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Reflections

CURRENCY MANAGEMENT

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CURRENCY MANAGEMENT

A Contrarian Response To Technically Based Currency Management: A RETURN TO THEORETIC FUNDAMENTALS

Currency management has traditionally focused on technical trading models, largely ignoring fundamental elements of currency valuation. We find this surprising given the rare theoretical simplicity of currency valuation - rare, that is, relative to other asset classes where valuation requires more subjective assumptions. We have addressed the widespread failure of academics and practitioners to find significant fundamental relationships for exchange rate dynamics, and have sought to build a currency management process which stands far apart from the majority of currency management approaches by succeeding in the use of fundamental relationships.

TECHNICAL OR FUNDAMENTAL?

Do fundamental value relationships have anything to do with short-term currency returns? If, for an indication, we were to look to the manner in which currencies are most typically managed today, the answer would be an overwhelming "No." The vast majority of active currency managers ignore fundamental currency relationships. Instead, those who seek to profit from currency movements base their decisions dominantly upon technical factors which are said to reflect "behavioral relationships" of traders and sometimes central banks. The theoretical structure of these relationships are not specified; they remain "mysteries" which offer small hints or patterns which can be observed in part by unexplained patterns in historical data. It's rather like reading tea leaves, except that rigorous empirical study is made of the sequence of patterns in which the "tea-leaves" have fallen.

We should find it ironic that so little attention is paid to fundamental valuation amongst currency managers. Perhaps no other financial asset has so simple a theoretical basis for determining fair *present* value. Simple? Currencies have no intrinsic value, and have, therefore, no value-generating characteristics which would require us to make projections regarding their future generation of value when estimating their present value.[1] They are non-productive assets for which the *present* value requires few, if any, assumptions to be made about the future. Valuing equities, for example, requires that we make projections regarding future growth and discount rates, and the more such projections required to measure the present value of an asset, the more difficult it becomes to accurately measure fair value. To measure today's equilibrium exchange rate, however, requires no such projections. Currencies are subject to scarcity only in the short-run, so only short-term pressures of supply and demand make currency valuation challenging.

So why don't most currency managers base their work on the fundamental determinants of nominal currency valuation? Because few have succeeded in relating long-term fundamentals to short-term currency movements, and active currency management, like virtually all active management strategies, is expected to operate over short- rather than long-term horizons. The easiest response, therefore, has been to throw the long-term fundamentals out the window and to try to read the "pulse" of the short-term market through technical factors.

If, on the other hand, a successful fundamental model can be built which does explain short-term currency movements, then we must assume that the opportunity to add value by using such under-exploited information

1 We make no claim that a *future* fair value is any easier to estimate with currencies than it is for other asset classes. Our statement only regards the present fair value which takes into account only *known* states of the world.

will be significant. This is not unlike the opportunity which is created for asset allocation managers through the lack of attention paid to active *asset class* allocations. In active management today, the vast majority of investment attention is applied to active management *within* asset classes rather than *across*, just as the vast amount of attention in the currency markets is focused on technical rather than fundamental factors.

The phrase that John Maynard Keynes made famous, "In the long-run, we are all dead," should perhaps be infamous in the currency markets. Such dismissal of the "long-run" has come too easily, and an entire industry has largely disregarded the theoretically oriented, and long-term natured relationships in currency prices. Both because of a broadly consistent failure to produce empirical evidence that long-term fundamentals influence short-term currency returns, and because of a misunderstanding of what role long-term relationships of any kind must play in short-term experience, the long-term has been ignored by currency managers. To motivate the search for a long-term fundamental measure of value, we will begin with a challenge to the disregard we find too easily placed upon the importance of long-term relationships in short-term investment management. Such relationships do matter in the short-term.

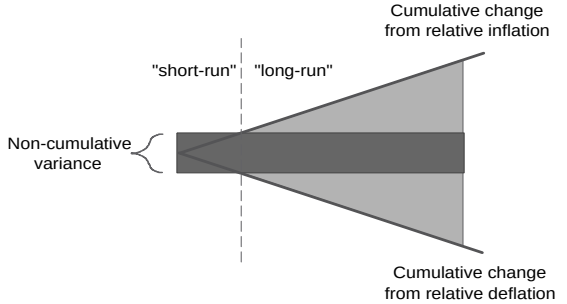
REAL EXCHANGE RATES: LONG-RUN *ONLY*?

We commonly hear it proclaimed that fundamental currency relationships, i.e., real exchange rate relationships, only work in the long-run. Can an influential factor which is important in the long-run fail to be relevant in the short-run? Quite simply, no; it is not possible. The long-run is composed of a sequence of short-term observations, and nothing more. Thus, what happens in the long-run must occur also in the short-run, whether that be in the form of a small, continuous influence, or in the form of large, discreet events. So yes, it is sometimes true that relationships which come to full fruition in the long-run may do so only after "we are all dead," but that does that *not* mean that they fail to exert any influence over what occurs in the short-run.

What *is* true of long-run relationships is that over short time horizons, the influence of various short-term factors may dominate the influence of longer-term factors, making it more difficult to *observe* the effects the long-term factors have. Line up a sequence of various short-term disturbances and you may have a continuum wherein short-term factors dominate determination of the market state. This can lead, and with currencies often has lead, to the naive view that "long-term factors don't matter."

To understand why this is a mistake, let's examine the relationship between short-term factors and long-term influences more closely. Let's assume that the current market price of an asset is created from a *cumulative* fundamental change in its equilibrium price, plus the result of *random variance* around its equilibrium price. The importance of the latter effect being random is that it does not accumulate, and since it does not accumulate, its impact on market price is relegated to the short-term only. This would not be unlike the behavior of foreign exchange rates. Exchange rates do change over time as a result of the cumulative effect of relative inflation vis a vis other currencies, and they also exhibit patterns of short-term volatility, which, much like stock market volatility, is most certainly not cumulative.

Exhibit 1
Suffering Under the Illusion that the Long-run Doesn't Matter

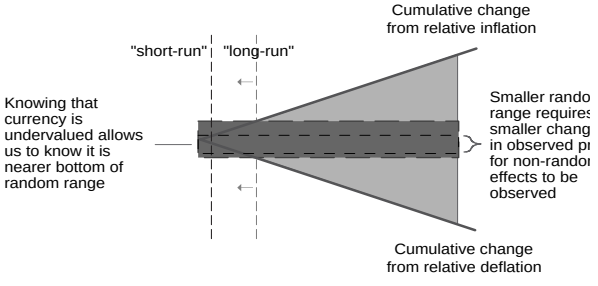


Furthermore, let's assume that we have no knowledge of whether the exchange rate as observed in the market today is fairly valued or not. Our best estimate of where the equilibrium exchange rate would lie is within the band which is centered at the current exchange rate, and has a width of plus or minus the

average historical variance. Under such conditions, it will be difficult to isolate and observe the effect which the cumulative change in fundamentals is having until the relative magnitude of the cumulative effects has grown (accumulated) significantly larger than the magnitude of the random variance. In the diagram above, this is represented by the point at which the cumulative effect breaks out of the range of short-term, random variance. Simply put, we cannot tell the difference between the two types of variance, random and explained, until the explained (i.e., fundamental) variance grows large enough. It takes time for the long-term effects to accumulate, and the "long-term" is defined to be the time that this takes.

Two pieces of information can help us shorten the length of time required before we can observe fundamental influences at work. First, not all of the short-term variance is necessarily random. If we were to succeed in explaining some portion of the short-term variance, then the band of *random* variance would shrink, *and the time horizon required to observe the cumulative effects of the long-term fundamentals breaking out of the band of random variance would shorten*. Second, if we can gather any information which more accurately identifies where in the band the current equilibrium rate lies, we will again potentially shorten (depending upon where in the band it falls relative to the direction the cumulative influences are pushing) the time required before we can observe the market rate breaking through the band of short-term variance.

Exhibit 2
Shorterning the Requisite Time Horizon



Even when short-term factors provide the dominant influence, it is clearly a mistake to choose to ignore the long-term determinants of exchange rates. Short-term pressures on exchange rates do not occur in a vacuum, and their influence is altered and constrained by long-term factors. To see this intuitively, picture a feather falling slowly through the air, drifting towards the ground. The long-term equilibrium state is defined by the feather coming to rest on the ground. If short bursts of air, rising currents, were to regularly strike the feather, keeping the feather afloat (i.e., away from its equilibrium state), would we claim that gravity is no longer playing a role in the movement of the feather? Would it behoove us to *ignore* the effect of gravity? Of course not. Gravity will play the role either as a counter- or as a complimentary-force to any and all short-term disturbances. If we incorporate the effect of gravity into our model, then we will be far more successful in predicting the movements of the feather through the air.

If short bursts of air keep a feather afloat indefinitely, this does not mean that gravity plays no short-term role in the movement of the feather through the air! Similarly, if shifting short-term demand for a currency keeps that currency away from its equilibrium exchange rate for five years, that does not imply that purchasing power parity plays no role in short-term currency movements.

With currencies, similar short-term disturbances such as shifts in short-term demand may keep a currency away from its equilibrium exchange rate for many years at a time. That does not imply that purchasing power parity plays no role in short-term currency movements. In fact, for equilibrium models to work effectively, the phenomena being modeled does not need to *ever* return to equilibrium, even if the relevant investment horizon for the model is short (just as the feather never need reach the ground for physicists to successfully model its path).

We've drawn attention here to two very important points. First, long-term effects *do* matter in the short-run. They just may be difficult to *observe* in the short-run. Second, the more information we have about both today's equilibrium rate, and any systematic (i.e., non-

random) causes of short-term variance away from that equilibrium rate, then the shorter the time horizon required before long-run relationships become observable. Through these two dimensions, we have found that we can observe real exchange rate influences on exchange rates for as short a time horizon as one month. These influences, as we shall discuss below, are quite significant.

THE FAILURE OF PURCHASING POWER PARITY

The academic literature is littered with articles proclaiming the failure of Purchasing Power Parity models to succeed empirically. They hardly even work in the long-run and many of the academic debates amongst those who have succeeded in finding some marginal significance of real exchange rate relationships in the very long-term have been centered upon "How long is long-term?" Does it take five, ten, twenty or fifty years for long-term fundamentals to become influential? In this context, it may seem arrogant for us to suggest we have succeeded where so many others have failed. The truth is, we haven't succeeded where they have failed, but rather, we have done something more than what they have attempted to do. To understand what we have done, it will help to understand why the traditional specifications for fundamental exchange rate models have fallen short.

The simplest form of purchasing power parity is the Law of One Price which suggests that the prices of similar goods should carry the same effective price regardless of the currency in which that price is stated. This is often referred to as the Strong Form of Purchasing Power Parity. Naively, it is assumed that in equilibrium, the price of an egg (or a Big Mac) will be identical from market to market. If we account for sources of market friction such as transportation costs, for example, the identity is required only to *approximately* hold. Thus, if an egg is priced in Tokyo at ¥100, and at US$1 in New York, then this pricing can only be in equilibrium if the exchange rate is ¥100/$1.

$$\frac{\text{yen price of an egg}}{\text{dollar price of an egg}} * \frac{\text{dollar}}{\text{yen}} = 1$$

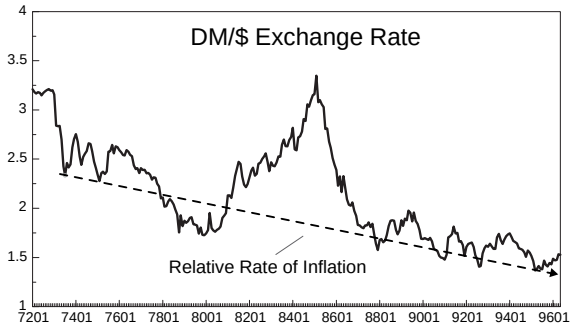
The first difficulty we encounter in the application of this metric is that goods prices don't move uniformly together, so this metric will yield different conclusions with different goods. Egg prices may suggest that the yen is overvalued relative to the US dollar, while at the same time, the prices of rice may indicate that the yen is undervalued relative to the dollar. We might try, therefore, to compare baskets of goods, e.g., consumption baskets, but we soon find that the relevant consumption baskets through which this comparison may be conducted are different. The Big Mac may be a significant good in the US consumption basket, but it is not significant in the Japanese consumption basket, so its weight in measuring fair value is different for the yen than it is for the dollar.

> We lack comparable consumption baskets by which to evaluate *significant* violations of the Law of One Price. A Big Mac Index fails to be meaningful for just this reason: if the pricing of Big Mac's violates the Law of One Price, it will, nevertheless, fail to have a significant influence on the exchange rate.

So, while the Law of One Price should hold regardless of whether the good in question is a significant component of the consumption basket or not, a *violation* of this law - a disequilibrium price - measured through goods which fail to share a common significance in two markets will fail to exert the expected pressure on the currency exchange rate. The problem here is related to measurement, not theory. We lack comparable consumption baskets by which to evaluate *significant* violations of the Law of One Price.

Unable to evaluate currencies according to their *absolute* purchasing power, we turn then to the Weak Form of Purchasing Power Parity where we evaluate exchange rates according *to relative changes* in their purchasing power. Here we ask how well changes in the exchange rate over time reflect relative changes in the prices of goods. Lower relative price inflation improves the relative purchasing power of a currency, and we therefore expect currencies associated with such lower rates of domestic price inflation to appreciate accordingly. From any prior exchange rate, we can project today's exchange rate by taking into account the appreciation which should have resulted from the inflation differential.

Exhibit 3
Projecting Today's Exchange Rate from a Prior Exchange Rate



But what if the prior exchange rate from which we have projected today's rate was not an equilibrium exchange rate? What if, for example, the prior nominal exchange rate reflected an overvaluation of the deutschemark relative to the dollar? Do we still expect the deutschemark to appreciate relative to the higher inflation dollar? While the lower inflation experienced in Germany relative to the US suggests an appreciation of the deutschemark relative to the dollar, the fact that the deutschemark was overvalued in the prior period conflicts with this expectation. The Weak Form of Purchasing Power Parity ignores this problem, and as mentioned previously, advocates of this form have focused their more recent debates on what minimal time horizon is required before the relationship implied by the weak form becomes significantly observable. We would, per our discussion of the relationship between short- and long-term influences, suggest that they are merely searching for the time horizon which is sufficiently large that *the error derived from choosing a disequilibrium point from which to project a current exchange rate* becomes small relative to the cumulative long-term changes in underlying fundamentals.

The ability to project an equilibrium rate today from inflation differentials is highly dependent upon knowing what the equilibrium rate was at some prior moment in time. Without knowledge of a prior equilibrium rate (which, of course, we do not have!) we run a high risk not only of producing an inaccurate judgment of the *degree* of current mispricing of the currency, but we run a risk of incorrectly judging the *direction* of mispricing. The former error may lead us to believe a currency to be trading at a deeper discount to fair value than it really is, while the latter, far more grievous error, may lead us to believe a currency to be trading at a premium when it is really trading at a discount.

DISTRIBUTIONAL CHARACTERISTICS OF REAL EXCHANGE RATES

What we really want to know is whether the exchange rate today is high, low or just about right. But "right" relative to what? To some arbitrarily chosen prior moment in time? This would not be an unfair description of the Weak Form of Purchasing Power Parity. And if we are interested in the pricing of one specific currency, the yen for example, to which currency should we compare to determine whether the yen is fairly priced or not? Most studies have evaluated currencies relative to the US dollar. Is this because each currency only moves relative to the US dollar?

The answer we give to this query is that we want to know whether the currency is fairly priced

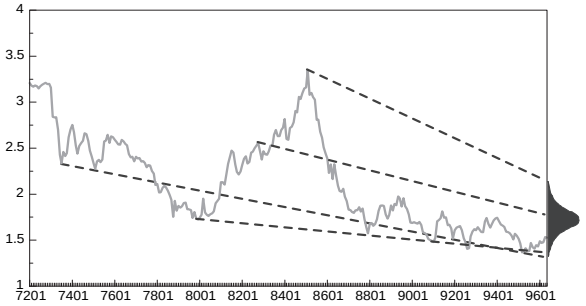
- relative to what history suggests is normal, and
- relative to all other currencies, not just the US dollar.

If we want to know what is "normal" by historical standards, we cannot simply select at random a point or two from prior history to compare with today's rate. Rather, we must compare today's exchange rate with *all* prior observations of the exchange rate. And if we recognize that the pressures on an exchange rate come from all directions simultaneously, i.e., from the pricing of a currency *relative to every other currency* with which it might be exchanged, then we must step beyond evaluating currencies on a bilateral basis, and evaluate them on a multilateral basis. These are the two steps we have taken in building an equilibrium real exchange rate model, and contrary to conventional wisdom, the data suggests that Purchasing Power Parity works, not only in the long-run, but in the short-run as well.

In the weak form of purchasing power parity, we projected one nominal exchange rate from another nominal exchange rate, by adjusting for the real effects

of underlying relative price inflation. Here we turn this procedure upon its head. Here we examine all previous exchange rates in *real* terms, in order to derive a historically observed "normal" real exchange rate. Using the same mechanism used in the weak form of purchasing power parity, we project each prior nominal exchange rate into current (i.e., real) terms. In this case, the interpretation we place on each projection is that it represents merely one observation of the past exchange rate stated in current price terms. We do not assume that it represents an equilibrium exchange rate, as the weak form version of Purchasing Power Parity did.

Exhibit 4
Distributional Characteristics
DM/$ Exchange Rate



Projecting from all previous exchange rates, we produce a distribution of projected current nominal exchange rates

From this sequence of projections arises a distribution of real exchange rates about which we may observe the historical mean and standard deviation. Today's exchange rate can now be described as standing either above, below, or at its historical (PPP implied) mean. Any deviations of today's exchange rate above or below the historical mean may be restated in units of standard deviation away from the mean so that we may observe just how abnormal a deviation from the mean today's rate really is. The more abnormal the current exchange rate is, the greater we can expect the market forces to be in pressuring it back towards the historical mean. We explicitly expect real exchange rates to exhibit mean reverting behavior.

The power of this relationship, when evaluated for currencies on a multilateral rather than bilateral basis is striking. It reveals itself not merely over long-term horizons stated in numbers of years, but even over time horizons as short as one month. The consistency of the relationship is also encouraging, as the following table indicates. But not only is the relationship strong, but a clear pattern of improvement is visible. This is expected. With each forecast, we gain one more data point in time from which to derive our expectations, i.e., with each forecast we gain more and more experience upon which to base our notions of normality. Thus, there is a *structural* reason related to modelling and statistics rather than the behavior of markets themselves which explains why the relationship should be getting stronger through time.

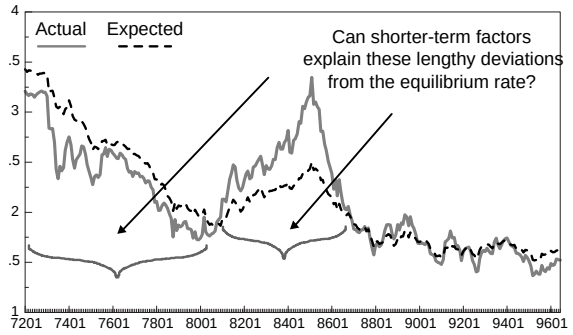
Exhibit 5
Strengthening PPP Relationship
correlations of PPP Implied Exchange Rate with subsequent forward rate return (relative to world currency basket)

	Last Five Years	Last Ten Years	Since 1982
United States	0.28	0.22	-0.01
Finland	0.28	0.04	0.04
Belgium	0.27	0.24	0.02
Denmark	0.27	0.31	0.09
Sweden	0.26	0.22	0.08
France	0.25	0.28	-0.02
Australia	0.24	0.14	0.12
Italy	0.21	0.05	0.05
Canada	0.21	0.04	0.04
Netherlands	0.21	0.21	0.11
Germany	0.20	0.14	0.09
Austria	0.19	0.20	0.11
Japan	0.18	0.12	0.08
Spain	0.17	0.08	0.04
Norway	0.17	0.12	0.05
Ireland	0.17	0.04	0.05
United Kingdom	0.15	0.13	0.09
Switzerland	0.10	0.18	0.12
New Zealand	-0.04	0.11	0.11
Average	0.20	0.15	0.07

SHORT-TERM EXCHANGE RATE FACTORS

Unfortunately, exchange rates may remain deviant from their fair values, sometimes for periods as long as five to seven years. Thus, despite the success of the real exchange rate model, we may find ourselves waiting for lengthy periods before a *full* return to equilibrium is observed. As in the example of the feather whose drift towards the earth may be disrupted over and over again for long periods of time by rising currents of air, currencies may similarly be subject to sequences of short-term influences which counteract the forces of equilibration. By adjusting our expectations in accordance with what can be observed in short-term conditions of supply and demand for currencies, we hope to refine the forecasts of monthly currency returns.

Exhibit 6
Lengthy Deviations from Equilibrium
DM/$ Exchange Rate



Currency demand is derived from four key sources. It is demanded for international transactions of goods and services, for effecting international capital flows, for the administration of exchange rate policy conducted by central banks, and for speculation or hedging. Our work on short-term influences has thus far successfully focused on the demands from capital flow and central bank activity, with the former playing a far more important role in our modeling.

Capital flows towards assets with the higher expected (risk-adjusted) yields. Short-term cash markets represent the markets where risk plays the most minor role, so it is the logical place to begin. Let's assume that one market has a higher short-term yield than another. Baring any significant risk differentials, the higher yield in the first market will attract capital. For capital to flow, however, currency from the second market must be exchanged for currency from the first market, thereby creating an increase in demand for the currency associated with the higher yield. Currencies associated with markets having higher interest rates will be more likely to appreciate as a result, and we see that this is borne out empirically in the following table.

Long-term yields should have a similar effect, and as the second column shows, even a naively simplistic comparison of long-term *nominal* rates leads to meaningful prediction of currency appreciation despite the fact that higher real, not nominal, yields should result in currency appreciation. If nominal yields are higher only because of an inflation differential, then we would expect that the benefit of holding long-term bonds where nominal yields are higher would be offset by long-term currency depreciation of equal magnitude. A more sophisticated approach would be to accompany information regarding the nominal long-term yields with information regarding expected inflation. Our proprietary work in this area exploits such key sources of information as the slope of the yield curve and the dynamics of change in that slope, in conjunction with realized inflation rates to adjust for the naivete of making *nominal* bond yield comparisons.

Exhibit 7
Relative Yields
correlations of relative yields with subsequent forward rate return (relative to world currency basket)

	Cash Yields	Bond Yields
can	0.24	0.22
u_k	0.26	0.19
jpn	0.25	0.16
swi	0.22	0.18
neh	0.16	0.11
aut	0.10	0.11
usa	0.09	0.11
ger	0.09	0.09
den	0.13	0.03
aus	0.06	0.09
bel	0.05	0.09
nwy	-0.02	0.14
nwz	0.21	-0.13
swd	-0.11	0.09
ita	-0.07	-0.03
spa	-0.10	-0.13
fra	-0.15	-0.12
fin	-0.25	-0.14
avg	0.06	0.06

What about forward rates? Do they reflect short-term market expectations which might be useful for predicting short-term changes in spot rates? While forward rates *appear* to have an interesting *perverse* relationship in the currency markets, there is some confusion regarding what exactly is interesting about this. If what is presumed to be interesting is that expectations reflected by forward rates are more often wrong than right, then any interest in the issue is dependent upon a basic misunderstanding of currency forward rates. Forward rates *do not* reflect market expectations, they only reflect short-term cash yield differentials. Expected changes to the spot price will affect the spot price today. Unlike assets which generate an intrinsic return over time, vested currency positions will only generate a short-term cash return over time. An investor who believes that the spot rate will change will simply transact *today* in the spot market and earn the risk-free cash return until the expected change in

exchange rate occurs. Thus, all market expectations are revealed in the spot rate, and the deviation of the forward rate from the spot rate is determined only by the interest rate differential.

On the other hand, if one assumes that real returns are equivalent across markets, then one might find this perverse relationship of interest. If real returns are equivalent, then any cash yield differentials will be derived solely from inflation differentials. Currencies are priced at a discount in the forward market because their nominal cash yields are higher. Higher nominal cash yields would reflect higher inflation, and higher inflation should result in a depreciation of the currency. Since discounted currencies tend to appreciate rather than depreciate, the forward prices would appear perverse from *this* perspective.

Dropping the bold assumption of equivalence in real rates of return forces us to separate the forward rate "bias" into two components: an inflation component and a differential real rate of return component. Given that higher relative nominal interest rates tend to attract foreign capital, thereby increasing the value of the associated currency, one reasonable assumption would be that higher real rates of return are positively correlated with high nominal rates of return. By including inflation measures and inflation-like measures in our models along side the nominal interest rate differential (or forward rate), we have attempted to separate out these two components as much as possible.

THE ROLE OF CENTRAL BANK INTERVENTION

The role of central banks in the currency markets merits special consideration. Exchange rate stabilization is one of the goals which central banks actively pursue. Volatility in any price represents price uncertainty, and when price uncertainty is significant, normal business transactions are adversely affected. For this reason, central banks intervene in the currency markets with the intention of dampening exchange rate volatilities. Their introduction of non-profit motivated demand or supply of currencies into the currency markets has the effect of slowing, or smoothing, directional changes to exchange rates.

As a result, central banks artificially induce a relationship between the currency in one month and the month following. If the currency rose last month and central banks were there to stabilize the exchange rate, then the currency has an increased likelihood of rising again in the subsequent month. In statistical terms, this means that they create *serial correlation* in exchange rate movements, something which we do not expect to find in efficient markets. Central banks introduce inefficiency into the currency markets, and importantly, it is precisely this inefficiency upon which so very many currency managers rely.

Serial correlation presents itself as one of the "patterns" which are statistically observable in the currency markets, and practitioners with a leaning towards technical analysis cannot but succeed in picking up on this effect. Nevertheless, our analysis shows that there remains a slight degree of unexploited inefficiency left in this technical-looking, but fully understood factor. Its contribution to the total sum of information we have found in forecasting currency returns is small, but marginally significant, so we will continue to include it until its value has been fully exploited by technical traders.

Exhibit 8
Serial Correlation

correlations of prior forward rate return with subsequent forward rate return (relative to world currency basket)

swd	0.20
jpn	0.14
ita	0.13
den	0.13
nwy	0.12
fra	0.09
spa	0.09
bel	0.09
swi	0.08
fin	0.07
ire	0.07
ger	0.06
neh	0.06
aut	0.06
usa	0.04
u_k	0.02
can	-0.02
aus	-0.02
nwz	-0.13
avg	0.07

CONCLUSION

Long-term fundamental measures of currency valuation do indeed matter in the short-run. Can we afford to overlook them in preference for short-term technical factors? We think not. Ours is an active currency management process which has reaped 540 basis points of value added per annum from April of 1992 through the end of 1996.

Importantly, the full set of factors upon which these models are based represent a diversified set of investment disciplines. When an investment strategy is built upon the exploitation of market inefficiencies, that strategy will always be vulnerable to either the temporary or even permanent disappearance of those inefficiencies. For this reason, an investment strategy which relies on the exploitation of a *diversified* set of market inefficiencies should provide protection against this risk and offer a more consistent performance over time. In fact, the strategy which we have described here does just this. The strategy relies on three uncorrelated market inefficiencies, tied to the three factors which drive the global capital flows which, in turn, drive foreign exchange rates:

(1) a long-term value-measure which will captures the "Purchasing Power Parity" relationship, and which drives physical goods trade, and

(2) a set of interest rate measures which drive the flow of investment capital, and

(3) a serial correlation factor, capturing central bank intervention,

It may be insightful, therefore, to observe what the relationship is between these three different sources of value added. Ideally, the correlation of value added would be low, while each of the components will, nevertheless, contribute a moderately consistent stream of value added.

As discussed above, the long-term value factor is based upon our own *successful* variation of the Purchasing Power Parity relationship, a relationship which interestingly both academics and practitioners have generally found to be ineffective in forecasting currency returns. Since our finding stands *contrary* to the findings of so many others, i.e., that we found it to be a successful predictor, it is surprising to note the *consistency* with which it adds value through time.

While it is true that individual currencies will tend to drift away from their fair value for long periods of time - we found this in our own work as well as in others' - the market corrections in disequilibrium prices tend to be largely uncorrelated. This means that the stream of value added in a multicurrency program will tend to be much smoother than the experience which any single currency model would imply. We observed the correlation between the timing of mispricings (i.e., opportunities for adding value) of individual currencies and found that there was very little correlation across the twenty-one developed market currencies. This finding suggest that a value-based, multicurrency program should be able to add value in a more continuous fashion rather than adding value in large, infrequent bursts.

Over the last fifteen years (1982-1996), our value measure based upon Purchasing Power Parity would have added 120 basis points annually on average. This would have come at the cost of 390 basis points of annualized tracking error, which leaves an information ratio of 31%, but one which is rising quickly.

For technical reasons the quality of the value measure itself is *expected to improve through time*, and this expectation is substantiated by the stream of value added observed. This model would have seen an average of 7 basis points of value added in the first five years, increasing to 123 basis points of value added in the middle five year period, and finally increasing again to *213 basis points of value added in the most recent five years*. In the chart below, the 31% information ratio for the value-based factor is, therefore, deflated by the earliest five year period. *Over the last ten years, the information ratio has risen to 70%*. Reliance upon this factor is expected, then to continue to grow increasingly rewarding.

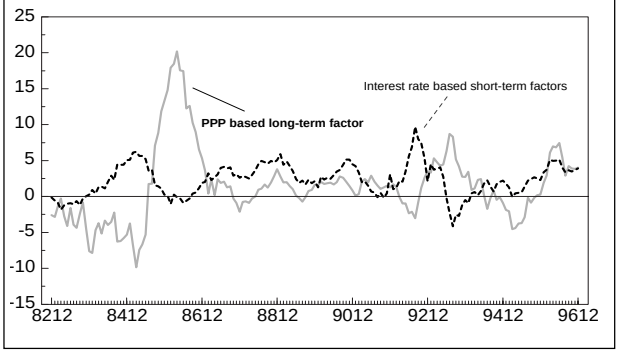
And what about the remainder of our currency models which focus on those factors which move currencies in the short-term? Interest rate factors (which drive international capital flows) clearly provide the dominant source of short-term predictive power while serial correlation (addressing the effect central bank

	Purchasing Power Parity Value Measure	Interest Rate Measures	Interest Rate Measures plus Serial Correlation
Equal Weight			
Value-Added	1.19%	2.63%	2.92%
Information Ratio	31%	132%	118%
Capitalization Weight			
Value-Added	1.55%	3.71%	4.24%
Information Ratio	34%	123%	127%

interventions have on currency returns) adds a marginal, but meaningful, source of predictive power. Since the focus of the vast majority of currency managers is, *unlike our focus*, tilted heavily towards the serial correlation factor, it is interesting to separate the two to see just how much value the addition of a serial correlation factors adds. The table above makes it rather clear that the interest rate based factors capture approximately 85%-90% of the value added derived from short-term type factors in our models.

Exhibit 9 confirms that the multiple sources of value added does, indeed, add valuable diversification of alpha. In this chart, the twelve month rolling value added obtained from both (1) the long-term value measure, and (2) those short-term factors based upon interest rate influences have been overlaid on each other. Note especially how the value added has been uncorrelated during those few periods where one of the sources has suffered a shortfall.

Exhibit 9
Long- and Short-term Factors Combined
Twelve Month Rolling Value-Added



On a technical note, it is also interesting that the serial correlation factor, if taken on its own, would have captured value added quite similar to the interest rate factors, but it would have done so by incurring twice the tracking error (an information ratio less than half what the interest rate factors would have obtained). Why? Interest rate factors tend to exhibit serial correlation and would be expected, therefore, to generate serially correlated movement in exchange rates. We can expect that the serial correlation factor will tend to "pick up" the predictive power which really belongs to interest rate factors (i.e., the cross correlation between the two predictive factors will result in the ability of one factor to proxy for the other in its absence). This is a common statistical problem which can mislead us into believing that we've "explained" movement in the dependent variable with the serial correlation factor when the serial correlation factor was not actually the explanatory factor but was merely correlated with the true explanatory factor. Its role as proxy will be noisy and we should not be surprised that the tracking error (noise) increased as a result.

When the serial correlation factor is also added to the interest rate measures, the pattern of value added changes very little due to the very small contribution which serial correlation makes once the identifiable interest rate influences are taken into account.

Finally, the aggregate result, i.e., the value added derived from combining all of these factors in a single investment model, is, indeed, consistent with our live experience where we have generated an average annualized value added of 5.4% (since April of 1992), and an information ratio of 81%.