

Currency Choices in Valuation: An Approach for Emerging Markets

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Abstract

One of the common decisions that multinational companies face is whether to value an investment or an acquisition in a foreign or an emerging market in the domestic currency or U.S. dollars. The choice of currency affects the inputs. Since these investments generate sales, expenses, and cash flows in domestic currency, senior management is required to express expected cash flows in a strong currency, usually U.S. dollars. Therefore, it is necessary to forecast the exchange rate for the investment horizon. In this paper, we demonstrate the equivalence value independent of the currency used in the valuation. This is done through using an arbitrage-free pricing model to obtain a fair value for the business. Users of the model assume the simultaneous fulfillment of Interest Rate Parity theory (IRP) and Purchasing Power Parity theory (PPP), which implies a constant real exchange rate (RER). This model can be extended to explore the effect on the business value as a consequence of a depreciation or appreciation of the currency.

Keywords: Valuation, emerging markets, arbitrage-free, interest parity theory, purchasing power parity, discounted cash flow, sovereign bond yield spread, forward exchange rate

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One of the common choices that multinational companies face when valuing an investment or an acquisition in a foreign or an emerging market is the choice of the currency because of how it affects the inputs. In particular, the issue is whether an analyst should value a foreign company in domestic currency such as pesos, reais, or rupees or in U.S. dollars. Each of these choices carries certain implications. By definition, the currency used to forecast cash flows should not affect the value, since the cash flow does not change as a consequence of being expressed in another currency. The key rule here is that the cash flows and the cost of capital have to be expressed in the same currency. In other words, if an analyst decides to perform the analysis in U.S. dollars, then the cash flows and the cost of capital have to be expressed in U.S. dollars. This leaves two alternative methods that can be used to obtain a fair value¹ for the company:

1. Forecast both cash flows and cost of capital in U.S. dollars, estimating the Discounted Cash Flow (DCF) value in U.S. dollars.
2. Forecast both cash flows and cost of capital in domestic currency, estimating the DCF value in domestic currency. Afterwards, this can be converted to U.S. dollars using the spot exchange rate.

The first is used frequently in emerging markets where the domestic currency is depreciated against the U.S. dollar or other strong currencies. The second is used when the domestic inflation rate is only two or three percentage points higher than the international inflation rate, like in Colombia. If the exchange rate and

inflation rate are forecasted consistently and the inflation differential rate is considered in the cost of capital expressed in domestic currency, both methodologies yield identical, fair values.

Although some corporate finance textbooks give examples of this equivalence using the Interest Rate Parity theory (IRP) and Purchasing Power Parity theory (PPP), they always assume constant, nominal interest rates (Berk & DeMarzo, 2007; Brealey, Myers, & Marcus, 2008; Emery & Finnerty, 2007; Graham, Smart, & Megginson, 2010; Ross, Westerfield, & Jaffe, 2009). This leads to a flat yield curve, which is rarely observed and transitional. Brigham and Erdhardt (2010) used the IRP to forecast the exchange rate but do not offer proof of the equivalence. Damodaran's (2012) opinion is similar:

If we assume purchasing power parity then differences in interest rates reflect differences in expected inflation rates. Both the cash flows and the discount rate are affected by expected inflation; thus, a low discount rate arising from a low risk free rate will be exactly offset by a decline in expected nominal growth rates for cash flows and the value will remain unchanged. If the difference in interest rates across two currencies does not adequately reflect the difference in expected inflation in these currencies, the values obtained using the different currencies can be different. In particular, projects and assets will be valued more highly when the currency used is the one with low interest rates relative to inflation. The risk, however, is that the interest rates will have to rise at some point to correct for this divergence, at which point the values will also converge. (p. 156)

Koller, Goedhart, and Wessels (2010) proposed an approach assuming constant, real interest rates and a slightly increasing inflation rate to obtain the nominal interest rates.

Since in all cases the use of the interest rates across two countries is proposed, some confusion remains. In reality, if the expected market exchange rate has to be obtained, it is more appropriate to use the sovereign bond returns from the same issuer. This is because the only risk difference between a bond nominated in domestic currency and a bond nominated in U.S. dollars is the exchange risk.

Since most financial statements are richer and more detailed in domestic currency, tax charges are based on nominal financial statements. Managers are familiar with this information; therefore, they could estimate the cash flows in domestic currency first and then convert them into U.S. dollars. It is usually better to estimate the expected cash flows in domestic currency to incorporate the senior management's forecasts of quantities and prices. Once this is done, it is easy to then convert the amounts into U.S. dollars using the expected market exchange rate. This can be obtained by comparing the yields spread in the market bonds issued in domestic currency and U.S. dollars by the foreign or emerging country, assuming the simultaneous fulfillment of IRP and PPP theories. Once the cash flows are expressed in U.S. dollars, managers can estimate the fair value of the business using a DCF model, with the cost of capital expressed in U.S. dollars. Valuing in U.S. dollars or domestic currencies yields identical fair values when the simultaneous fulfillment of the IRP and the PPP is assumed. The Weighted Average Cost of Capital (WACC) and the long-term growth rate used to estimate the Terminal Value of the business is adjusted by the inflation differential rate.

Despite empirical tests for both, IRP and PPP theories have shown poor results. These play instrumental roles in an arbitrage-free valuation model, since both are used to forecast the exchange rate and inflation rate. Once the projections are made, analysts have a framework to analyze a strongly linked triad of interest rates, inflation rates, and exchange rate.

The simultaneous fulfillment of IRP and PPP implies that the real exchange rate (RER) remains constant for the explicit forecast period. However, users can extend the model to analyze different economic scenarios such as devaluation, different pass-through rates, etc. This is particularly important in emerging markets, since the exchange rate has observed periods ranging from strong appreciation to periods with strong depreciation.

The remainder of this paper is organized as follows. First, the focus is on describing the equivalence of the DCF value using free cash flows (FCF) nominated in U.S. dollars and domestic currency. The second section focuses on the method used to forecast the exchange rate using yields spread in market bonds. The next section focuses on describing an example. The fourth section includes a summary of the works done on the effect of an unexpected change in foreign exchange rates on the market value of businesses where it is suggested that the model can be extended to consider such effects. The final section contains some concluding remarks.

The Equivalence of the DCF Value Using Different Currencies

In an ideal world, the prices of goods and services that companies buy or sell should reflect the average inflation rate. Valuing a company in this ideal world using nominal FCF and discounting them with a nominal cost of capital should yield the same value as using real FCF and real cost of capital. Financial theory already recognizes this issue. Since taxes are based upon nominal income and senior management is used to working with nominal rather than real categories on a daily basis, making the analysis in nominal terms is more appropriate.

Another issue that analysts often engage with when valuing an acquisition in a foreign country is whether the analysis should be done in domestic or foreign currency. When a valuation is performed in an emerging market, there are important reasons for performing it using both nominal FCF and cost of capital expressed in U.S. dollars. First, as the currency of emerging markets has observed a tendency towards depreciation and higher inflation rates than developed countries, senior management of a multinational is required to forecast the FCF in U.S. dollar amounts. This creates a consistent set of macroeconomic assumptions regarding exchange rate, domestic inflation rate, interest rates, and gross domestic product (GDP) growth. Second, all inputs of the Capital Asset Pricing Model (CAPM) are nominated in U.S. dollars. A risk free rate is commonly the expected return on U.S. Treasury Bonds and the market risk premium for emerging markets is commonly assumed as the American risk premium because of the lack of representativeness or the absence of the emerging market stock index. If a country's risk premium is added to the cost of capital, this is usually estimated as the spread of a long-term Bond issued by the relevant country and nominated in U.S. dollars rather than a long-term U.S. T-Bond. Third, a business sale transaction is performed in U.S. dollars and not in domestic currency.

To be consistent, the cost of capital and cash flows should be expressed in the same currency. By definition, the company value does not depend upon what currency is used for creating the analysis; the value should not change whether the analysis is done in domestic currency or foreign currency. If the company value is USD 100 million, in Argentinian pesos it will be ARS 434 million, in euros it will be EUR 79 million, and so on (quotes from Reuters on 1/19/2011). The important fact is that cash flows and the cost of capital have to be estimated consistently in the same currency.

In order to estimate the fair value of the company's operations indicated with the term V , the DCF model is used, which consists in calculating the present value of FCF. FCF reflects the cash flow that is generated by a company's operations. This cash flow should also be available to all the company's capital providers, both debt and equity.

For consistency with the cash flow definition, the discount rate applied to the FCF should reflect the opportunity cost to all the capital providers. In other words, this should reflect the WACC. The formula used to estimate the fair value of operations, including the Terminal Value, is as follows:

$$V = \sum_{t=1}^{\infty} \frac{FCF_t}{(1+WACC)^t} \quad (1)$$

The WACC can be expressed as the weighted average of the after-corporate-tax required return for debt and the required return for equity:

$$WACC = kd(1-t) \frac{D}{D+E} + ke \frac{E}{D+E} \quad (2)$$

In this equation:

kd = required return for debt,

t = marginal corporate tax rate,

D = debt market value,

E = equity market value,

ke = required return for equity.

The required return for equity is usually estimated using the formula of the famous CAPM model:

$$ke = rf + [E(rm) - rf] \beta \quad (3)$$

The CAPM model expresses the required return for equity as the riskless return, r_f , plus a risk premium (Sharpe, 1964). This is calculated as the difference between the market portfolio's expected return $E(r_m)$ and the riskless return adjusted by the common stock's beta coefficient. The beta coefficient plays a critical role in asset pricing, since it measures how much an individual asset contributes to the standard deviation of the market portfolio.

An additional challenge in valuing a business is its explicit forecast period and its indefinite life. The value after the explicit forecast period is referred to as the Terminal Value. This is generally calculated using the growing perpetuity formula, which assumes that the company's free cash will grow at a constant rate, g , beyond the explicit forecast period². The formula to estimate the terminal value is as follows:

$$TV = \frac{FCF_T(1+g)}{(WACC-g)} \quad (4)$$

In this formula, $FCF_T(1+g)$ is the FCF in the first year after the explicit forecast period and g is the nominal growth rate at which the FCF is expected to grow for perpetuity. This technique provides the same result as a long explicit forecast when the company's cash flow is forecasted to grow at the same rate and the company earns a constant rate of return on all new capital invested during the continuing-value period. Terminal Value is added to the last forecasted cash flow before all cash flows are discounted to obtain the fair value of operations.

Analysts can perform a valuation using nominal FCF in U.S. dollars and then discount them with a WACC expressed in U.S. dollars to obtain the fair value of the business in U.S. dollar amounts:

$$V^{USD} = \sum_{t=1}^{\infty} \frac{FCF_t^{USD}}{(1+WACC_t^{USD})^t} \quad (5)$$

Otherwise, analysts could perform the valuation discounting the FCF in domestic currency using a WACC expressed in domestic currency to obtain the fair value in domestic currency:

$$V^D = \sum_{t=1}^{\infty} \frac{FCF_t^D}{(1+WACC_t^D)^t} \quad (6)$$

To obtain the fair value in U.S. dollar amounts, analysts can divide Equation 6 by the spot exchange rate $S^{D/USD}$:

$$V^{USD} = \frac{V^D}{S^{D/USD}} \quad (7)$$

The inflation rate observed in emerging countries is higher compared to the international inflation rate observed in developed countries. Therefore, the WACC expressed in U.S. dollars must be adjusted by the inflation rate differential to obtain the discount factor expressed in domestic currency:

$$(1+WACC_t^D) = (1+WACC_t^{USD}) \frac{(1+\pi_t^D)}{(1+\pi_t^*)} \quad (8)$$

In this equation:

π_t^D = t -period domestic inflation rate,

π_t^* = t -period international inflation rates.

For the same reason, the inflation differential rate must be used to adjust the long-term growth rate in order to calculate the terminal value for a company that operates in the foreign market³:

$$g^D = g^* \frac{(1+\pi_t^D)}{(1+\pi_t^*)} \quad (9)$$

In this equation:

g^D = nominal long-term growth rate in the emerging country,

g^* = nominal long-term growth rate in the developed country,
 π_T^D = last forecast period domestic inflation rate,
 π_T^* = last forecast period international inflation rate.

Then, the Terminal Values in U.S. dollars and domestic currency are expressed as:

$$TV^{USD} = \frac{FCF_T^{USD}(1+g^*)}{WACC_T^{USD} - g^*}, \quad (10)$$

$$TV^D = \frac{FCF_T^D(1+g^D)}{WACC_T^D - g^D}. \quad (11)$$

IRP states a relationship between the interest rates and the currency exchange rates for the two countries. In the absence of arbitrage opportunities, the interest rate differential is equivalent to the differential between the spot and forward rates, so the IRP must hold for every period of t in equilibrium. To illustrate this for a single year:

$$\frac{F_t^{D/USD}}{S^{D/USD}} = \frac{1+i_t^D}{1+i_t^{USD}}. \quad (12)$$

In this equation:

i_t^D = one period forward domestic interest rate,
 i_t^{USD} = one period forward U.S. dollar interest rate,
 $F_t^{D/USD}$ = forward exchange rate for one period forward.

Therefore, the forward exchange rate can be expressed as:

$$F_t^{D/USD} = S^{D/USD} \frac{1+i_t^D}{1+i_t^{USD}}. \quad (13)$$

Uncovered IRP refers to the condition where exposure to unanticipated changes in exchange rates is uninhibited. On the other hand, covered IRP refers to the condition where a forward contract has been used to cover risks concerning the exchange rate. The use of a forward market eliminates the investor's risk, and as a result there are no interest rate arbitrage opportunities.

On the other hand, the relative PPP theory is formally stated in terms of inflation rates. It requires that the inflation rate differential between two countries be equal to the change in the foreign exchange rate. The expectations theory of forward exchange rates maintains that the expected spot exchange rate t periods in the future equal the t -period forward rate, so the PPP must hold for every period of t in equilibrium:

$$\frac{F_t^{D/USD}}{S^{D/USD}} = \frac{1+\pi_t^D}{1+\pi_t^*}. \quad (14)$$

Therefore, the forward exchange rate for one period forward is:

$$F_t^{D/USD} = S^{D/USD} \frac{1+\pi_t^D}{1+\pi_t^*}. \quad (15)$$

IRP, coupled with PPP and the expectations theory of forward exchange rates, implies the international Fisher effect (Emery & Finnerty, 2007). These relationships are mutually consistent, so both theories should be predicting the same forward exchange rate:

$$F_t^{D/USD} = S^{D/USD} \frac{1+i_t^D}{1+i_t^{USD}} = S^{D/USD} \frac{1+\pi_t^D}{1+\pi_t^*}. \quad (16)$$

Since the inflation rate fluctuates much less and is lower in developed countries than developing countries, staying around 2.2% and 5.5%, respectively, analysts can assume the international inflation rate remains

constant along the forecast period (Central Intelligence Agency, 2012). Thus, analysts can obtain the expected domestic inflation rate from Equation 16 for one period forward:

$$\frac{F_t^{D/USD}}{S^{D/USD}} (1 + \pi_t^*) - 1 = \pi_t^D. \quad (17)$$

The forecasted FCF expressed in domestic currency is equal to the forecasted FCF in U.S. dollars multiplied by the forward foreign exchange rate:

$$FCF_t^D = FCF_t^{USD} F_t^{D/USD}. \quad (18)$$

Now, analysts can use these equations to prove the equivalence of valuing a company in domestic or foreign currency. This is done through replacing Equations 7, 8, and 18 in Equation 6 to create:

$$V^{USD} = \frac{V^D}{S^{S/USD}} = \frac{1}{S^{S/USD}} \sum_{t=1}^{\infty} \frac{FCF_t^{USD} F_t^{D/USD}}{(1 + WACC_t^{USD})^t \frac{(1 + \pi_t^D)^t}{(1 + \pi_t^*)^t}}. \quad (19)$$

Equations 5 and 6 assume a flat yield curve. It is common that practitioners consider a constant cost of capital along the investment horizon; if the interest rates change, as is the general case, the WACC must be recalculated for each period. In this case, the WACC expressed in U.S. dollars for the t -period will be equal to the WACC expressed in U.S. dollars for the $t-1$ period plus the change in the interest rate:

$$WACC_t^{USD} = WACC_{t-1}^{USD} + (i_t^{USD} - i_{t-1}^{USD}). \quad (20)$$

As is shown in Equation 8, the WACC expressed in domestic currency will be equal to the WACC expressed in U.S. dollars multiplied by the inflation rate differential. The forward exchange rate is estimated using IRP rather than PPP. This is because one can observe forward interest rates in the market, but one cannot directly observe the expected inflation rates. In the next section, the data of market bonds is used to obtain the forward interest rates. With the forecast for the forward exchange rate, analysts can obtain the domestic inflation rate assuming the fulfillment of the PPP.

If both theories predict the same exchange rate, the RER can be subtracted from Equation 15. Rearranging terms, if the PPP holds, it implies that the RER remains constant along the projection. To illustrate for one single year:

$$RER_0^{D/USD} = F_t^{D/USD} \frac{1 + \pi_t^*}{1 + \pi_t^D}. \quad (21)$$

Use of the Sovereign Bond Yield Spread to Forecast the Exchange Rate

When valuing a company in an emerging market, analysts usually find that the forward exchange rates are not liquid or are not available beyond 12/18 months. To obtain the company fair value using the DCF method, analysts need to forecast the forward exchange rate for a longer horizon, usually ten years. To fill the gap, analysts can use the data of market bond yields in an emerging country and forecast the forward exchange rate for the explicit forecast period, assuming that the IRP holds. Emerging market borrowers able to issue bonds in local currency generally pay a premium for bonds issued in a strong currency like U.S. dollars. The premium reflects the expected depreciation of the domestic currency. Since the issuer and the jurisdiction are the same and differ solely in the currency, the yield spread reflects the market's opinion about the forward exchange rate.

Figure 1 shows the yield curves in domestic and foreign currency for the Sovereign Mexican Bonds on June 2011 (Source: Reuters). While there are a number of sophisticated techniques for constructing yield curves, these are beyond the scope of this paper. We obtain the best-fit curves adjusting a logarithmic trend-line to illustrate expected returns for both sovereign bonds in domestic currency and in U.S. dollars.

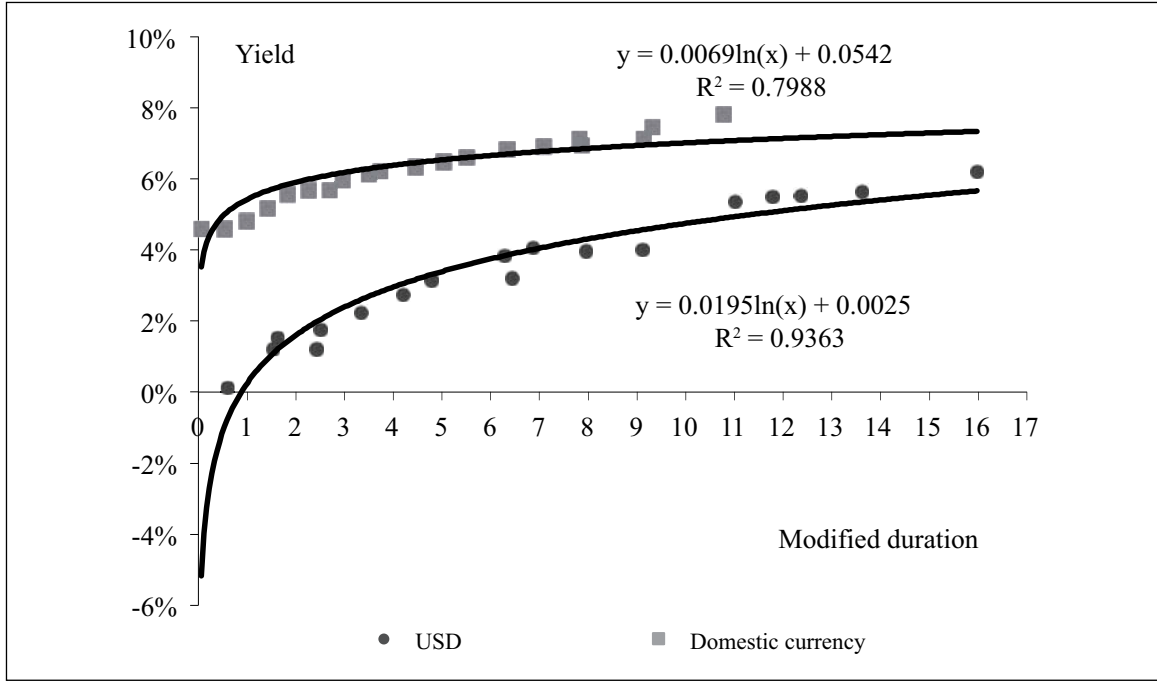


Figure 1. Yield curves for sovereign Mexican bonds.

As can be seen, bonds nominated in domestic currency have higher yields than bonds nominated in U.S. dollars. Since the market requires a currency premium for the devaluation risk, the yield spread reflects the market’s opinion about the expected exchange rate. Analysts can easily obtain the required returns for a specific year using the yield curve equations. For example, here is an equation to calculate the required return in domestic currency and U.S. dollars for one year from now:

$$i_1^D = 0.0542 + 0.0069 \ln(1) = 5.42\%,$$

$$i_1^{USD} = 0.0025 + 0.0195 \ln(1) = 0.25\%.$$

To obtain the expected yields for subsequent years, analysts only have to change the year number in the equation. For example, to obtain the expected yields for three years from now:

$$i_1^D = 0.0542 + 0.0069 \ln(3) = 6.18\%,$$

$$i_1^{USD} = 0.0025 + 0.0195 \ln(3) = 2.39\%.$$

To forecast the forward exchange rate for a specific year, analysts can extrapolate what some market participants refer to as the market’s consensus of forward interest rates. Given the two-year spot rate, there could be a rate on a one-year instrument one year from now that will make the investor indifferent between two alternatives:

$$(1 + i_1^{USD})(1 + f_1^{USD}) = (1 + i_2^{USD})^2. \tag{22}$$

Solving Equation 22 for f_1^{USD} , there is this equation:

$$f_1^{USD} = \frac{(1 + i_2^{USD})^2}{(1 + i_1^{USD})} - 1. \tag{23}$$

For example, to forecast the expected exchange rate for two years from now:

$$F_2^{D/USD} = S^{D/USD} \frac{(1 + i_1^{USD})(1 + f_1^{USD})}{(1 + i_1^D)(1 + f_1^D)}. \tag{24}$$

A Hypothetical Example

“Foreign investor” is a company that has operations in several countries and is considering an acquisition in México. As the currency of México has observed a higher inflation rate than developed countries, senior management is required to forecast the FCF in U.S. dollar amounts. This forecast creates a consistent set of macroeconomic assumptions regarding the exchange rate, the domestic inflation rate, the interest rates, and the GDP growth.

The target acquisition’s FCF is expected to grow at a rate of 3% per year plus the domestic inflation rate. The explicit forecast period is projected until the company reaches a stable state by the end of the forecast period of ten years. Beyond this period, FCF is expected to grow at a rate of 2% per year plus the domestic inflation rate. A Terminal Value in foreign and domestic currency is estimated using Equations 10 and 11, the WACC expressed in U.S. dollars is estimated to be 15%, and the spot exchange rate is $S^{D/USD} = 11.72$.

Table 1 shows the forecasted FCF values for the Target Company in domestic currency and U.S. dollars, domestic and U.S. dollar interest rate, domestic and international inflation rate, and the forward exchange rate. The last row shows the RER, which, as mentioned earlier, if the IRP and the PPP hold, remains constant along the explicit forecast period.

Table 1
DCF Equivalence With Domestic and Foreign Currencies

	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
FCF ^D		100.00	109.50	119.30	129.50	140.19	151.42	163.23	175.69	188.82	202.67
Terminal Value ^D											1 565.42
FCF ^D		100.00	109.50	119.30	129.50	140.19	151.42	163.23	175.69	188.82	1 768.09
FCF ^{USD}		8.11	8.52	8.96	9.41	9.89	10.39	10.91	11.46	12.04	12.65
Terminal Value ^{USD}											97.73
FCF ^{USD}		8.11	8.52	8.96	9.41	9.89	10.39	10.91	11.46	12.04	110.38
F ^{D/USD}	11.72	12.32	12.85	13.32	13.76	14.18	14.58	14.96	15.33	15.68	16.02
i ^D		5.42%	5.90%	6.18%	6.38%	6.53%	6.66%	6.76%	6.85%	6.94%	7.01%
i ^{USD}		0.25%	1.60%	2.39%	2.95%	3.39%	3.74%	4.04%	4.30%	4.53%	4.74%
π ^D		7.26%	6.31%	5.77%	5.39%	5.10%	4.86%	4.66%	4.49%	4.34%	4.21%
π*		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Disc. factor ^{USD}		0.87	0.75	0.65	0.56	0.48	0.42	0.36	0.32	0.27	0.24
PV Cash Flow ^{USD}	70.73	7.06	6.37	5.78	5.26	4.78	4.36	3.97	3.62	3.30	26.24
Disc. factor ^D		0.83	0.68	0.57	0.48	0.40	0.34	0.28	0.24	0.20	0.17
PV Cash Flow ^D	828.95	82.69	74.67	67.75	61.59	56.06	51.05	46.52	42.40	38.66	307.57
Real exchange rate	11.72	11.72	11.72	11.72	11.72	11.72	11.72	11.72	11.72	11.72	11.72

Using Equations 5, 6, and 7, these are the equivalence values:

$$V^{USD} = 70.73,$$

$$V^D = 828.95,$$

$$V^{USD} = \frac{828.95}{11.72} = 70.73.$$

The approach used here differs from the work of Koller et al. (2010) in that they forecast the nominal interest rates assuming that the real interest rate will remain constant and the inflation rate will slightly increase

along the projection. In the model used for this study, the interest rates are observed in the market bonds. The domestic inflation rate is then subtracted from the PPP arbitrage formula. This proposal can be summarized in the following steps:

1. Estimate the FCF in domestic currency. This allows senior management to work with prices and quantities that they deal with every day.
2. Build the yield curves of the foreign or emerging country using sovereign bonds nominated in domestic currency and U.S. dollars for a similar, modified duration⁴.
3. Assuming that IRP holds, forecast the forward exchange rate.
4. Convert the FCF expressed in domestic currency to U.S. dollars using the forward exchange rate and then discount that amount with the cost of capital expressed in U.S. dollars. If a valuation in domestic currency is performed, the expected inflation rate needs to be estimated using the PPP, and both the WACC in U.S. dollars and the long-term growth rate for the inflation differential rate to obtain the WACC in domestic currency has to be adjusted. Finally, the cash flow must be discounted and expressed in domestic currency and the value must be divided by the spot exchange rate.

Since this model assumes the simultaneous fulfillment of IRP and PPP, it is pertinent to examine the empirical evidence of the theories. Both IRP and PPP have been highly researched since the 70s, and an intense debate has been generated on their fulfillment both in the short and long-term. The conventional view is that uncovered interest parity (UIP) and PPP are appealing in theory but rejected empirically.

Early empirical studies tested the null hypothesis that the RER does not mean revert, but instead, follows a random walk. They argued this to be an implication of the efficiency of international markets (Adler & Lehmann, 1983). Generally, the hypothesis of mean reversion has not been successful.

Meese and Rogoff (1983) suggest that the random walk model outperforms a range of fundamentals-based models of exchange rate determination at horizons of up to one year. Beyond the one year period, however, the random walk model does not yield the minimum forecast errors. Mark (1997) arrived at a similar conclusion.

Abuaf and Jorion (1990) examined the evidence on PPP and in the long term discredited the random walk hypothesis. Deviations from PPP, while substantial in the short term, appear to decrease over time. Cerrato and Sarantis (2003) have also found that the mean reversion hypothesis does not hold when testing the PPP in emerging markets.

Taylor (2002) and Taylor and Taylor (2004) made an overview and concluded that the new econometric methods permit some degree of confidence in the long-term PPP again. Bansal and Dahlquist (2000) and in the short term, Flood and Rose (2001) found evidence supporting UIP for emerging market currencies.

Using bonds with maturities ranging from five to ten years, Chinn and Meredith (2004), Chinn (2006), and Zhang (2006) showed that yield differentials explain future currency movements. They suggested that UIP tends to hold for financial instruments of longer maturities. Cheung, Chinn, and Garcia Pascual (2005) found that UIP performs well in predicting exchange rate movements at long horizons, relative to other structural models of the exchange rate.

Singh and Banerjee (2006) tested the real interest parity in emerging markets and found significant deviations between short-term, emerging market, real interest rates, and world real interest rates. Their paper suggests that real interest rates in the emerging markets show some convergence in the long term.

Mehl and Capiello (2009) found support in favor of UIP for U.S. dollar rates vis-à-vis major mature economy currencies, but far less against emerging market currencies.

Burnside, Eichenbaum, Kleshchelski, and Rebelo (2010) suggest that the forward exchange rate is a biased forecaster of the future spot exchange rate. They argue that the explanation for the higher average payoff to the carry trade is that it reflects the presence of a peso problem, which refers to a rare event where there are negative payoffs to the carry trade. Even though the losses of an unhedged carry trade in the peso state are moderate, the investor attaches great importance to those losses. This results in a higher value of the stochastic discount factor in the peso state.

Skinner and Mason (2011) found that while covered IRP holds for large and small triple-A rated economies, it does not hold for longer maturities for Brazil, Chile, Russia, and South Korea.

Currency's Effect on Business Value

It is a common belief among practitioners that unexpected changes in foreign exchange rates should affect the market value of certain firms. Shapiro (1975) focused on cash flow sensitivity. He stated that the major factors affecting a multinational firm's exchange risk include the distribution of its sales between domestic and export markets, the amount of import competition it faces domestically, and the degree of substitutability between local and imported factors of production. The economic exposure to exchange rate changes can be interpreted as the regression coefficient of unexpected firm value changes on unexpected exchange rate changes (Adler & Dumas, 1983; Adler & Dumas, 1984; Adler & Simon, 1986; Dumas, 1978; Hodder, 1982; Jorion, 1990). However, empirical evidence suggests that firms are not systematically affected by foreign exchange rate changes (Allayannis, 1996; Bartov & Bodnar, 1994; Bodnar, 1993; Choi & Prasad, 1995; Jorion 1990; Miller & Reuer, 1998).

Several studies show that using various functional forms, such as quadratic and cubic functions, can more effectively capture the degree of exposure when a linear model cannot, at least for some firms (Allayannis & Ihrig, 2001; Bodnar & Wong, 2003; Priestley & Ødegaard, 2007). Bartram and Bodnar (2007) suggested that the hedging behavior of firms could explain the lack of exposure. Nevertheless, documenting a strong and systematic contemporaneous relation between stock returns and exchange rate exposure continues to be puzzling.

Although the empirical evidence is puzzling, managers should be interested in a model that provides a framework to estimate the possible effect on the business value as a consequence. For example, they should be interested in a model that could factor in a sudden devaluation which could affect the GDP and probably the business sales. Senior management could explore different economic scenarios and different combinations of devaluation and pass-through rates. Appreciated currencies in emerging countries generally lead to sharp devaluations that generate a fall in the GDP and sales measured in domestic currency. In this case, there would be an effect on the business value, although the value measured in domestic or foreign currency would continue to be the same.

Conclusions

Valuation in foreign currency or in domestic currency yields identical values when the simultaneous fulfillment of both interest rate parity theory and purchasing power parity theory is assumed. This study is focused on obtaining fair value for a company using an arbitrage-free valuation model based on the simple fact that an asset cannot be sold for more than one price in the market. If one assumes that the IRP does not hold, one is immediately valuing an asset assuming arbitrage opportunities. The use of a forward market eliminates the risk for an investor, and as a result there are no interest rate arbitrage opportunities. If no forward exchange rates were available for more than one or two years in emerging markets, their prices would certainly be governed by the IRP should they exist.

The concept of arbitrage is at the heart of the financial economic analysis, just like the notion of general equilibrium is at the heart of the macroeconomic analysis. While the conclusion is obviously theoretical, since a given asset cannot consistently sell at more than one price in the market, establishing the correct assumptions is required. At the practitioner level, one way to forecast the expected exchange rate is to adjust the spot rate by the yield spread observed in market sovereign bonds, for bonds issued in domestic and U.S. dollar currencies. In this way, the exchange rate is forecasted and reflects the appreciation or depreciation rate expected by the market.

While our approach is essentially a suggestion for valuation in emerging markets, it can also be used by multinationals which have businesses in developed countries. It provides a framework to assess the consistency of the macroeconomic variables of the financial projections. This can be extended to consider the effect of something like a sudden devaluation within a set of economic assumptions to assess the effect on the fair value.

Endnotes

- ¹ Fair value is understood to be the price at which the company would change hands when both parties have reasonable knowledge of the relevant facts and no one is under the effects of compulsion.
- ² The terminal value is sometimes estimated as a multiple of EBITDA or as a liquidation value of the firm's assets in the terminal year, estimating what others would pay for the assets that the firm has accumulated at that point.
- ³ If a high-inflation currency is used to estimate cash flows and discount rates, the long-term growth rate will be much higher, since the expected inflation rate is added on to real growth. For instance, the long-term growth rate that would be used to value a company that operates in an emerging market will be much higher if the valuation is done in domestic currency than in U.S. dollars.
- ⁴ Modified Duration is a measure of the price change as a consequence of a change of one percentage point in the interest rate.

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