instructive and solving the

riddle leads directly to consideration of the factors that cause it to fail. This brings us to a more realistic understanding of global financial investment rather than one based on rational expectations, ergodicity, and exogenous money.

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