Corporate FX Hedging Models

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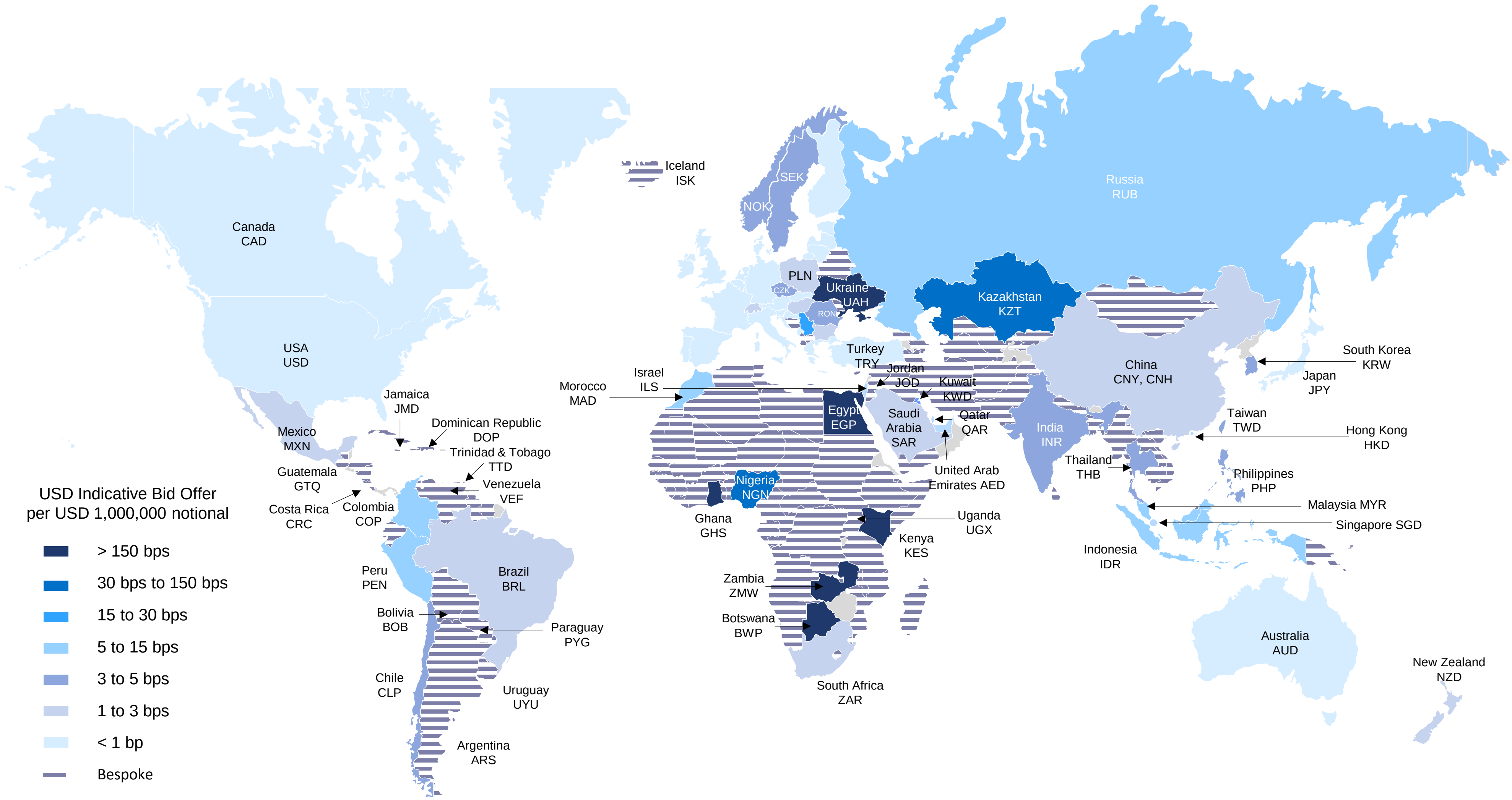
Goldman Sachs Corporate Coverage

Private Side coverage for the full capital cycle

Source: Goldman Sachs Investment Banking Division. For illustrative purposes only,

GS is a Worldwide FX Player

Currencies Traded by GS and Indicative Bid Offers



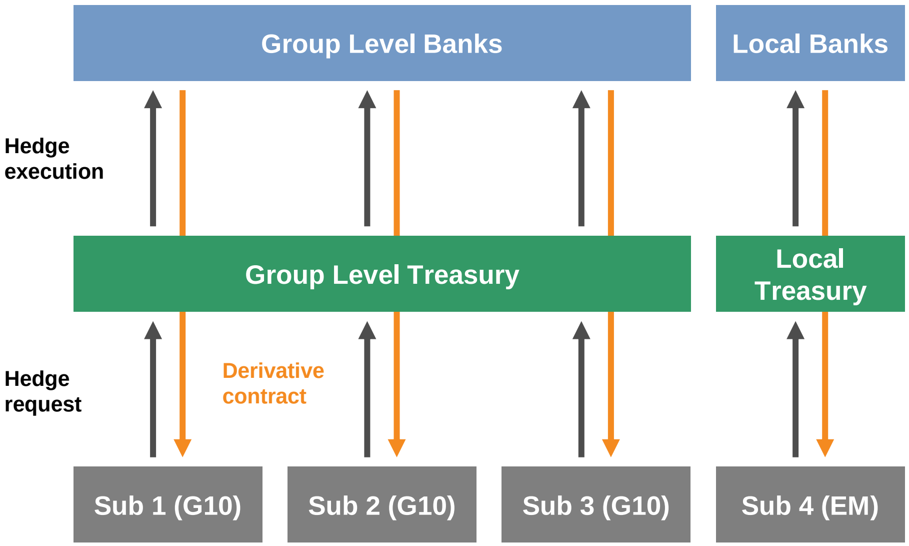
Goldman Sachs Investment Banking Division. Indicative bid/offer data only. Subject to prevailing market conditions.

II. Corporate FX Hedging Models – Micro Hedging

Corporate Hedging Model I

Entity specific Micro Hedging

Illustrative Hedging Structure



- Subsidiaries determine exposures and hedging needs based on individual hedging policies
- Subsidiaries submit hedging request to the centralized Group Treasury execution desk
- Hedges are closed in separate trades for each request with external banks
- Trading takes place “on behalf of” the respective subsidiary. I.e. the contract is closed between the winning bank and the subsidiary
- Depending on local regulation, EM based subsidiaries trade with local banks directly

Example Corporate

- German industrial
- >100bn Revenue, 90% of revenue abroad
- Centralized group treasury function with offices in Germany, US and Asia

Considerations

Economic:

- No benefit from netting and aggregation
- Managers focus only on business line specific exposures
- Banks face credit risk on subsidiary level
- CSA collateral would be segregated

Operational:

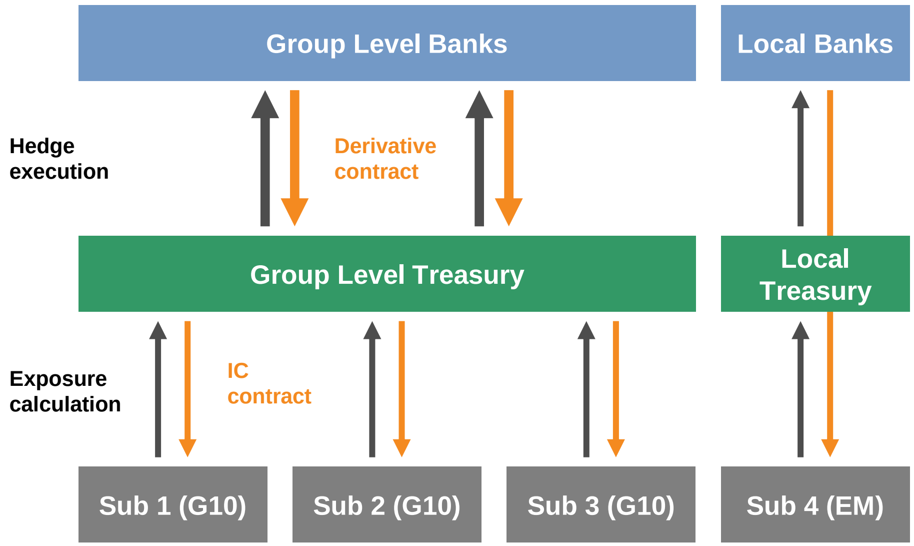
- Reduced / no IC derivatives, but large number of external transactions
- Increased documentation requirements due to separate bank relationships (separate ISDAs, group guarantees, etc)
- Clear segregation between entities

Source: GS Internal as of 30-Apr-2019. Illustrative and for discussion purposes only. Does not purport to contain a comprehensive analysis of strategies or risks herein.

Corporate Hedging Model II

Group Level Net Exposure Hedging

Illustrative Hedging Structure



- Subsidiaries submit exposures to the Group Treasury
- Group Treasury determines the group exposure and hedges in line with the Group Hedging Policy
- Hedges are closed on the aggregated and netted exposure with external banks
- The Group entity faces the external market directly
- Intercompany derivatives are closed with subsidiaries
- Depending on local regulation, EM based subsidiaries trade with local banks directly

Example Corporate

- Swiss industrial
- ~30bn Revenue, 90% of revenue abroad
- Centralized group treasury function with consistent group wide hedging policy. Execution desks in Switzerland, the US and in several EM countries

Considerations

Economic:

- Execution benefit from netting and aggregation
- Centralized information and exposure management
- CSA collateral can be effectively applied
- Banks face HQ credit risk and can pass on CVA portfolio effects

Operational:

- Use of intercompany contracts
- Reduced number of external transactions
- Centralized bank relationship management
- Operational complexity in for example carve-out scenarios

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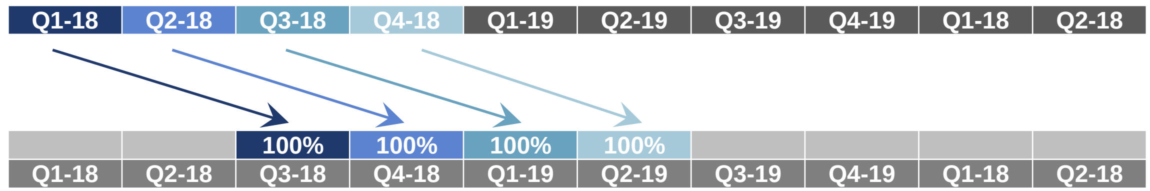
A. Micro Hedging Frameworks

Illustration of Different Hedging Frameworks

Corporates frequently utilize variants of the below strategies to hedge

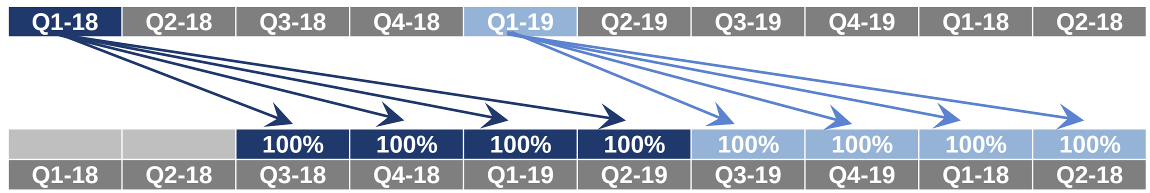
Fixed-term Hedging Strategy

- Establish hedges each quarter for a fixed term (e.g.,1 year) in advance



Concentrated Hedging Strategy

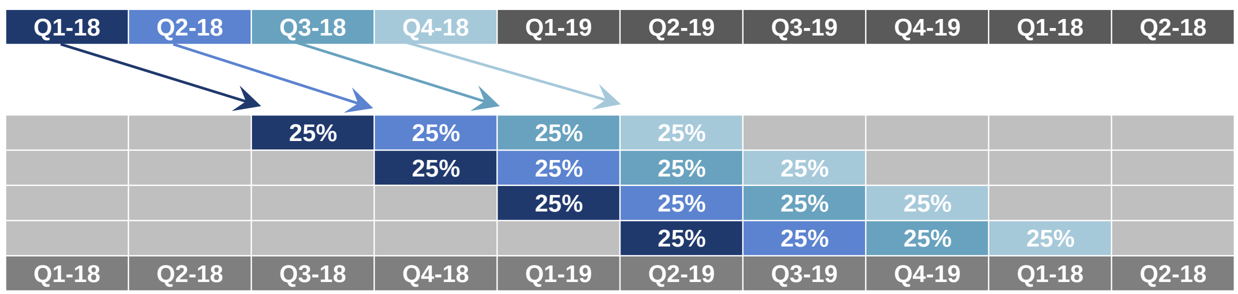
- Establish hedges for multiple periods at a single point in time.



Because the achieved average exchange rate at maturity consists of multiple contracts, the **Layered Hedging Strategy** outlined below will have **lower P&L volatility** than the above strategies or remaining unhedged.

Layered Hedging Strategy

- Implement a hedge gradually over multiple quarters to reduce the volatility of overall hedge rates.
- Given an uncertain holding period of 5 to 20 years, the layered hedging strategy is particularly preferable.



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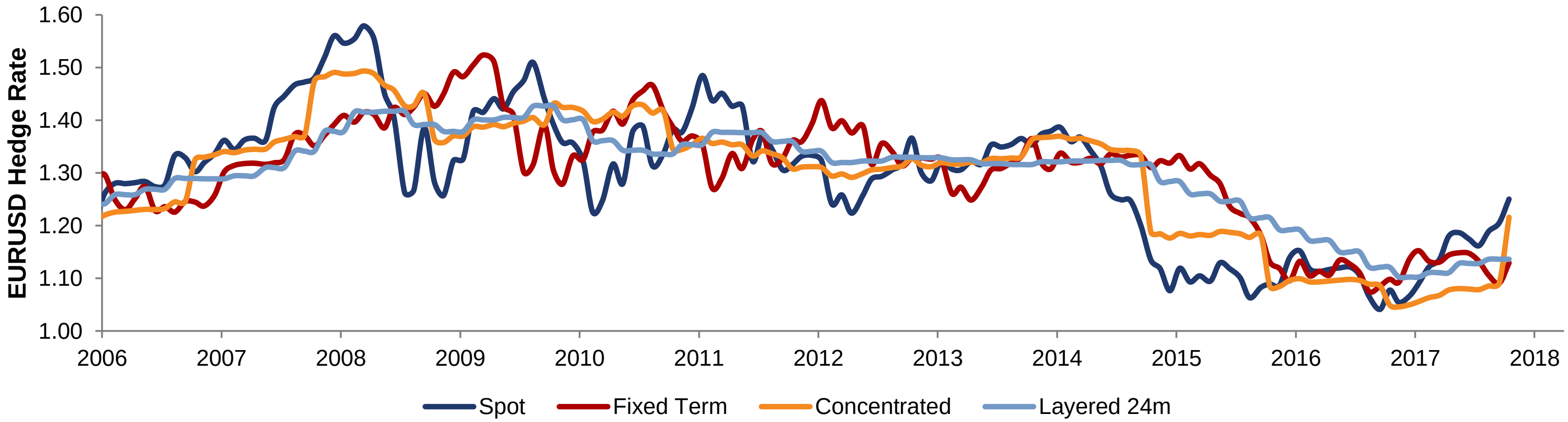
Volatility Impact: Historical Performance

The various hedge implementation strategies perform differently

- We provide a historical back-test of a few potential implementation strategies to highlight the benefits of a layered approach
  - When compared to being unhedged or a fixed or concentrated strategy, the layered implementation strategy will reduce period on period volatility the most effectively
- The longer term a layered approach uses, the more volatility reduction can be achieved.
- For illustration purposes, we use just forward contracts and focus on just the EUR to demonstrate the smoothing benefit a layering approach provides

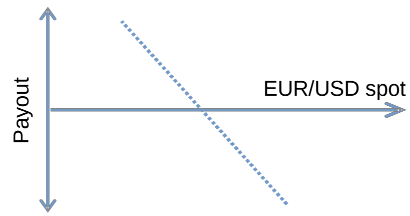
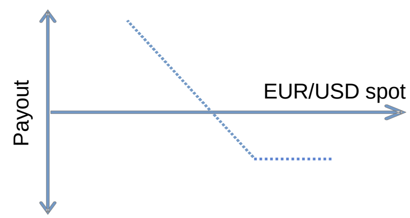
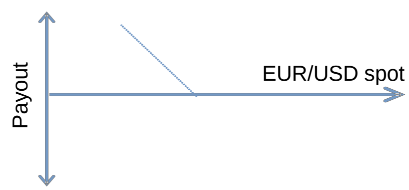
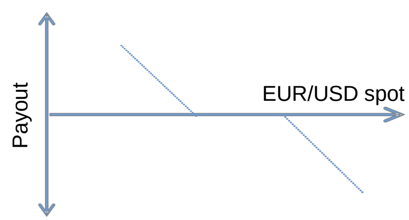


	Spot	Fixed Term	Concentrated	Layered 24m
Average Effective Rate	1.2102	1.2483	1.2574	1.2464
QoQ Return Volatility	5.13%	3.88%	4.17%	3.46%
YoY Return Volatility	10.17%	8.17%	8.68%	5.93%

Source: GS Internal as of February 2018. Past performance is not indicative of future results.
Fixed term hedging strategy assumes a 1 year tenor so that the 80% of the total forecasted exposure is hedged. Concentrated hedging strategy assumes hedging each month for a year every year so that 80% of the total forecasted exposure is hedged. Layered 24m hedging strategy assumes hedging 10% every quarter out 24 m every month so that 80% of the total forecasted exposure is hedged..

Hedging Strategy Product Overview

Instrument selection dependent on hedge objectives and market environment

Strategy	Payout at Maturity	Pros	Cons
FX Forward		■ Zero premium at inception ■ Obligation, whether positive or negative value ■ Preferred instrument for hedging when there is higher certainty around timing and sufficient liquidity at the fund in the event margin posting is required	■ Does not provide participation in favorable currency moves ■ Requires credit lines and potentially posting collateral ■ Potential liability if hedged asset value is not realized and hedge has a negative mark-to-market
Limited Loss Forward		■ Can be zero premium at inception ■ Negative mark-to-market on the hedge is limited by the purchase of an option capping maximum collateral required in the case of outsized moves	■ Does provide partial participation in large favorable currency moves ■ Strike of the forward is worse than that of the market forward in case of a zero premium structure
FX Option		■ Known worst-case loss on the hedge (i.e. premium paid) ■ Opportunity to participate from favourable currency moves	■ Requires premium spend ■ If the option expires in-the-money, you may end up having the same protection as an FX forward but paid premium for it
Zero Cost Collar		■ Allows some benefit from favourable moves in currencies, without premium to be paid ■ In some currency pairs, the strikes can provide skewed risk reward in favour of the hedger	■ Leaves the hedger exposed to risk until the currency weakens to the strike of the purchased option ■ Requires credit lines and potentially posting collateral

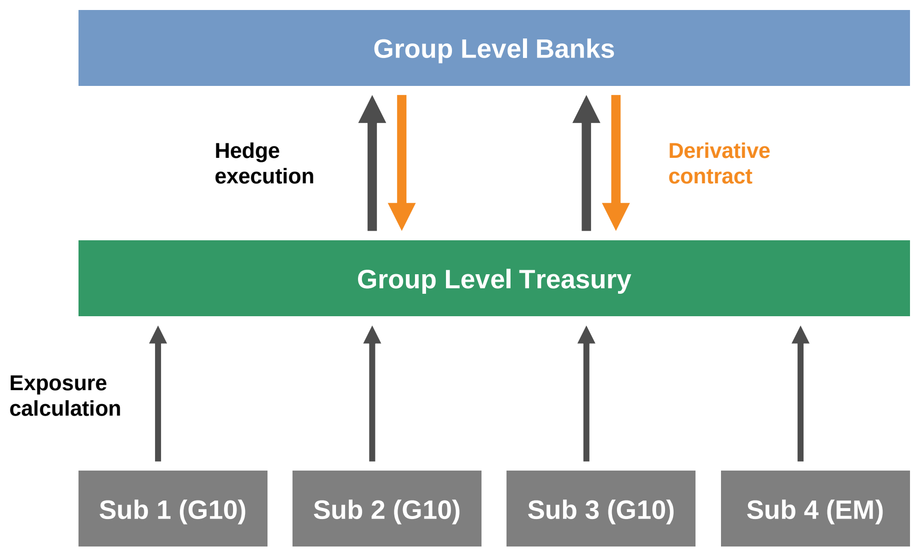
For illustrative purposes only; Past performance is not indicative of future results

III. Corporate FX Hedging Models – Macro Hedging

Corporate Hedging Model III

Macro Hedge Application

Illustrative Hedging Structure



- Subsidiaries submit exposures to the Group Treasury
- Group Treasury determines the group exposure and hedges in line with the Group Hedging Policy
- Hedge strategy depends on exposure type:
  - ICL balance sheet hedges are 100% covered via FX swaps
  - All other FX exposures are viewed as a basket exposure and hedged along an efficient frontier taking into account portfolio effects of the exposure
- The Group entity faces the external market directly
- EM based subsidiaries participate in the group hedging

Example Corporate

- German chemical
- ~60bn Revenue, 60% of revenue abroad
- Centralized treasury function and group risk management policy
- Separate execution desk for ICL balance sheet and strategic hedging

Considerations

Economic:

- Benefit from netting, aggregation and correlation
- Centralized information and exposure management
- CSA collateral can be effectively applied
- Banks face HQ credit risk and can pass on CVA portfolio effects

Operational:

- Intensive application of transfer pricing in local currency and local currency ICLs to lift exposures to group entity level
- Global ERM and TMS system to report exposures in real-time
- Reduced / no IC derivatives
- Accounting and product complexity

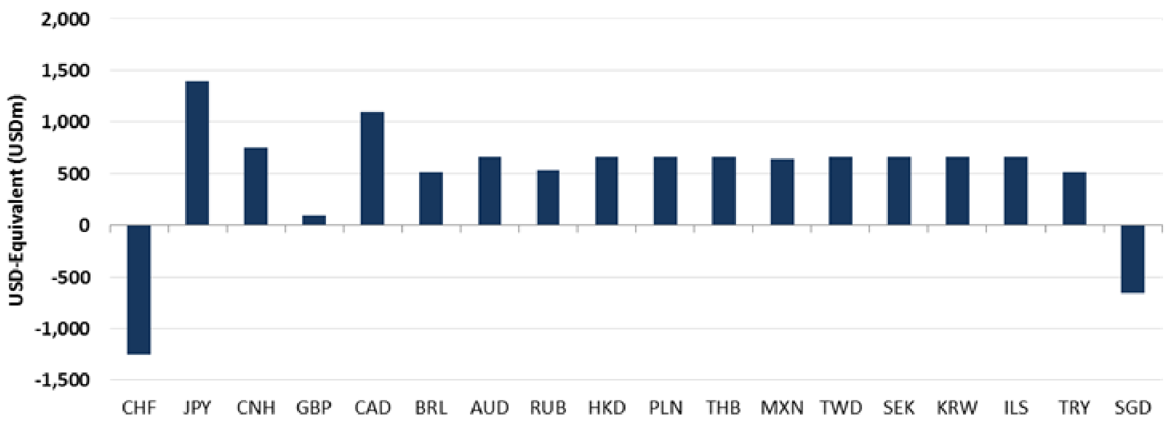
Source: GS Internal as of 30-Apr-2019. Illustrative and for discussion purposes only. Does not purport to contain a comprehensive analysis of strategies or risks herein.

A. Basket Hedging Framework

Basket Hedge Illustration

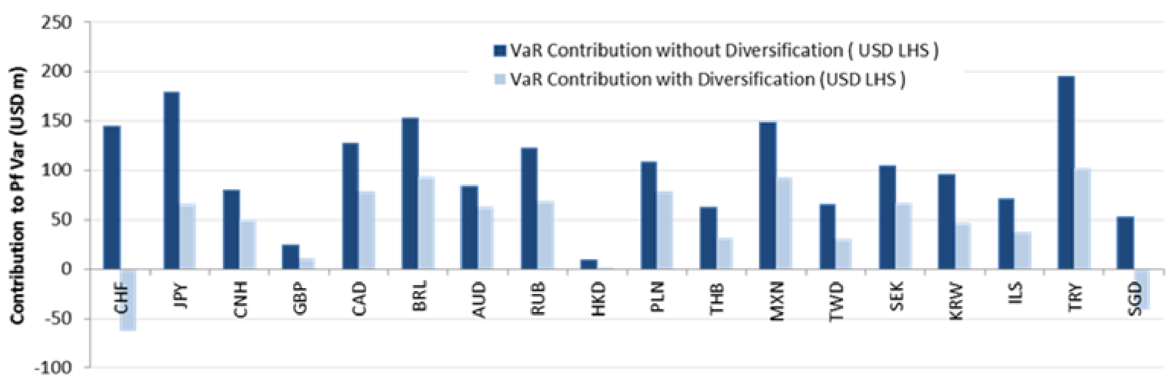
Adjusting with correlation already reduces the VaR substantially

Illustrative Exposure Profile



- Size of FX exposure in overall notional terms gives good guidance to overall risk, but ignores:
  - Volatility effects; e.g. managed/pegged currencies demonstrate significantly lower VaR
  - Correlation effects; multiple currencies and mix of long/short can cheapen hedging costs through valuable diversification benefits

Value-at-Risk contribution



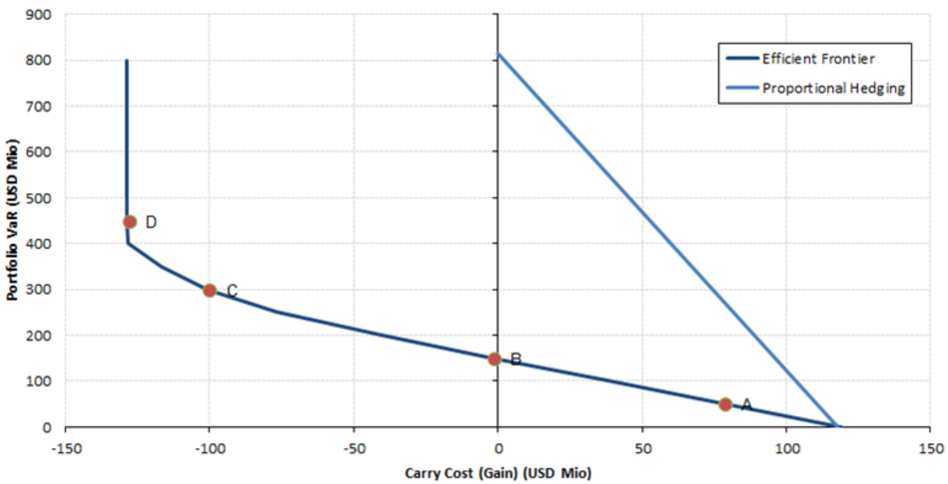
- Our analysis on the illustrative exposure above shows that, when considered on a standalone-basis, the exposures result in 1.8bn USD of FX 5% VaR over a 1-year tenor
- This reduces to 0.8bn USD of FX 5% VaR when taking correlation between crosses into account

Source: GS Internal. % exposures as estimated. Goldman Sachs provides no assurance that the projected analysis will hold true at any time in the future."Backtesting analysis/simulated results are for illustrative purposes only. GS provides no assurance or guarantee that the strategy will operate or would have operated in the past in a manner consistent with the above backtesting analysis. Backtested and/or past performance figures are not a reliable indicator of future results." Analysis does not include the impact of transaction or credit charges.

Basket Hedging Illustration

Hedge strategies can be solved for along an efficient frontier of carry cost and VaR

Basket based hedging application



	Hedge Strategy	A	B	C	D
	VaR (USDm)	50	150	300	450
	Carry (USDm)	78.7	-1.3	-100.8	-128.9
Hedge Ratios	CHF	87%	51%	0%	0%
	JPY	100%	100%	100%	100%
	CNH	85%	69%	89%	0%
	GBP	100%	100%	100%	100%
	CAD	100%	100%	100%	100%
	BRL	95%	86%	66%	0%
	AUD	99%	100%	100%	100%
	RUB	99%	99%	57%	0%
	HKD	100%	100%	100%	100%
	PLN	100%	100%	100%	100%
	THB	100%	100%	100%	100%
	MXN	90%	72%	0%	0%
	TWD	100%	100%	100%	100%
	SEK	100%	100%	100%	100%
	KRW	100%	100%	100%	100%
	ILS	100%	100%	100%	100%
	TRY	78%	33%	0%	0%
	SGD	44%	0%	0%	0%

- Hedge 1: FX Forward Hedge
  - — Strategy D implementation
  - — 100% FX Forward Hedge: JPY, GBP, CAD, AUD, HKG, PLN, THB, TWD, SEK, KRW, ILS
  - — This generates ~125m USD of carry benefit compared to spot, and leaves open 450m USD of 5% VaR in the remaining currency crosses

- Hedge 2: Basked Option Hedge
  - — Protect the remainder of the FX exposure via a Basket-Put/USD-Call option, with the strike at the Index ATM-Spot level

Source: GS Internal. % exposures as estimated. Goldman Sachs provides no assurance that the projected analysis will hold true at any time in the future."Backtesting analysis/simulated results are for illustrative purposes only. GS provides no assurance or guarantee that the strategy will operate or would have operated in the past in a manner consistent with the above backtesting analysis. Backtested and/or past performance figures are not a reliable indicator of future results." Analysis does not include the impact of transaction or credit charges.

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