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SVB FX Risk Advisory for PE/VC Investors

With cross-border investments, realize that currencies will mean revert

March 2021

Key takeaways

It's important to consider where a currency trades relative to its historical mean when allocating capital overseas.

Our machine learning model trained on 30 years of data demonstrates that a currency hedging strategy based on SVB's proprietary signals could add significant internal rate of return (IRR) to overseas investments.

The gravitational pull of mean reversion may take years to take hold, so this strategy is appropriate for private equity and growth investors with long-dated investment horizons.

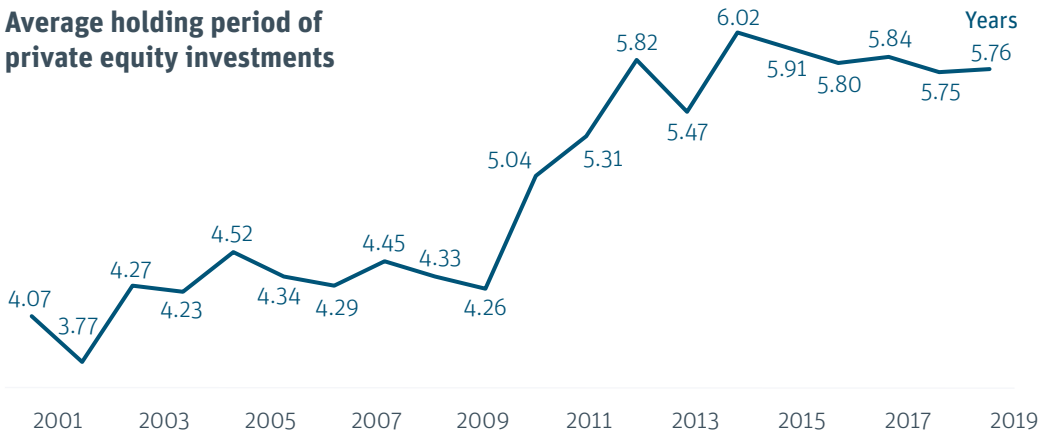
The focus of this paper is to introduce an objective framework to arrive at a hedging decision — when to hedge and how much to hedge — to maximize the economic value of the hedges on the basis of risk versus reward.

Currency: A major risk for private equity and venture investors, can be material and often overlooked

Private equity and venture investors tend to have long time horizons. Investments exited in 2019 had an average holding period of almost six years, on average, according to Pitchbook.

Those long investment durations heighten currency risk for PE and VC investors who inherit foreign exchange (FX) risk as a by-product of allocating capital abroad. Cross-border investments typically are denominated in a foreign currency[1], introducing the risk that depreciation in the destination currency between the entry and exit date could undermine the investment's IRR.

Average holding period of private equity investments



Source: Pitchbook, August 1, 2019

[1] Applies when both the acquisition and the exit price are denominated in a foreign currency.

Many fund investors assume, incorrectly, that currency risk is a short-term phenomenon, and that fluctuations in exchange rates tend to wash out 'over the long run'[2]. The policy action that typically follows is to remain agnostic about FX and the risk is left unmanaged and unhedged. However, inaction is an action of itself, resulting in an open position in the foreign currency. Even worse, inaction represents somewhat of an agency problem.

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Absent of a well-defined view or expected return on the currency from the fund manager, responsible for making investment decisions on behalf of the investor, the reward side of the equation is absent. The end investor in the fund is then exposed to risk, exchange rate risk, and not being compensated for it.

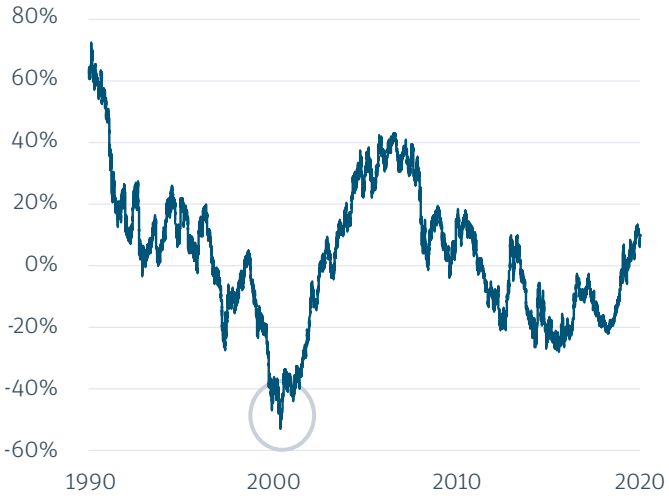
Incurring risk for no expected return is indeed counter to one of the basic principals in finance[3].

Furthermore, currencies tend to move in multi-year cycles of over- or under-valuation relative to each other. PE and VC investors face the distinct possibility that they could invest near the destination currency's high point and exit at a low point, reducing their investment's IRR. The gaps between those high and low points can be large: For example, some five-year euro-denominated investments made between 1990 and 2019 could have incurred FX-related losses as high as 50% (see chart below). Currency hedging can mitigate this risk.

Reversion to the mean

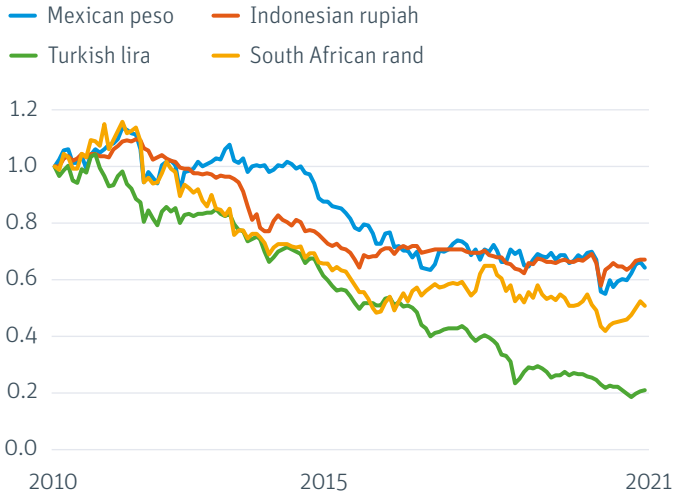
Most exchange rates exhibit a tendency to revert to a mean level over long periods. This typically holds for currencies issued by economies that keep inflation and capital flight in check. Mean-reversion does not hold, for instance, for exchange rates involving some Emerging Market (EM) currencies versus the USD. Over time, stubbornly high inflation has eroded the purchasing power and thus the value of such currencies as the lira, the peso, the rand and the rupiah, discarding the possibility of any reversion to the mean.

Change in value of the euro versus the dollar over rolling 5-year periods



Source: Bloomberg

Value erosion of 1 unit of currency versus the USD



Source: Bloomberg

[2] For more on this topic please see: https://www.svb.com/blogs/ivan-asensio/how-currency-movements-can-affect-your-global-business-for-pe-vc-investors
[3] Risk and reward go together, see Markowitz, H.M. (March 1952). "Portfolio Selection". The Journal of Finance. 7(1): 77–91.

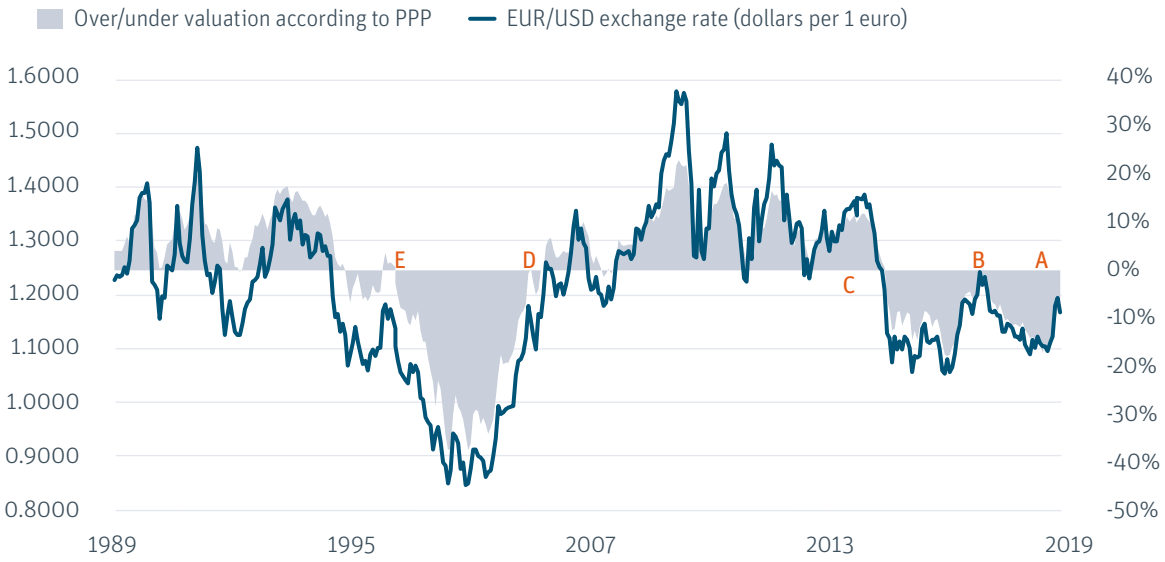
Our model will instead focus on major currencies that do mean-revert. Establishing a long-term mean exchange rate, however, isn't as simple as averaging historical market rates. The metric can be improved by accounting for differences in economic fundamentals between the two economies. One such approach involves a concept known as Purchasing Power Parity (PPP).

The idea of PPP is that over time, exchange rates move in a way such that the price of a basket of goods and services should be the same in one country vs any another, implying the exchange rate between countries should only move insofar as inflation differences evolve through time[4]. All else being equal, for instance, a currency in an economy with lower inflation will appreciate relative to a currency in an economy with higher inflation. Inflation, by definition, is a loss of a currency's purchasing power.

Over the period 1990-2020, the exchange rate between the euro (EUR) and the US dollar (USD) fluctuated around the PPP value, a measure of long-run mean. We can see from the chart that it has been close to three years since the EUR traded at its long-run mean (the time period is highlighted in the chart by points A and B), six years since it traded above its long-run mean (highlighted by points A to C), and that periods of over or under-valuation have been as long as 7 years (highlighted by points D to E). Furthermore, the euro ended 2020 roughly 6% undervalued relative to the dollar, helping account for the fact that inflation has been running higher in the US than in the EU in recent years.

This type of structured approach to analyzing longer-term movements in currencies enables global fund managers and investors to make informed decisions about hedging the risk inherited though the allocation of capital abroad. Based on both the current level of the undervaluation and the time spent below this level, the euro is poised to appreciate against the dollar in the coming years. However, there are no guarantees about timing and the path higher will undoubtedly carry two-way risk.

Purchasing power exchange rate



Source of data & PPP calculation: Bloomberg

[4] The term was coined about 100 years ago (Cassel 1918), but the concept may be traced back to the fifteenth century (Officer, 1982). The Economist magazine's Big Mac Index is one well-known PPP metric. There are many others approaches (Dornbusch, 1980; Obstfeld and Rogoff; 1996, Sarno, 2001).

Predicting exchange rates: Folly in the short term, fruitful in the long term

Some investors may be skeptical about using currency forecasts to inform hedging practices, possibly because they are familiar with the notorious inaccuracy of short-term FX predictions. The table below shows three things about consensus forecasts made by contributors to Bloomberg for projections 1, 2, 3 and 4 quarters ahead made between 2010 and 2020[5]:

1. How often consensus was right about the direction of short-term currency moves
2. The average miss — the difference between consensus forecasts and the actual move
3. The short-term focus of the forecasting exercise by experts (most go out just 4 quarters and few go as far as 8 quarters).

		+Q1	+Q2	+Q3	+Q4
(A) Average miss	EUR	4.52%	5.82%	6.64%	7.26%
	GBP	4.06%	5.52%	6.20%	6.62%
	AUD	4.57%	5.82%	6.91%	8.13%
	CNY	1.58%	2.11%	2.65%	3.27%
	MXN	4.84%	5.60%	7.03%	8.05%
(B) Directional accuracy	EUR	37.5%	46.2%	39.5%	45.9%
	GBP	32.5%	28.2%	36.8%	43.2%
	AUD	47.5%	43.6%	55.3%	59.5%
	CNY	67.5%	64.1%	65.8%	62.2%
	MXN	45.0%	48.7%	57.9%	45.9%

Source: Bloomberg

The data suggests forecasters were not consistently or materially better than a coin flip — and magnitude of misses was wide.

Long-term FX moves are more predictable, due to the well-established tendency for exchange rates to revert to a long-term mean. However, very little is published by professional forecasters on projecting currencies beyond 1 or 2 years. This is an important gap addressed by this paper.

From PPP to currency hedging decision

PPP alone, however, does not ensure alpha will be generated by executing speculative trades based on a currency's position relative to its mean. Nor are there any guarantees that if PPP is used to determine whether or not to hedge currency risk, that the hedges will be additive to IRR, versus being a drag to investment performance. While it is true that exchange rates 'eventually' gravitate to the mean, the magnitude of the divergence from the mean and the actual timing of the reversion are not always known.

Hence, in order to use PPP to make hedging decisions, the signal must be refined.

We deploy a machine learning model trained on 30 years of data to arrive at a decision of whether to hedge and, if so, how much to hedge. We learn from the past about what works, over 25-year training sample, and repeat to validate that it indeed works over a 5-year validation sample. Machine computation helps us avoid a common pitfall of econometric forecasting — overfitting — which is analogous to a pastry chef over-beating the egg whites. An overfitted model works great in the past, but then loses value when used prospectively, just as over-beaten egg whites will singlehandedly ruin a dessert.

> The end goal is to base hedging decisions on a better than 50-50 chance of accurately forecasting the direction of the foreign currency over a longer-term future period.

Historical simulation and validation

Our analysis is based on the following situation. Suppose a US-based private-equity fund allocates capital into Europe. For purposes of the simulation, we assume two investments are made per year, in January and June, each with an expected holding period of 4-6 years. The investments are denominated is euros (EUR). The fund's investors, however, are concerned about returns measured in US dollars (USD) and thus 'inherit' currency risk through the deployment of capital overseas.

[5] Banks, think-tanks, and academics regularly publish forecasts of where currencies will be in the future. Bloomberg acts as a central repository for this forecast data, and actively monitors and reports contributor forecast accuracy. The consensus forecast is the median of all Bloomberg contributors.

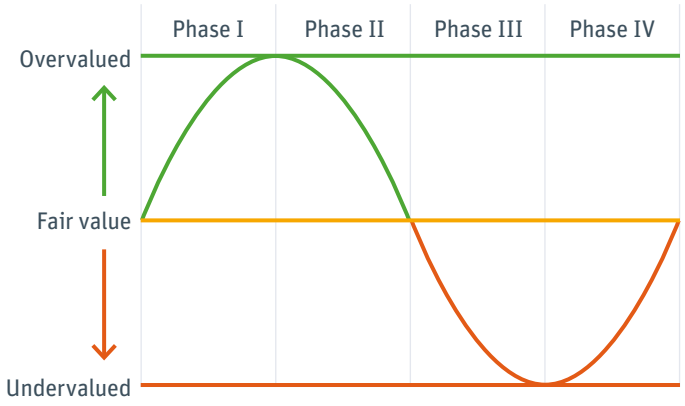
The fund manager's expertise is private-equity investing, not currencies. Inaction on the currency risk, however, would be considered irrational as it would imply the fund, and by extension its investors, are taking on risk they are not being compensated for.

Simultaneous with the allocation of capital, a currency hedging decision is made which applies to the entire tenor of the investment. Our model establishes an objective framework which determines whether the currency will be hedged, and if so, how much of it will be hedged, based on its position along the mean-reversion spectrum illustrated on the right.

- Phase I: Overvalued and appreciating
- Phase II: Overvalued and depreciating
- Phase III: Undervalued and depreciating
- Phase IV: Undervalued and appreciating

If the foreign currency is projected to fall by our mean-reversion model (representing a drag to total return), the recommended action would be to hedge 100% of the exposure with a forward. If, however, the foreign currency is projected to rise, hedge less than 100% with an aim to maximize risk-adjusted return. If the signal from the model is inconclusive, no hedge is placed.

The in-sample results assuming 4, 5, and 6-year investment holding periods are highlighted in the table below. For each period, we show a side-by-side comparison of the impact of



FX on total return under both scenarios, unhedged versus hedged according to the model recommendations.

Without exception, model-based hedging adds significant return to a cross-border investment: the average annual returns from FX for the hedged case are 8.7%, 12.2%, and 13.2% for 4, 5, and 6 year holding periods respectively, much improved from the unhedged returns, which all show losses from FX. The distribution of returns show that the model did a very good job at avoiding large losses, whilst preserving organic gains from FX during periods of foreign currency strength. This dynamic is confirmed by the consistent improvements made to the risk-adjusted return metrics: Sharpe, Sortino, and Capture ratios.

In-sample performance	4yr No Hedge	4yr Model	5yr No Hedge	5yr Model	6yr No Hedge	6yr Model
Annual return from FX						
Average	-1.6%	8.7%	-1.9%	12.2%	-2.7%	13.2%
Distribution of returns						
Min	-41.9%	-26.3%	-46.5%	-18.5%	-47.2%	-23.0%
1st Quartile	-13.3%	0.3%	-16.5%	3.7%	-18.2%	5.6%
Median	-4.1%	9.1%	-2.8%	11.5%	-6.7%	10.9%
3rd Quartile	9.0%	16.6%	9.7%	20.0%	10.8%	22.7%
Max	42.0%	38.5%	42.7%	39.8%	59.4%	41.0%
Std deviation of currency returns						
All returns	17.7%	11.5%	20.3%	11.4%	22.2%	12.2%
Only negative returns	9.3%	5.1%	10.9%	4.6%	11.1%	6.5%
Risk-adjusted return metrics						
Sharpe	-0.1	0.9	-0.1	1.2	-0.1	1.3
Sortino	-0.2	2.0	-0.2	3.1	-0.2	2.5
Capture	1.0	1.9	1.0	2.4	1.0	1.8

Data: Bloomberg
Analysis: SVB FX Risk Advisory, Global Fund Banking

As of Q1 2021, we report the signals and corresponding hedging recommendation for key currencies traded by global private equity and venture funds with Silicon Valley Bank.

Currency (versus USD)	Over or undervalued	Spot	PPP mean	Distance away from mean (in percentage)	Time away from mean (in months)	Recommended	
						Hedge ratio	Hedge product
EUR	Undervalued	1.2200	1.2900	-5.6%	73	25%	Forward
GBP	Undervalued	1.3700	1.4800	-7.7%	62	25%	Forward
CAD	Undervalued	1.2700	1.1700	-8.2%	72	25%	Forward
AUD	Overvalued	0.7700	0.7300	5.3%	1	100%	Forward
CHF	Overvalued	0.8900	0.9600	7.6%	10	100%	Forward

Conclusion

Domestic long-term investors face substantial currency risk when they invest outside the United States. Exchange rates tend to diverge considerably from the mean and then revert to it over multi-year periods. As a result, a long-tenor investment made in a significantly overvalued currency has a high probability of losing part of its IRR — possibly a meaningful part — as the currency reverts to and possibly beyond the long-term mean.

Our study demonstrates that hedging based on PPP-based signals can empower these investors to insulate their investments from long-term currency risk. The upshot: Thoughtful, PPP-based hedging can help them ensure that their results reflect their skill as investors and are not diminished by the vagaries of the currency markets.

About Silicon Valley Bank's Global Fund Banking FX Team

SVB's Global Fund Banking FX team focuses exclusively on fund banking and has FX professionals on the east and west coasts to support your international investments. We welcome you to use this resource, as you assess the value proposition of international investments and the associated currency risks. We are here to help at any stage of the process, from the pre-close analysis and due diligence stage all the way through closing and beyond.

Contact us

If you'd like to discuss your specific situation to determine if incorporating our hedging signals into your decisioning is right for your fund, contact the authors directly: Ivan Oscar Asensio, Head of FX Risk Advisory, at iasensio@svb.com and David Song, FX Advisor, at dsong@svb.com.

Technical appendix

The model

For in-sample or training dataset $\{(x_1, y_1), \ldots, (x_i, y_i), \ldots, (x_N, y_N)\} \subseteq (X \times Y)^N$, where x_i and y_i denote the input and target data respectively, the support vector regression (SVR) seeks to minimize the upper bound of the generalization error (instead of the empirical error as in standard regression) and is defined as follows:

$$f(x) = \omega^T \varphi(x) + b$$

where $\varphi(x)$ is the feature, φ is a non-linear mapping from the input space to the future space. The coefficients ω and b are estimated by minimzing.

$$\frac{1}{N}\sum_{i=1}^{N}[(y_i - f(x_i)]^2 + \lambda \sum_{j=1}^{M} \omega_j^2$$

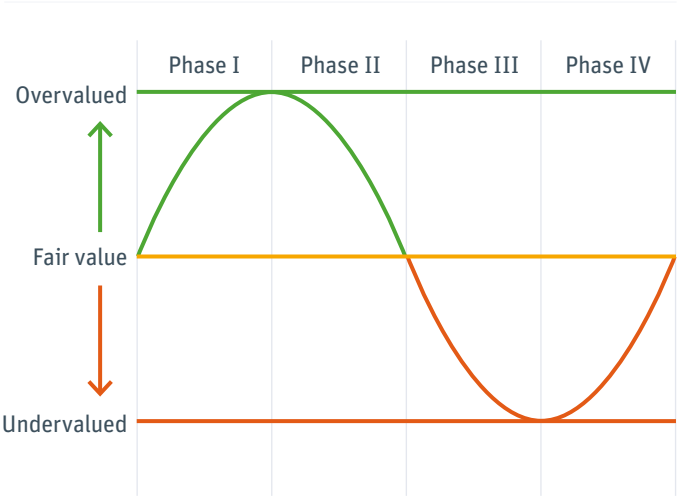
where λ is prescribed to train the model to find the appropriate 'fit', y_i are the actual values, and $f(x_i)$ are the forecasted values (which do not depend on λ).

For each feature j, the term $\lambda\omega_j^2$ is added to the mean sqaured error, thus encouraging the model to keep the weights ω_j as small as possible. At the extremes, a very large value λ for results in an uninteresting model as it would force ω_j all to zero and always predict b. On the other hand, the choice of zero for λ means the output of the model would be the same as that of OLS.

The features (model predictors)

The model uses 5 **features** which attempt to capture the behavior of PPP for prediction of nominal exchange rates over the medium term (4, 5, and 6 years).

1. 4-month moving average PPP
2. Monthly change in PPP
3. Rolling 6-month change in spot
4. Rolling 12-month change in spot
5. Consecutive months PPP is above or below fair value



Phase I: Early-stage overvaluation
Initial phase when exchange rate establishes trend away from fair value and is overvalued according to PPP.

Phase II: Late-stage overvaluation
Exchange rate reaches resistance level while still over-valued, but begins mean reversion process.

Phase III: Early-stage undervaluation
Reversion to the mean overshoots and now exchange rate trends in undervalued territory.

Phase IV: Late-stage undervaluation
Exchange rate reaches support level while still undervalued, but begins reversion back to the mean or fair value.

Regression results for both in-sample and out-of-sample data sets

Backtesting period: 1990-2020

- N=312 months (i.e. each month, an investment is made lasting 5-years)
- In-sample (training set): 1990-2015
- Out-of-sample (validation set): 2015-2020

λ	mse training set	mse validation set	Coefficients for each feature 1	2	3	4	5
0.00	0.2904	0.5502	-0.841	-0.122	0.003	0.161	-0.133
0.01	0.2905	0.5346	-0.831	-0.119	0.005	0.154	-0.134
0.02	0.2908	0.5196	-0.821	-0.116	0.006	0.148	-0.134
0.03	0.2912	0.5052	-0.811	-0.113	0.007	0.143	-0.134
0.04	0.2918	0.4915	-0.802	-0.110	0.008	0.137	-0.134
0.05	0.2926	0.4783	-0.793	-0.107	0.009	0.132	-0.135
0.08	0.2955	0.4419	-0.767	-0.099	0.012	0.118	-0.135
0.10	0.2979	0.4200	-0.751	-0.094	0.013	0.110	-0.135
0.13	0.3022	0.3900	-0.728	-0.088	0.014	0.099	-0.135
0.14	0.3038	0.3807	-0.721	-0.085	0.014	0.095	-0.135
0.15	0.3054	0.3718	-0.714	-0.084	0.015	0.092	-0.135
0.20	0.3141	0.3314	-0.681	-0.075	0.016	0.078	-0.134
0.21	0.3160	0.3241	-0.675	-0.073	0.016	0.075	-0.134
0.22	0.3179	0.3170	-0.668	-0.071	0.016	0.073	-0.134
0.23	0.3198	0.3102	-0.662	-0.070	0.016	0.070	-0.133
0.24	0.3218	0.3036	-0.657	-0.068	0.016	0.068	-0.133
0.25	0.3238	0.2972	-0.651	-0.067	0.016	0.066	-0.133

Source: SVB Risk Advisory 2021

Predicted versus actual exchange rate changes

Scatterplot of in-sample model predictions and ex post exchange rate changes reveals that both the size and the magnitude of the prediction matters.

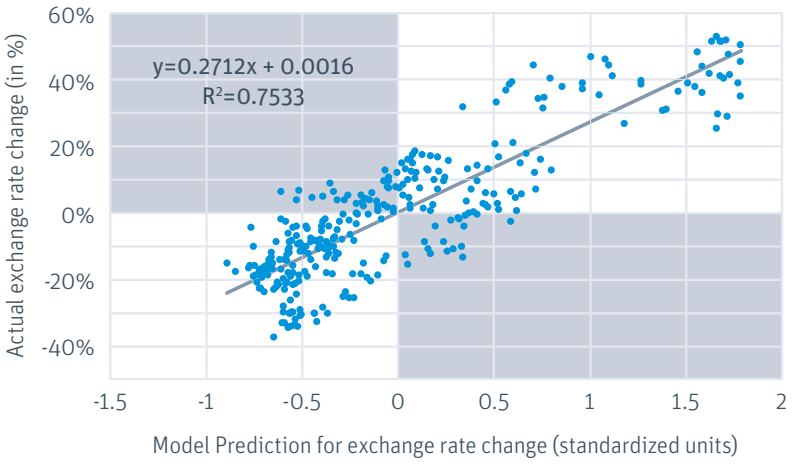
Quadrants I and III contain cases where the model called the 'direction' of the exchange rate change correctly.

Model seems to do well in predicting the largest magnitude changes (both positive and negative).

Currently hedging decision

If prediction is for the foreign currency to fall and therby result in a drag on total return, hedge 100% of the exposure with a forward. If, however, the foreign currency is being projected to rise, hedge less than 100% aiming to maximize risk-adjusted return.

Prediction versus actual (5-year exchange rate change)



Source: SVB Risk Advisory 2021