

August 2015



# Portfolio Risk Management Platform

MFX Currency Risk Management Service



**mfx**

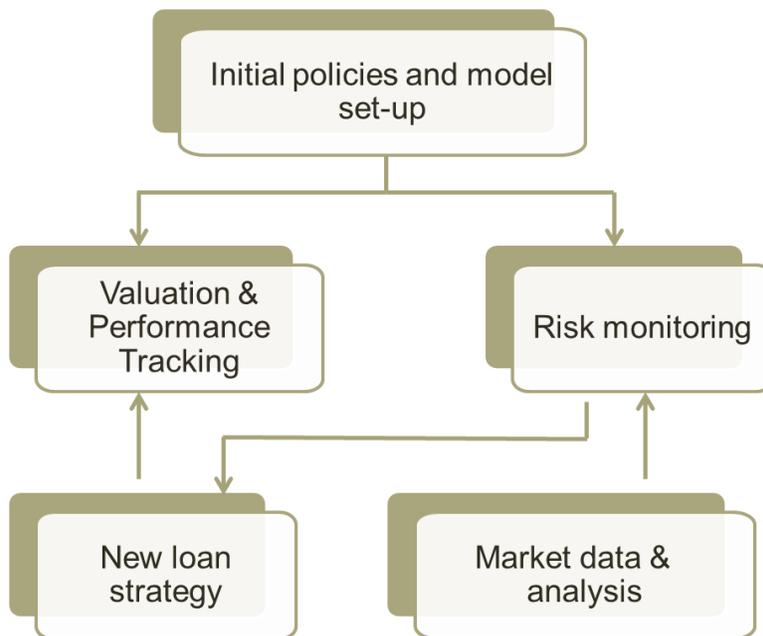
MICROFINANCE  
CURRENCY RISK SOLUTIONS

# Risk Management Service

An overview

MFX's Currency Risk Management Service is designed for microfinance or other debt funds that plan to carry some level of open currency position in their portfolio. The Service is built around a portfolio analytics model which shows the fund manager in real time her financial position and performance relative to current spot markets, forward markets and a variety of future scenarios. Using the model, the client can implement a risk strategy to guide decision-making on where to lend, whether to lend in hard or local currency, and whether and when to hedge a local currency loan. The model also provides all of the information needed for portfolio valuation.

The risk management process is as follows:





## Initial Set up

The first step in the risk management process is to load portfolio data into the model, set risk parameters and establish hedging policies:

### Loading data

To populate the model, existing loans must be loaded. If the client is starting a new fund, then a dummy portfolio can be entered upon which risk scenarios can be tested to determine the risk parameters.

The following data must be captured for each loan:

DEAL	FLOW	TENOR	CUR1	INTEREST				BASE CASH FLOW			EXPOSURE
				FIX	VAR	POINTS	TOTAL	PRINCIPAL	INTEREST	TOTAL	
CF00	11-Feb-14	-	KZT	14.61%	0.00%	0.00%	14.61%	(368,900,000.00)	-	(368,900,000.00)	-
CF01	11-May-14	53	KZT	14.61%	0.00%	0.00%	14.61%	-	13,324,360.58	13,324,360.58	13,324,360.58
CF02	11-Aug-14	145	KZT	14.61%	0.00%	0.00%	14.61%	-	13,773,496.33	13,773,496.33	13,773,496.33
CF03	11-Nov-14	237	KZT	14.61%	0.00%	0.00%	14.61%	-	13,773,496.33	13,773,496.33	13,773,496.33
CF04	11-Feb-15	329	KZT	14.61%	0.00%	0.00%	14.61%	-	13,773,496.33	13,773,496.33	13,773,496.33
CF05	11-May-15	418	KZT	14.61%	0.00%	0.00%	14.61%	-	13,324,360.58	13,324,360.58	13,324,360.58
CF06	11-Aug-15	510	KZT	14.61%	0.00%	0.00%	14.61%	-	13,773,496.33	13,773,496.33	13,773,496.33
CF07	11-Nov-15	602	KZT	14.61%	0.00%	0.00%	14.61%	-	13,773,496.33	13,773,496.33	13,773,496.33
CF08	11-Feb-16	694	KZT	14.61%	0.00%	0.00%	14.61%	368,900,000.00	13,773,496.33	382,673,496.33	382,673,496.33

### Choosing risk scenarios

The model automatically calculates the expected portfolio IRR based on current exchange rates and forward curves. The client then must specify which additional future fx market scenarios it wishes to test the portfolio against. MFX can provide fx market forecasts from several sources (Economist Intelligence Unit, Reuters polls) and use an average of several sources. In addition, if the client is a subscriber to a forecast service such as Mantis, MFX can feed that data directly into the model as one of the risk scenarios. The Client also must specify particular scenarios that should be tested. For example a client could test:

- 1) a base case that runs the portfolio using the mean historical movement of the currency over a certain period, which should approximate the average tenor of the portfolio;
- 2) a low stress case that assumes either a percentage depreciation below this mean or one standard deviation depreciation.
- 3) a high stress case that assumes 2 standard deviation depreciation of local currency

Additional scenarios can be run on an ad hoc basis including specific scenarios for single currencies or groups of currencies.

## Setting risk limits

Risk limits are the rules that the fund manager sets to guide lending and hedging decisions. The appropriate risk triggers depend on the risk tolerance of the fund managers and investors. Limits can be hard (i.e. written into the fund's operating agreement or set by the fund board) or can be softer guidelines for the Client's risk committee to consider. Normally it is better not to have too many hard limits as it hampers managers' ability to deal with unexpected circumstances. Rather, risk limits can be set to trigger a meeting of the risk committee which then determines whether action is appropriate. The committee can be guided by non-binding guidelines that reflect the risk tolerance of the fund. Risk limits should be established both at the portfolio and individual loan level.

### Sample risk limits

#### Sample hard limits

- *Limit on the amount of unhedged local currency exposure as a % of total portfolio.* This provides a general parameter for limiting the amount of risk. Diversification within the exposed portfolio and volatility of the currencies would further affect risk at a given % of exposure.
- *Maximum exposure to single currency as % of portfolio.* This sets a minimum level of diversification once the portfolio is disbursed.
- *Maximum VAR concentration as % of portfolio.* This is an alternative to the previous limit. It has the advantage of, in some cases, being more focused on potential risk. However since VAR can move once a position is taken it may be difficult to implement in a non-fully tradable portfolio.

#### Sample Guidelines

- *Increase exposure as portfolio diversifies.* This is a way of limiting the risk of big swings in a single currency before the portfolio is diversified.
- *Favor new deals that lower portfolio correlation.* Having lower portfolio correlation overall should limit the amount of volatility in the portfolio. However correlations can move up and down over time, especially during crisis periods. Correlations also don't always reflect fundamentals and thus can change suddenly. Therefore setting a hard limit on correlations is not practical.
- *Partially hedge positions as IRR approaches stop loss or stop gain triggers.* Stop-loss and stop-gains are important tools to prevent catastrophic loss and to lock in gains. Stop-losses should be set below the target return of the fund and stop-gains above. How much above and below is determined by the client's risk appetite. The decision to apply stop-losses and stop-gains should not be hard-coded however, so that they can be adjusted for the size of the transaction or other circumstances monitored by the risk committee that might argue against closing out an open position. These limits can be applied incrementally by partially hedging a position as it approaches the stop-loss or stop-gain level. This avoids cutting off all upside while limiting downside risk.

#### Triggers for risk committee meeting

- *VAR in a given currency hits certain % of the exposed currency position.* This can be an indication of increased risk (higher volatility) but it need not be (currency appreciation).
- *Movement in any transaction's or the book's forward IRR by a given percentage (ex: 1.5%)* A large rapid shift in IRR either from a shift in interest rates or FX should trigger a risk committee meeting to assess the reasons and potential courses of action. The trigger level must be set to limit the amount of actual triggers to a manageable level.

- *Significant social or political events.* Events which seem likely to have a big impact on the macro situation of a country and its currency should trigger a meeting.
- *Stop-loss or stop gain-triggers (forward rate IRR hits trigger level for committee consideration).* The level for consideration by the committee need not be the same as the one for locking in a gain or loss.

## Hedging policies

Hedging policies follow from the risk limits and are the primary tool – other than not entering into a position – for controlling currency exposure. It is important that hedging policies take into account the limitations on hedging for different currencies. For example in more liquid currencies hedges can be taken on and off while in illiquid currencies, it is generally expected that hedges would be maintained for the life of the loan.

From a currency risk standpoint a fully hedged loan (\$/LC) and a dollar loan are the same. The Client may have a preference to provide a hedged local currency loan rather than a dollar or euro loan to limit credit risk from having its MFI client exposed to currency risk. The hedging policy also includes the process for pricing unhedged local currency loans.

Hedging policy has two purposes: 1) guiding the decision of whether to hedge a loan at inception and 2) guiding the decision of whether to apply or remove a hedge once a loan is already in place.

For new loans, a policy generally will hedge all local currency loans if the dollar return on the hedge of the local currency loan is above the stop-gain level.<sup>1</sup> Loans can be hedged, either fully or partially, at a lower but still acceptable return if necessary to stay within risk limits or to implement a diversification strategy. Partial hedging can take one of several forms:

1. The most conservative partial hedging approach is to hedge all of the loan principle via a basis swap or a forward but leave the interest payments exposed. The principle repayment generally represents the majority of the exposure on the loan. For example, on a two-year bullet loan of \$1M at 10% p.a. in local currency, the principle is 83% of the total cash flow (\$1.0M/\$1.2M). This approach therefore provides downside protection while still allowing the lender to potentially benefit from the higher local rate. A basis swap provides marginally more protection than a forward matching the principle amount since the client receives the hard currency benchmark return. With dollar and euro benchmark rates (LIBOR/EURIBOR) near zero, the difference is currently negligible but could increase if those benchmarks rise in the future. Either approach ensures against ever having a negative return on a position. Hedging with a basis swap or a forward can be a good approach for clients with low risk appetite or as a way to build a more diversified local currency portfolio before opening up the portfolio to more risk.
2. Another approach is to hedge the entire cash flow with a swap but only a certain percentage of it. This maintains the same exposure as the loan but less of it. For more liquid currencies this percentage can be adjusted by adding or subtracting from the swap, though in practice this may be difficult for smaller trades.

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<sup>1</sup> Exceptions can be made if fundamentals of the currency are especially strong.

3. A third way is to hedge the loan for less than the full tenor. This can provide cost advantages in currencies with steep yield curves, but it also is more speculative in the sense that it is a bet that there is higher downside risk in the short term than the long-term. Such an approach should be supported by analysis that this is the case.

For local currency loans that cannot be hedged at an acceptable return, the policy must dictate the process for setting the price at which the loan can be offered. Generally this done by starting with the swap price (the local rate at which the loan could be hedged at an acceptable dollar return) and then making adjustments based on a list of risk factors considered by the risk/pricing committee. The most important factors to consider initially are polls of fx rate forecasts, historical volatility and mean movements over prior periods. If these show forecasts that are significantly better (i.e. local currency is stronger) than the actual forward fx rates, then applying an adjustment that would lower the local currency rate offered can be considered. The next step is to understand the analysis behind the poll forecasts (inflation, growth, central bank guidance, recent fx moves). It is important that the risk adjustment be made objectively and not with a view to matching an “acceptable” local currency rate.

For existing loans there are two possible cases: 1) exposed loans that can be hedged and 2) hedged loans where the hedge can be removed to create exposure and potentially collect on a positive mark-to-market. For existing exposed local currency loans, the committee should be guided by stop-loss and stop-gain guidelines to either apply a partial or full hedge on the position. Loans that are already hedged can be reviewed to assess the advantages of unhedging them either partially or fully. This, however, should be done carefully and only when the committee has a strong view. That is because presumably these loans already have locked in an acceptable return (unless they were hedged as the result of a stop loss). Hedges that carry a positive mark-to-market position have been depreciating, so to take off the hedge the committee must have a strong view that that trend will reverse. For hedges where the client already owes m-t-m and the local currency has been appreciating, the cost of unwinding would only be justified if the committee felt strongly that that trend would continue.

## Setting monitoring criteria

MFx will monitor the portfolio on a daily basis for currency movements that could indicate the need for action. This level should be set so as not to miss important movements but also so as not to lead to extensive alarms that in fact could be handled on a weekly basis. The trigger level for a one-day currency movement will be determined by the client but could start at the [1.5-2.0%] range initially and then be adjusted based on experience.



# Reporting

As a report, which can be set weekly, monthly or quarterly, the client will receive three files that provide a complete overview of the currency risk position of the portfolio.

## Report 1 – Position report and Valuation

DEAL: LOAN01	AS OF: 19-Mar-14	CLIENT:	EXPOSURE: PARTIALLY HEDGED
BASE CURR: KZT	19-Mar-14	COUNTRY: KAZAKHSTAN	COMMENTS: Partially hedge with swap 01
STARTS: 11-Feb-14		END DATE: 11-Feb-16	
DxS: (36)		DxE: 694	

BASE CURRENCY POSITION KZT NET OF HEDGING				
	ORIGINAL	REALIZED	EXPOSURE	P/L
PRINCIPAL:	368,900,000.00	-	368,900,000.00	-
INTEREST:	109,289,699.17	-	109,289,699.17	0.00
EXPOSURE:	478,189,699.17	-	478,189,699.17	-
NPV:	413,893,333.04	-	419,184,343.48	5,291,010.44
IRR:	15.6563%	-	15.6600%	0.0037%

USD POSITION				
	ORIGINAL	REALIZED	EXPOSURE	P/L
PRINCIPAL:	2,000,000.00	-	2,027,702.96	27,702.96
INTEREST:	592,516.67	-	600,723.90	8,207.23
EXPOSURE:	2,592,516.67	-	2,628,426.86	35,910.19
NPV:	2,243,932.41	-	2,304,096.87	60,164.46
IRR:	15.6563%	-	16.5600%	0.9037%

CHF POSITION				
	ORIGINAL	REALIZED	EXPOSURE	P/L
PRINCIPAL:	1,793,600.00	-	1,786,000.77	(7,599.23)
INTEREST:	531,368.95	-	529,117.61	(2,251.34)
EXPOSURE:	2,324,968.95	-	2,315,118.38	(9,850.57)
NPV:	2,012,358.59	-	2,029,448.52	17,089.93
IRR:	15.6563%	-	15.3800%	-0.2763%

USD FWD POSITION				
	ORIGINAL	REALIZED	EXPOSURE	P/L
PRINCIPAL:	2,000,000.00	-	1,770,221.78	(229,778.22)
INTEREST:	541,936.99	-	556,631.26	14,694.27
EXPOSURE:	2,265,313.06	-	2,326,853.04	61,539.98
NPV:	2,243,931.43	-	2,304,098.42	60,166.99
IRR:	7.2636%	-	8.9000%	1.6364%

CHF FWD POSITION				
	ORIGINAL	REALIZED	EXPOSURE	P/L
PRINCIPAL:	1,793,599.99	-	1,543,642.07	(249,957.92)
INTEREST:	484,022.77	-	488,294.30	4,271.53
EXPOSURE:	2,015,235.94	-	2,031,936.37	16,700.43
NPV:	2,012,357.77	-	2,029,449.82	17,092.05
IRR:	6.7810%	-	7.2800%	0.4990%

USD POLL POSITION				CHF POLL POSITION					
	ORIGINAL	REALIZED	EXPOSURE	P/L		ORIGINAL	REALIZED	EXPOSURE	P/L
PRINCIPAL:	2,000,000.00	-	1,628,812.17	(371,187.83)	PRINCIPAL:	1,794,553.34	-	1,691,304.66	(103,248.68)
INTEREST:	494,042.98	-	499,920.86	5,877.88	INTEREST:	489,210.60	-	489,680.82	470.22
EXPOSURE:	2,128,720.15	-	2,128,733.03	12.88	EXPOSURE:	2,190,275.80	-	2,180,985.48	(9,290.32)
NPV:	2,108,519.93	-	2,107,861.75	(658.18)	NPV:	2,187,098.19	-	2,178,274.89	(8,823.30)
IRR:	3.5014%	-	3.5600%	0.0586%	IRR:	11.7569%	-	11.5000%	-0.2569%

USD SCENARIO 1 POSITION (Mean Movement of 2 years)				CHF SCENARIO 1 POSITION (Mean Movement of 2 years)					
	ORIGINAL	REALIZED	EXPOSURE	P/L		ORIGINAL	REALIZED	EXPOSURE	P/L
PRINCIPAL:	2,000,000.00	-	1,912,648.97	(87,351.03)	PRINCIPAL:	1,793,599.99	-	1,576,587.97	(217,012.02)
INTEREST:	572,627.86	-	582,167.05	9,539.19	INTEREST:	494,552.09	-	495,018.01	465.92
EXPOSURE:	2,454,332.84	-	2,494,816.02	40,483.18	EXPOSURE:	2,071,296.87	-	2,071,605.97	309.10
NPV:	2,431,031.57	-	2,470,270.49	39,238.92	NPV:	2,068,333.55	-	2,069,066.69	733.14
IRR:	12.1838%	-	13.2300%	1.0462%	IRR:	8.4394%	-	8.4500%	0.0106%

USD SCENARIO 2 POSITION (50% of Worse Movement of 2 years)				CHF SCENARIO 2 POSITION (50% of Worse Movement of 2 years)					
	ORIGINAL	REALIZED	EXPOSURE	P/L		ORIGINAL	REALIZED	EXPOSURE	P/L
PRINCIPAL:	2,000,000.20	-	1,803,288.87	(196,711.33)	PRINCIPAL:	1,793,600.02	-	1,333,307.07	(460,292.95)
INTEREST:	555,210.03	-	564,220.42	9,010.39	INTEREST:	450,347.27	-	453,636.67	3,289.40
EXPOSURE:	2,335,084.49	-	2,367,509.29	32,424.80	EXPOSURE:	1,778,137.79	-	1,786,943.73	8,805.94
NPV:	2,313,006.66	-	2,344,330.27	31,323.61	NPV:	1,775,630.63	-	1,784,788.16	9,157.53
IRR:	9.1061%	-	9.9700%	0.8639%	IRR:	-0.4889%	-	-0.2100%	0.2789%

The first section allows the client to choose what he or she wants to analyze. She can choose either a single loan transaction, a single hedge, a currency position (which combines loans and hedges in a single currency) or the entire portfolio. The cells show the client ID, how the loan is exposed (if there is a hedge), the base currency, start and end dates, and days from start and to end.

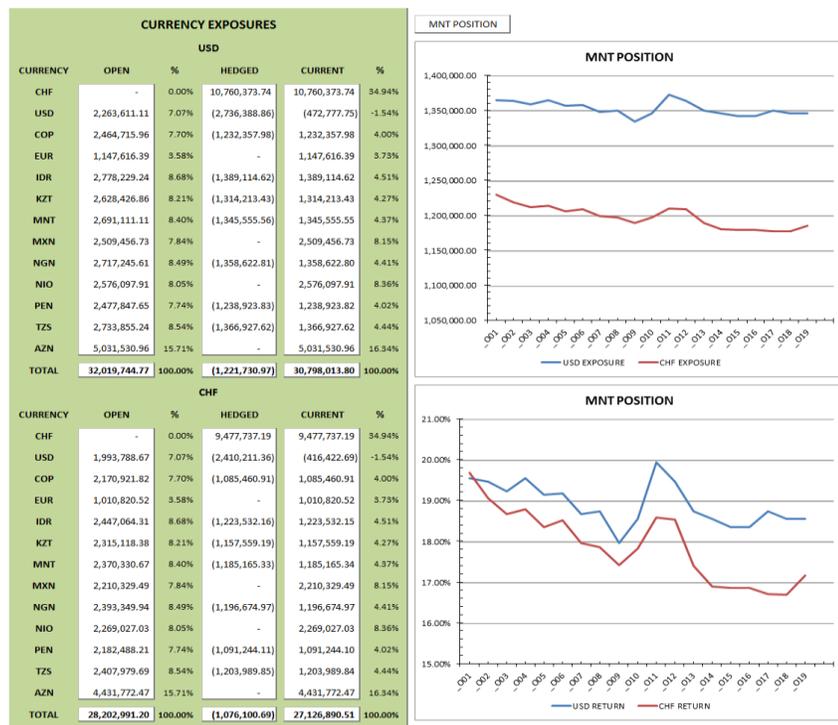
The second section shows where the loan, hedge or portfolio stands today. It presents the status of each transaction (or the entire book) in their original currency and in the functional currency at current “spot” market values. It includes the original values at the time of disbursement, any realized cashflows and the current exposure, including NPV and current P/L, for each deal.

The third section shows the portfolio’s future value at market forward rates (fair value). It presents the current forward valuation of the transaction at inception and at current rates, taking into account realized income. This allows the client to compare the “hedged” return at inception against the return at current forward market prices. The forward market return is the IRR that can be locked in by hedging the open exposure being analyzed.

The fourth section values the transaction using the current “polls” (forecasts) for the local currency (ies) against the functional currency. These provide an alternate estimate of the return and attention should be paid when polls and forward markets are very different.

The remaining sections present the valuation of the transaction (portfolio) based on scenarios that are determined by the risk management committee, typically the “mean” movement over a period of time and 1 or 2 standard deviation depreciations.

## Report 2 – Currency Exposure Report



The Currency Exposure Report allows for more detailed/graphical analysis of net currency positions and how they move over time. It presents, the original exposure at disbursement per currency, the current amount that is hedged, and the current exposure per currency (principal + interest). This is tracked on a weekly basis. This report is an easy way to keep track of currency limits and diversification.

## Report 3 – VAR Report

NPV POSITIONS														TOTAL
	CHF-	TZS-	NGN-	PEN-	KZT-	IDR-	NIO-	COP-	MNT-	MXN-	EUR-	AZN-	USD-	
LOCAL	9,462,160.06	1,840,385,868.59	178,123,659.00	3,250,819.80	209,663,567.31	13,672,428,460.86	56,726,829.28	2,281,808,382.50	1,944,330,165.74	30,848,619.15	821,996.81	3,286,930.34	(463,768.86)	
USD	10,723,209.50	1,126,307.14	1,080,716.29	1,157,287.21	1,150,480.50	1,197,235.41	2,215,536.94	1,143,998.71	1,104,733.05	2,334,363.92	1,134,101.56	4,201,623.86	(463,768.86)	28,105,825.23
CHF	9,462,160.06	995,853.42	953,624.06	1,021,190.24	1,015,184.00	1,055,440.53	1,954,989.79	1,009,464.46	974,816.44	2,059,842.72	1,000,731.22	3,707,512.89	(409,229.64)	24,800,580.19

Var Days	1
Confidence	95%

USD VOLATILITIES														
3Y	11.75%	9.05%	7.77%	3.97%	9.97%	5.72%	7.37%	7.01%	9.66%	12.32%	9.10%	4.10%	0.00%	
3M	7.28%	4.85%	6.15%	2.53%	34.49%	6.53%	6.30%	7.46%	14.08%	8.84%	5.89%	0.08%	0.00%	

CHF VOLATILITIES														
3Y	0.00%	14.60%	14.10%	12.17%	15.40%	12.83%	13.93%	12.70%	15.03%	14.49%	9.27%	12.51%	11.72%	
3M	0.00%	9.01%	9.88%	7.45%	34.98%	8.73%	8.86%	10.63%	14.76%	11.40%	3.13%	7.20%	7.23%	

USD VaR 3Y data														TOTAL
COMPONENT	121,209.62	1,191.26	413.56	764.33	878.38	698.76	1,775.08	2,397.02	1,085.22	14,132.29	7,554.89	1,344.56	-	153,444.97
%	79.00%	1.00%	0.00%	0.00%	1.00%	0.00%	1.00%	2.00%	1.00%	9.00%	5.00%	1.00%	0.00%	100.00%

USD VaR 3M data														TOTAL
COMPONENT	69,971.88	31.43	372.49	573.53	15,012.18	2,205.94	2,639.84	881.63	4,109.81	4,623.85	5,707.87	119.20	-	106,249.65
%	66.00%	0.00%	0.00%	1.00%	14.00%	2.00%	2.00%	1.00%	4.00%	4.00%	5.00%	0.00%	0.00%	99.00%

CHF VaR 3Y data														TOTAL
COMPONENT	-	11,879.48	11,848.97	11,917.17	11,905.04	12,279.99	24,025.92	11,388.48	11,595.98	21,364.10	6,792.83	44,313.73	(4,723.80)	174,087.89
%	0.00%	7.00%	7.00%	7.00%	7.00%	7.00%	14.00%	7.00%	7.00%	12.00%	4.00%	25.00%	-3.00%	101.00%

CHF VaR 3M data														TOTAL
COMPONENT	-	7,296.43	7,541.76	6,907.75	15,425.49	6,463.09	11,895.35	8,020.79	5,772.58	16,933.36	2,013.55	24,907.20	(2,758.87)	110,418.48
%	-	7.00%	7.00%	6.00%	14.00%	6.00%	11.00%	7.00%	5.00%	15.00%	2.00%	23.00%	-2.00%	101.00%

The VaR Report (Value at Risk) includes the “component” VaR per currency. VaR measures, based on historical movements and correlations, the potential for the value of the portfolio (or loan) to change during a given time period at a specified level of confidence. Changes in VaR can be set as soft triggers for committee review but the source of the VaR movement should always be identified, as some movements may not actually result from increased risk.

VaR is calculated with both long term and short term historical data. The risk committee selects the VaR days (the period over which value can change) and confidence interval. A typical choice is 1 day with 95% confidence level although since this is not a trading portfolio longer periods can be considered. For example if the portfolio is to be reviewed monthly a 30 day VaR could be used.

## Updating portfolio data

To keep the model accurate, the client must supply all portfolio data on a timely basis. This includes new hard currency loans, hedges undertaken with counterparties other than MFX, and any modifications to any loan contracts that would impact portfolio cash flows. MFX will provide a template for sending data so it can be easily uploaded to the model.



## Procedures for analyzing new loans

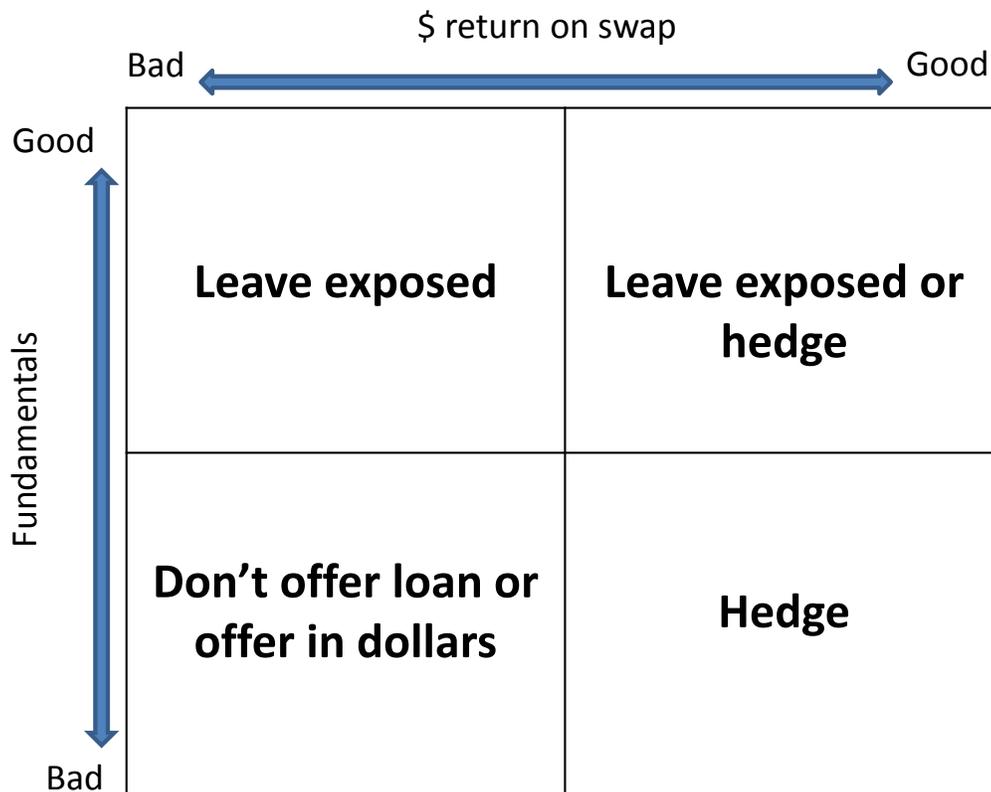
When the client has a new potential loan to add to the portfolio, MFX will assist with the loan evaluation based on the following steps:

**Step 1:** Evaluate fundamentals of the currency – What are the poll forecasts? Is it trending up, down or flat? Is inflation rising? What is the central bank guidance? Is the economy growing? The client can use analytical sources provided by MFX or other providers.

**Step 2:** What is the fair market value of the loan (priced at the swap rate)? How does this compare to the rate the MFI will accept? Can we achieve an acceptable return without exposure (either by a hedge or lending in hard currency?)

**Step 3:** Analyzing loan (on a stand-alone basis) under different scenarios. MFX will help the client to look at the loan under different currency scenarios with different hedging strategies using MFX's loan analytics tool. This analysis will give a feel for the options available including potential return under a variety of hedging strategies.

### Decision Point #1:



**Step 4:** If the decision is to offer an unhedged local currency loan (top two boxes) then the loan will be loaded into the model. Does the loan cause the portfolio to hit any risk triggers such as currency concentration, total exposure or VAR exposure? Is the evaluation of fundamentals and swap prices clear cut? Do I need to save exposure room for other loans in the pipeline?

**Decision point #2:** Depending on the answers to the questions in Step 4, the client may still want to hedge the risk, at least partially, to manage its risk limits. Partial hedging is also an option when the hedge prices are in range and fundamentals are not clear-cut (i.e. the analysis falls somewhere close to center of the decision matrix). As noted above, the local rate for an exposed loan should not be determined by what the MFI is requesting. The risk committee should set a minimum local currency rate based on its assessment of the fundamentals. Only if that rate is at or below what the MFI will accept, should it proceed with the loan.

## Methodology

### Basics of the model

The model takes live-market (tradable) information from multiple sources (Reuters, TCX), applies it to the portfolio cash flows to calculate 4 main components:

- The portfolio/single loan at current spot prices
- The portfolio/single loan if fully hedged at market swap prices
- The portfolio/single loan assuming the average of polls of market forecasts
- The portfolio/single loan assuming stress test scenarios based on statistical movements from historical mean fx rates

For each of these components the model calculates:

- Total exposure
- Realized and unrealized P & L
- Net Present Value (NPV)
- Internal rate of return

The model applies correlation and historical volatility data to the NPV calculation in a standard Value at Risk (VAR) model for each currency and for the portfolio.

### Data Sources

- Interest Rate Curves
  - Liquid curves are sourced from Reuters on a weekly basis
  - Illiquid curves are sourced from TCX generally on a monthly basis but more often if available
- FX data
  - The daily fixing from Reuters

- Historical volatility and correlations from Reuters
- Analytics
  - Reuters
  - Standard Chartered
  - Citi
  - Deutschebank
  - EIU