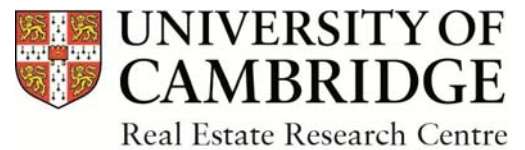


# Department of Land Economy

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**Title:** Currency Risk Management for Investors in Asia Pacific Non-Listed Real Estate Funds

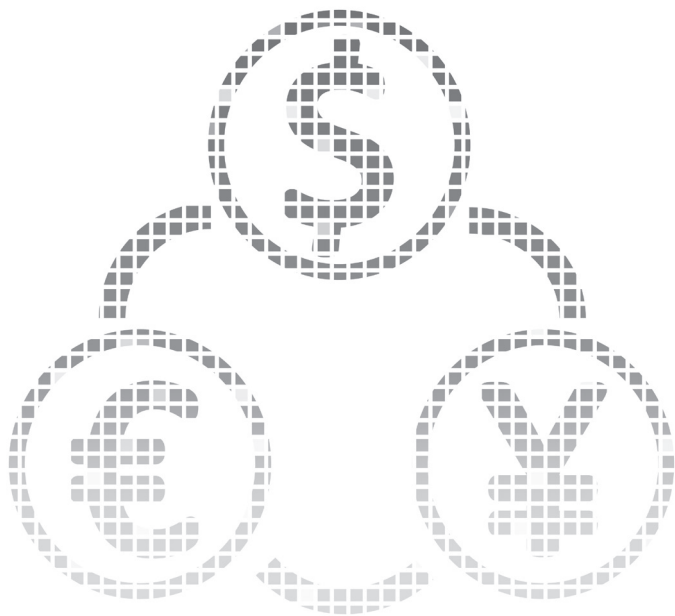
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# CURRENCY RISK MANAGEMENT FOR INVESTORS IN ASIA PACIFIC NON-LISTED REAL ESTATE FUNDS



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ANREV is the Asian Association for Investors in Non-listed Real Estate Vehicles Limited. ANREV is a not-for-profit organisation driven by institutional investors in Asian non-listed property funds. Our aim is to serve as a platform for investors who guide the association's strategy. ANREV's agenda is driven by its members, in particular institutional investors, and is focused on improving transparency and accessibility through market information, professionalism and best practice. Fund managers, investment banks and advisors provide support in addressing key issues facing the Asian non-listed real estate fund markets.

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## EXECUTIVE SUMMARY

Currency movements potentially have a major impact on the domestic currency cashflows from international real estate investments and understanding and managing currency risk is therefore an important part of the investment process. This research explores how investors in Asia Pacific non-listed real estate vehicles approach these issues and uses a simulation analysis to explore the impact of different hedging strategies.

The real estate literature highlights how currency volatility can potentially offset the diversification benefits from international real estate portfolios. The literature highlights that it is appropriate for large multi-asset investors to manage currency at an aggregate level. It also suggests that different hedging strategies might be appropriate for different investors and that 100% hedging may not be appropriate for some investors in some markets.

The survey of Asia Pacific non-listed real estate vehicle investor undertaken as part of this research provides an indication of current practice in managing currency risk arising from international real estate investment. It highlights:

- Most allocate their assets globally and most aim to manage currency risk through hedging.

- The most popular currencies hedged are US dollar (USD) and Japanese Yen (JPY), followed by the British pound (GBP) and Australian dollar (AUD).
- Investors prefer passive hedging rather than managers taking any views about currency in their hedging decisions.
- Investors prefer to hedge at the portfolio level and tend to hedge 100% of their exposures (or a substantial proportion when less than 100% but with some variation by country).
- Hedging is typically done on a rolling three-month basis or something similar but with some variation in frequency and approach.
- Investors typically use a combination of instruments including forwards, swaps and options.
- There is little evidence that the expected holding period affects the investor's choice of hedging instrument or that investors believe that hedging real estate currency risk is different from other asset classes.
- There does appear to be a clear desire to manage and reduce currency risk arising from international real estate investment.

These findings reflect the respondents tended to be larger multi-asset investors (pension funds, insurance companies and sovereign wealth funds).

The research includes a simulation analysis to explore whether hedging improves risk adjusted returns and whether 100% hedging ratios are optimal. This finds that under different scenarios for different investors and across a range of holding periods that hedging improves risk adjusted returns but that the optimal hedging ratio is sometimes below 100%.

### About the survey:

The research has been commissioned to Cambridge University for the Erwin Stouthamer Research Grant and has been written by Professor Nick Mansley and Zilong Wang.

The research represents the joint efforts of the research team from the University of Cambridge, ANREV (who managed the survey) and Chatham Financial (who conducted the simulation analysis).

# 1. INTRODUCTION

Modern portfolio theory (MPT) suggests that the primary reason for international real estate investment should be to enhance mean-variance portfolio efficiency. That is, by including international real estate investment into the portfolio, the investor can achieve a better return performance given the same amount of risk. Non-listed real estate funds provide investors a wide range opportunities to invest in international real estate markets.

Many institutional investors are trying to diversify their real estate portfolio by including international real estate investment. Given that the cash flows from international investment have to be converted back to the domestic currency, the volatility of exchange rate induces a level of risk that could offset the potential diversification benefit. Currency hedging and understanding the risks from currency movement is therefore an essential element in managing the risk of international real estate investments.

This research examines the impact of currency risk management on the performance of non-listed real estate funds. It aims to address the following two research questions:

1. What are the current practices used by the institutional investors in managing currency risk in their international real estate investments?
2. How effective are the current practices of currency hedging strategies? In particular, how effective is currency hedging in different market conditions (periods of the real estate cycle) and for different investment holding periods?

The first question is addressed via a survey of institutional investors in real estate. Based on the survey, we extract the most popular approach to manage currency risk and use this to formulate scenarios for Monte Carlo simulation. A forward-looking Monte Carlo simulation is used to address the second research question.

The research represents the joint efforts of the research team from the University of Cambridge, ANREV (who managed the survey) and Chatham Financial (who conducted the simulation analysis).

## 2. LITERATURE REVIEW

This section explores the real estate literature on currency risk management and industry practice with respect to currency risk management. This literature highlights how currency volatility can potentially offset the diversification benefits from international real estate portfolios. The literature also highlights that it is appropriate for large multi-asset investors to manage currency at an aggregate level. It suggests that different hedging strategies might be appropriate for different investors and that 100% hedging may not be appropriate for some investors in some markets. The literature notes that whilst returns might be lowered by currency hedging the reduction in risk means that currency hedging generally improves risk-adjusted returns (lowering the amount of risk per unit of return).

Over the last three decades there have only been a few studies on the effects of currency hedging on international real estate investment. An important motivation for including international real estate investment into a portfolio is diversification, but empirical findings based on the 1970s and 1980s indicated that US real estate offers foreign investors no benefits in terms of diversification, return and risk profile (Ziobrowski and Boyd 1991; Ziobrowski and Curio 1991; and Ziobrowski and Ziobrowski 1993, 1995).

Ziobrowski and Boyd (1992) examined financing a foreign asset with a combination of equity and foreign currency-denominated debt to reduce currency exposure. This found that the foreign leverage virtually eliminated exchange rate risk. However, the advantage of lower exchange rate risk was more than offset by the higher financial risk associated with the debt. Ziobrowski and Ziobrowski (1993) studied the usefulness of option hedging in the portfolio context. The empirical evidence suggested that the foreign currency-denominated returns from US real estate are far too risky to provide foreigners with any diversification gains. Ziobrowski and Ziobrowski (1995) follow a similar approach as Ziobrowski and Ziobrowski (1993), but test the benefit of using forward hedging. It was found that forward contracts are useful to restrict losses in the short term, but forward contracts are not effective in improving return and risk profile in the long run. Ziobrowski, Ziobrowski and Rosenberg (1997) adopt a similar approach by using a currency swap to hedge foreign exchange risk. Again, the results show no diversification gains for foreign investors.

The above studies do not consider roll-over costs and assume that the financial contracts close out at the end of each year without incurring settlement or transaction costs. Worzala (1995) examines the use of forward contracts for a US investor purchasing UK real estate. She shows that forward contracts appear to improve the risk-adjusted return (measured by the coefficient of variation) for the US investor. However, when the transaction and roll-over costs of the three-month forward contracts are included, the volatility increases sharply.

Worzala et al. (1997) argue that the results based on portfolio-based indices may be misleading. Most investors would be exposed to tracking error and specific risk, given the heterogeneity of private real estate performance and the typically small number of foreign properties held. Worzala et al. (1997) examine the use of simulation to model the impact of hedging an international (a UK office building) with currency swaps for a US investor. The results indicate that hedging using currency swaps can improve risk-adjusted return. Johnson et al. (2006) build on an approach adopted by Worzala et al. (1997), in addition to allowing exchange rates to vary across time, this study also allows the rental growth rate and the capitalization rate to vary. The results indicate that hedging the initial investment improves the risk-adjusted return.

Kateley (2002) states that currency risk is real but that large institutional investors will have other international investment allocations and should invest in a currency overlay management system to manage the entire exchange rate exposure for the portfolio. Hoesli et al. (2004) point out that not necessary all nationalities need to hedge their currency risk. The US and UK investors have better performance from unhedged mixed-asset portfolios while investors in some of the smaller countries gain additional benefits by taking on a forward contract hedging strategy. Furthermore, Whitaker (2001) suggests that hedging is only an appropriate strategy for real estate investments in developed markets, given the lack of (or expensive transaction costs of) hedges available for investments in emerging markets.

Beyond the above empirical studies, two survey based studies have been conducted. Newell and Macintosh (2007) conduct a survey based study to understand the hedging strategies of Australian listed property trusts (LPT). The results show that LPTs employ a wide range of hedging strategies, this includes natural hedging strategies, use of currency forwards to hedging the income component and use of cross currency swaps to hedge the capital components.

Newell and Lee (2017) examined the significance of currency risk and its management for investors in European non-listed real estate funds. A survey of INREV investor members found a mixture of currency risk management strategies. These included hedging against a range of currencies and at different levels, such real estate portfolio level (28%<sup>1</sup>), asset by asset (28%), multi-asset portfolio (24%). Three-month continual currency hedging strategy is the preferred strategy and the preferred hedging instrument is currency forwards. Target hedging ratios vary from 50% to 100% of the NAV. Historical analysis and Monte Carlo simulation were adopted to examine the effectiveness of different hedging ratios. The optimal hedging ratio varies under different conditions and across different portfolios, 100% hedging ratio is not always the optimal.

Previous studies on whether hedging currency risk can improve the risk adjusted return for international real estate investment have not reached consistent conclusions but generally indicate that currency hedging reduces risk. There has been limited research of currency hedging practice in the real estate industry. This research aims to provide more insights into the current practice in currency hedging and how the effectiveness of currency hedging could be affected by different phases of the real estate cycle and different investment holding periods.

<sup>1</sup> 28% of the respondents hedging their currency risk at the real estate portfolio level.



### 3. THE INVESTOR SURVEY

The section analyses the results of the Asia Pacific non-listed real estate vehicle investor survey. It provides an indication of current practice in managing currency risk from international real estate investment. Overall, most of the investors in our survey allocate their assets globally and most aim to manage currency risk to some extent through hedging. There is a significant variation in practice but with most organisations having a fairly sophisticated approach. Key findings are:

- The most popular currencies to be hedged are US dollar (USD) and Japanese Yen (JPY), possibly because of their importance as real estate markets and possibly because they are amongst the most liquid currencies with relatively low transaction costs in hedging and instruments readily available. The next most popular currencies for hedging are the British pound (GBP) and Australian dollar (AUD). Since a significant proportion of the respondent base is from within the Eurozone it is not surprising that the hedging against Euro is less popular.
- Investors prefer passive hedging rather than any views about currency affecting hedging decisions.
- Investors prefer to hedge at the portfolio level and tend to hedge 100% of their exposures (or a substantial proportion when less than 100% but with some variation by country).

- Typically hedging is done on a rolling three-month basis or something similar but with some variation in frequency and approach.
- In terms of instruments, typically a combination of instruments are used including forwards, swaps and options.
- There is little evidence that the expected holding period affects the investor’s choice of hedging instrument or that investors believe that hedging real estate currency risk is different from other asset classes.
- There does appear to be a clear desire to manage and reduce currency risk arising from international real estate investment.

This survey was conducted in November 2017 amongst ANREV investor members with 18 responses received.

#### Respondent profile

Table 3.1 highlights the breakdown of the 18 respondents. 11 out of the 18 respondents are pension funds.

16 out of 18 respondents allocated their investment globally, one respondent stated they invested in Europe and one Australian investor only invests in Australia and does no currency hedging.

5 out of 18 (28%) respondents are from Netherlands. The other respondents cover a broad range of domiciles as set out in table 3.2.

**Table 3.1: Respondents by type of investors**  
Respondents by type of investors

Type of investors	No. of respondents	Percentage
Pension fund	11	61.1%
Insurance company	2	11.1%
Fund of funds	2	11.1%
Others	3	16.8%
Total	18	100%

**Table 3.2: Respondents by location**  
Respondents by location

Location	No. of respondents	Percentage
Europe	9	50%
North America	4	22.2%
Asia-Pacific	2	11.1%
Unknown	3	16.7%
Total	18	100.0%

**Table 3.3: Hedged currency**  
**Currency hedging —**  
**12 investors used currency hedging**

Currency	No. of respondents	Percentage
USD	10	83.3%
GBP	8	66.7%
EUR	5	41.7%
JPY	9	75.0%
AUD	7	58.3%
CHF	3	25.0%
CAD	1	8.3%
HKD	1	8.3%

## Currency hedging

12 out of 18 respondents use currency hedging. Of those investors who use currency hedging, the main currencies that are hedged are USD (83.3%), GBP (66.7%), EUR (41.7%), JPY (75%), AUD (58.3%), CHF (25%), CAD (8.3%) and HKD (8.3%) as set out in table 3.3. 9 out of those 12 investors hedge at least three currencies. 7 out of those 12 investors manage their currency hedging themselves. There is not a clear pattern of what investors would like the manager to do in terms of currency hedging but the investors do not want to see managers speculating or taking views on currency movements in currency hedging decisions.

Among those 12 investors who use currency hedging, currency hedging has been applied at different levels. Only one investor only hedges on an asset by asset basis. Most hedge either by country or at the real estate portfolio or at the multi-asset level. 33% hedge only some real estate fund styles and 50% of respondents hedge certain countries only. 67% state that they hedge at entire real estate portfolio level and 42% hedge at the multi-asset portfolio level (incorporating a proportion that also say they hedge at the real estate portfolio level).

25% of respondents indicate real estate investment style affects currency hedging strategies and another 25% of respondents indicate their currency hedging strategies affect real estate investment style. The remaining 50% of respondents have no crossover effect between currency hedging strategies and real estate investment styles.

## Currency hedging strategies

75% of respondents choose continually currency hedging and 25% of respondents choose a specific time period for their currency hedging. Whilst three respondents indicated a preference for a three months hedging period

and one respondent prefers six months and one respondent prefers 1-3 years the bulk of respondents suggested that it varies or they use some other period.

Regarding hedging ratios, half of the respondents aim to be 100% hedged with the other respondents typically aiming for some lower ratio with this in some cases varying by country (currency) and time. 10 investors answered the question regarding the choice of hedging instrument. 70% of investors used swaps, 60% of investors used forwards and 50% of investors used options. 80% of investors used a combination of at least two hedging instruments. We expected that the investment horizon for the investor will affect the choice of hedging instrument but in the survey only 16.7% of respondents think the choice of hedging instrument is influenced by their expected holding period. Despite the differences in real estate from other asset classes in liquidity, holding periods and valuations, only one respondent thought real estate currency hedging is different from other asset classes.

**Table 3.4: Hedging instruments**  
**Currency hedging instruments —**  
**10 investors used financial instruments**

Instrument	No. of respondents	Percentage
Swaps	7	70%
Forwards	6	60%
Options	5	50%

The results of this Asia Pacific non-listed real estate vehicle investor survey provide an indication of current practice in managing currency risk from international real estate investment. Overall, most of the investors in our survey allocate their assets globally and most aim to manage currency risk to some extent through hedging. The most popular currencies to be hedged are US dollar (USD) and Japanese Yen (JPY), possibly because of their importance as real estate markets and possibly because they are amongst the most liquid currencies with relatively low transaction costs in hedging and instruments readily available. The next most popular currencies for hedging are the British pound (GBP) and Australian dollar (AUD). Since a significant proportion of the respondent base is from within the Eurozone it is not surprising that the hedging against Euro is less popular.

Investors prefer passive hedging rather than using views about a specific currency affecting hedging decisions. Investors prefer to hedge at the portfolio level than at the asset level. Investors tend to hedge 100% of their exposures (or a substantial proportion when less than 100% but with some variation by country). Typically hedging is done on a rolling three-month basis or something similar but with some variation in frequency and approach. In terms of instruments, typically a combination of instruments are used including forwards, swaps and options. There is little evidence that the expected holding period affects the investor's choice of hedging instrument or that investors believe that hedging real estate currency risk is different from other asset classes. There does appear to be a clear desire to manage and reduce currency risk arising from international real estate investment.

## 4. SIMULATION ANALYSIS

*This section sets out the approach used in the simulation analysis (conducted by Chatham Financial) using a number of assumptions that draw on INREV and ANREV data to test what hedging ratios are appropriate for different types of global investor under different scenarios and holding periods. The results are considered in the next section.*

The results of the survey provide a useful context to explore how hedging strategies perform. The survey indicates investors allocate their assets globally, hedging at the portfolio level and typically aim to hedge 100% of currency exposure. In order to compare with a 100% hedging ratio, another hedging ratio will be adopted in the simulation. Since in the survey investors have no clear preference of hedging instrument, we will use three-month rolling forward as the hedging instrument.

To examine the impact of different hedging strategies we use a Monte Carlo simulation approach. The Monte Carlo simulation uses assumptions on expected return and volatility for key variables, then simulates the possible paths for all the key variables. This method advances the historical analysis in two ways. First, the decision is made in an ex-ante, expectations context — hedging decisions should not be based on ex-post data. Secondly, it reflects the

uncertainty of the future and does not treat historical data as being representative of all possible futures. The Monte Carlo simulation was conducted by Chatham Financial.

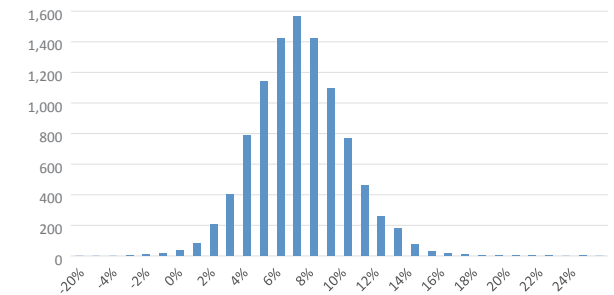
We assume there are two type of investors with the following asset allocation:

- 1) US investor invested in US (40%), Europe (25%), UK (15%), Japan (12%), Australia (12%) and Switzerland (12%);
- 2) European investor invested in Europe (40%), US (25%), UK (15%), Japan (12%), Australia (12%) and Switzerland (12%).

Based on the data from IPD, INREV and ANREV and our adjustments, we formed three scenarios for the real estate return – 1) Normal case; 2) Boom/Upside case with strong real estate returns; 3) Crash/Downside case with weak real estate returns. This allows us to compare the effectiveness of currency hedging under different patterns of returns in real estate. Furthermore, given real estate prices tend to have a mean reversion pattern with a trend, we expect that the volatility of the real estate price tends to be lower for a longer time horizon. Thus, we considered three different investment holding periods: 1) 3 years; 2) 5 years; 3) 10 years. Newell and Lee (2017) suggested that the optimal

hedging ratio varies under different conditions across different portfolios, 100% hedging ratio is not always the optimal. Thus, we explored three hedging ratios: 1) 0%; 2) 50%; 3) 100%.

**Figure 4.1: Distribution of IRR**



The simulation was run with 10,000 iterations to obtain the distributions for the internal rate of return (IRR) as illustrated in Figure 4.1. The purpose of this study is comparing the risk-adjusted returns among different scenarios. This can be tested by examining the coefficient of variations. Expected mean and standard deviation of the IRR distribution from the simulation are calculated and the coefficient of variation is measured by the ratio of the standard deviation to the mean. Coefficient of variation is a useful summary measure of the portfolio risk per unit of return, given a positive expected value, the lower the coefficient of variation, the less the portfolio risk per unit of return.

## 5. SIMULATION SCENARIO RESULTS

*This section sets out the results of the simulation analysis for different scenarios and investment holding periods. This highlights that for a USD based investor, hedging improves typically improves returns and lower risk. For a EUR based investor hedging is likely to reduce risk substantially but this tends to be at the cost of a slight reduction in returns. Thus generally it makes sense from a risk adjusted return point of view to be fully hedged for holding periods of 3 and 5 years and under all market environments – particularly when values are falling in a weak market environment. In exploring the impact of holding period it emerges that for a long-term investor with a 10 year holding period that a 50% hedging ratio is preferable to a 100% hedged position. These results suggests that investors (or the ultimate clients) should generally be using currency hedging to reduce risk and that hedging strategy should reflect the expected duration of exposure to particular currencies.*

The simulation analysis is based on three-month rolling forward as the hedging instrument. The analysis, drawing on the survey, assumes the principal of the forward contract is updated every three months according to the new valuation of the real estate portfolio and that income is not hedged. Transaction costs and settlement costs are considered as well. The assumptions are set out in Appendix 4.

Appendix 5A shows the simulation results with a 3 year holding period for US (USD domestic currency) and European (EUR domestic currency)

investors, respectively. For all the real estate return scenarios, the return for USD investor improves as the hedging ratio increases, at the same time, the risk of the portfolio (measured by standard deviation) decreases. The return for EUR investor portfolio deteriorates as the hedging ratio increases but the risk of the portfolio decreases. For both USD and EUR investors, the coefficient of variation decreases as the hedging ratio increases, indicating that currency hedging improves the risk return profile of the investments.

Hedging and conversion into domestic currency improves the return for the USD investor and reduces the return for the EUR investor. This is due to the interest rate differential and we are using the current interest rate environment to simulate the forward price. The central bank rate in US and Europe is 1.5% and 0.5%, according to the covered interest rate parity as explained in Appendix 3, foreign investment by US investors tends to have a gain in carry and foreign investment by EUR investors tends to have a cost in carry.

Appendix 5B shows the simulation results with 5 year holding period for USD and EUR investors respectively. The results are similar to the results for the 3 year holding period. For all real estate return scenarios, the coefficient of variation decreases as the hedging ratio increases, thus currency hedging improves the risk return profile of the investments.

Appendix 5C shows the simulation results for a 10 year holding period for USD and EUR investors respectively. The effect of hedging on returns are similar to the results for 3 or 5 year holding periods, but the coefficient of variation shows a different pattern. The coefficient of variation is at the lowest with a 50% hedging ratio except the case for a USD investor in the downside case. This suggests that when the holding period is long, 100% hedging ratio may not be the optimal, partial hedging (e.g. 50%) could be better off.

Appendix 5D shows the effect of hedging ratios on the coefficient of variation for investment with holding period 3 years, 5 years and 10 years, respectively. For both USD and EUR investments, currency hedging reduces the coefficient of variation the most for downside real estate return case and the least for upside real estate return case regardless of the holding period. This suggests that currency risk hedging is needed the most when the real estate is in the downward movement of the real estate cycle.

Appendix 5E shows the effect of hedging ratios on the coefficient of variation under normal, upside and downside real estate cases, respectively. For both USD and EUR investments, currency hedging reduces the coefficient of variation the most with a 3 years holding period and the least with 10 years of holding period regardless of the real estate return scenarios. This suggests that currency risk hedging is needed the most for a short-term investment horizon.

## 6. PRACTICAL IMPLICATIONS AND CONCLUSIONS

Many institutional investors are seeking real estate investment opportunities abroad and unhedged currency exposure could substantially increase the risk of the overseas investment.

This study provides insight into current industry practice of managing currency risk amongst institutional investors and Monte Carlo simulations are performed to analyse the effectiveness of currency hedging under different scenarios. Key messages from this research are:

- Investors in Asia Pacific non-listed real estate vehicles typically apply sophisticated and systematic currency risk management strategies. This includes the use of wide range of instruments to hedge against a range of currencies.
- Investors do not want managers to take currency views. They are comfortable managing currency at a multi-asset level and so need managers to accurately report currency exposures to them.
- Most investors think that real estate currency hedging is not different from other asset classes and their choice of hedging instrument is not affected by the expected holding period.
- Our analysis on the impact of hedging (which uses rolling forwards) indicates that hedging reduces risk and improves the risk adjusted return.
- Currency hedging has a greater impact when the real estate market is weak and less essential when the real estate market is strong.
- Currency hedging has a great impact for shorter-term investment and is less essential for longer-term investment.
- Whilst 100% hedging ratios are optimal in some conditions and for some domiciles of investor this is not always the case. Our analysis indicates for a 10 year investment horizon a 50% hedging ratio is preferable to a 100% hedging ratio.
- Overall, management of currency risk is recognized in the industry as being important in managing overall risk. There is also a recognition that currency hedging should generally be done at a more aggregated level which makes accurate reporting and transparency essential.
- There remain unanswered questions about how currency is integrated into real estate investment decision-making and this study has not sought to address what best practice should be with respect to investment in emerging markets. Both are areas that would merit further research.

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## APPENDIX 2: SURVEY QUESTIONNAIRE

**Q1: Do you use currency hedging?** Yes  No

If No, please answer questions 16-17.

**Q2: Which currencies do you hedge (you may select more than one currency)?**

€  £  US  Japanese yen  Australian \$

Other  (specify currencies \_\_\_\_\_)

**Q3: Do you manage the currency hedging yourself?** Yes  No

**Q4: Do you allow or request your managers to use currency hedging?**

Yes  No  Not applicable

**Q5: Do you explicitly prefer your managers not to hedge?**

Yes  No  Not applicable

**Q6: If you prefer the manager to hedge, is there anything you want done by the manager**

(specify) \_\_\_\_\_

**Q7: If you prefer the manager to hedge, is there anything you do not want done by the manager**

(specify) \_\_\_\_\_

**Q8: At what level is currency hedging carried out?**

Asset by asset: Yes  No

Elements of real estate portfolio:

Style: Yes  No

Certain countries only: Yes  No

Entire real estate portfolio: Yes  No

Multi-asset portfolio: Yes  No

**Q9: Is your choice of hedging instrument influenced by your expected holding period?** Yes  No

(If Yes, please describe \_\_\_\_\_)

**Q10: Does investment style affect your currency hedging strategy?**

Yes  No

**Q11: Does currency hedging affect your investment style?** Yes  No

**Q12: When is currency hedging done?**

Continually: Yes  No

Specific times only: Yes  No

(If Yes, please specify the times \_\_\_\_\_)

**Q13: When you hedge, for what time period do you hedge?**

3M  6M  1Y  3Y  Other

**Q14: What hedging ratio(s) do you use?**

100%  50%  Other

(specify the ratios \_\_\_\_\_)

**Q15: How is currency hedging implemented?**

Swaps: Yes  No

Forwards: Yes  No

Options: Yes  No

Other  (please specify): \_\_\_\_\_

**Q16: Do you treat real estate currency hedging differently to other asset classes?** Yes  No

If Yes, specify how it is different and why? \_\_\_\_\_

**Q17: What is your overall currency hedging policy?**

\_\_\_\_\_

**Q18: Respondent profile**

Type of investor:

Pension fund  Insurance company  Family office

Sovereign wealth fund  Fund of fund  Multi-manager

Other

Portfolio size (specify): \_\_\_\_\_

Geographic diversification:

Global  Asia Pacific  Europe  US  Australia  Japan

Other  (please specify \_\_\_\_\_)

Investment styles used:

Core  Value-added  Opportunistic  Debt

Main location of your organization (specify): \_\_\_\_\_



## APPENDIX 3: EXPLANATION OF KEY TERMS

### Covered Interest rate parity

Covered interest rate parity define the relationship between the spot rate and the forward rate, the formula is defined as following:

$$F_0 = S_0 e^{(r^* - r^F)t}$$

Where  $S_0$  is the spot price at time 0,  $F_0$  is the forward price at time 0.  $r^F$  is the annual foreign currency interest rate,  $r^*$  is the domestic currency interest rate and  $t$  is the number of years.

### Cost/gain of carry

According to the covered interest rate parity, the forward rate does not equal to the spot rate unless the interest rate differential between two currencies is 0. Thus, there is a gain of carry if the agent engaged in forward contract which sell the relatively low interest rate currency. There is a cost of carry if the agent engaged in forward contract which sell the relatively high interest rate currency. Table 1 show the central bank interest rate at the end of 2017.

**Table 1: Interest rates as at 31st December 2017**

Currency	Europe	Japan	Switzerland	Australia	US	UK
Current central bank interest rate	0.00%	-0.10%	-0.75%	1.5%	1.5%	0.5%

## APPENDIX 4: ASSUMPTIONS USED IN THE MONTE CARLO SIMULATIONS

### Real estate returns

Normal Case						
	Australia	Japan	Europe	Switzerland	UK	US
Capital index	100.00	100.00	100.00	100.00	100.00	100.00
Year 1	103.00	100.00	102.00	101.00	102.00	102.00
Year 3	109.27	100.00	106.12	103.03	106.12	106.12
Year 5	115.93	100.00	110.41	105.10	110.41	110.41
Year 10	134.39	100.00	121.90	110.46	121.90	121.90
Year 1-5 income (per annum)	7.26	5.38	5.25	4.43	5.64	5.94
Year 6-10 income (per annum)	8.41	5.38	5.80	4.65	6.23	6.55
Boom/upside case						
Capital index	100.00	100.00	100.00	100.00	100.00	100.00
Year 1	112.00	108.00	111.00	107.00	114.00	114.00
Year 3	131.51	118.54	127.94	117.00	135.83	135.83
Year 5	149.08	125.96	142.33	124.87	154.47	154.47
Year 10	181.43	131.67	165.04	135.60	182.22	182.22
Year 1-5 income (per annum)	6.31	3.94	4.81	3.68	3.98	3.43
Year 6-10 income (per annum)	9.40	4.96	6.85	4.60	6.15	5.31
Crash/downside case						
Capital index	100.00	100.00	100.00	100.00	100.00	100.00
Year 1	94.00	92.00	93.00	95.00	90.00	90.00
Year 3	89.69	83.50	86.93	90.22	81.09	81.09
Year 5	88.95	78.51	84.49	87.92	77.03	77.03
Year 10	98.63	75.36	89.18	89.60	80.18	80.18
Year 1-5 income (per annum)	8.20	6.82	5.69	5.17	7.30	8.44
Year 6-10 income (per annum)	7.30	5.36	4.81	4.55	5.62	6.50

Data Source: IPD index, INREV index and ANREV index.

### Spot rate path assumptions

We assume the return of the exchange rate follows an autoregressive moving average (ARIMA) process, the volatility of the return of the exchange rate follows a generalized autoregressive conditional heteroskedasticity (GARCH) process. A vine copula dependence model was employed to capture the correlations of returns among different currencies pairs.

### Forward rate path assumptions

Forward point is the difference between the forward rate and spot rate. Based on the historical data of spot rates and forward rates, we calculated the mean and the standard deviation of the forward point. We assume the forward point follows a Brownian motion. Furthermore, we used vine copula to capture the correlation between the spot rate and forward point.

### Transaction cost assumption

We assume the transaction cost is 0.1% per year.

### Settlement cost assumptions

At the expiration of the forward contract, the contract needs to be settled before it rolled over to the new contract, the settlement amount is the difference between the forward price which is purchased in the last period and the current spot price. We assume that the settlement amount is not directly paid at the expiration of the contract, the broker holds a settlement balance account for the hedger, the settlement balance for US investor either pays or earns Libor+1% per annum depending on whether the balance is negative or positive. Similarly, the settlement balance for European investor either pays or earns EURIBOR+1% per annum. The final settlement balance is paid at the end of the investment.

## APPENDIX 5: MONTE CARLO SIMULATION RESULTS

### Appendix 5A: Investment with 3 years holding period

Table 5A.1: USD investment with 3 years holding period

Normal Case			
Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	7.5%	8.1%	8.6%
Standard deviation	2.7%	1.4%	0.5%
Coefficient of variation	0.359	0.168	0.057
Boom/Upside Case			
Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	13.3%	13.9%	14.5%
Standard deviation	2.8%	1.4%	0.5%
Coefficient of variation	0.212	0.101	0.036
Crash/Downside Case			
Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	2.0%	2.5%	3.0%
Standard deviation	2.6%	1.3%	0.5%
Coefficient of variation	1.304	0.522	0.155

Table 5A.2: EUR investment with 3 years holding period

Normal Case			
Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	7.3%	6.9%	6.5%
Standard deviation	2.7%	1.3%	0.5%
Coefficient of variation	0.363	0.188	0.079
Boom/Upside Case			
Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	13.1%	12.7%	12.2%
Standard deviation	2.8%	1.4%	0.6%
Coefficient of variation	0.215	0.108	0.045
Crash/Downside Case			
Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	1.7%	1.4%	1.0%
Standard deviation	2.5%	1.2%	0.5%
Coefficient of variation	1.438	0.908	0.483

Note: Based on the reported value of US\$126.2 billion.

## Appendix 5B: Investment with 5 years holding period

Table 5B.1: USD investment with 5 years holding period

Panel A: Normal Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	7.4%	8.0%	8.5%
Standard deviation	2.1%	1.1%	0.7%
Coefficient of variation	0.283	0.133	0.077

Panel B: Boom/Upside Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	11.7%	12.2%	12.8%
Standard deviation	2.2%	1.1%	0.7%
Coefficient of variation	0.185	0.088	0.054

Panel C: Crash/Downside Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	3.7%	4.2%	4.7%
Standard deviation	2.1%	1.1%	0.6%
Coefficient of variation	0.559	0.252	0.129

Table 5B.2: EUR investment with 5 years holding period

Panel A: Normal Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	7.3%	6.8%	6.4%
Standard deviation	2.1%	1.0%	0.7%
Coefficient of variation	0.287	0.147	0.111

Panel B: Boom/Upside Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	11.5%	11.1%	10.6%
Standard deviation	2.2%	1.0%	0.8%
Coefficient of variation	0.189	0.093	0.075

Panel C: Crash/Downside Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	3.4%	3.0%	2.6%
Standard deviation	2.0%	1.0%	0.6%
Coefficient of variation	0.596	0.337	0.241

Note: Based on the reported value of US\$126.2 billion (for 2017)

## Appendix 5C: Investment with 10 years holding period

Table 5C.1: USD investment with 10 years holding period

Panel A: Normal Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	7.4%	8.0%	8.5%
Standard deviation	1.5%	0.8%	0.9%
Coefficient of variation	0.199	0.103	0.108

Panel B: Boom/UpSide Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	9.5%	10.1%	10.6%
Standard deviation	1.5%	0.8%	1.0%
Coefficient of variation	0.158	0.081	0.095

Panel C: Crash/Downside Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	5.4%	6.0%	6.5%
Standard deviation	1.5%	0.8%	0.8%
Coefficient of variation	0.270	0.139	0.130

Table 5C.2: EUR investment with 10 years holding period

Panel A: Normal Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	7.3%	6.8%	6.4%
Standard deviation	1.5%	0.8%	1.1%
Coefficient of variation	0.210	0.118	0.172

Panel B: Boom/UpSide Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	9.5%	9.0%	8.5%
Standard deviation	1.6%	0.8%	1.3%
Coefficient of variation	0.163	0.090	0.153

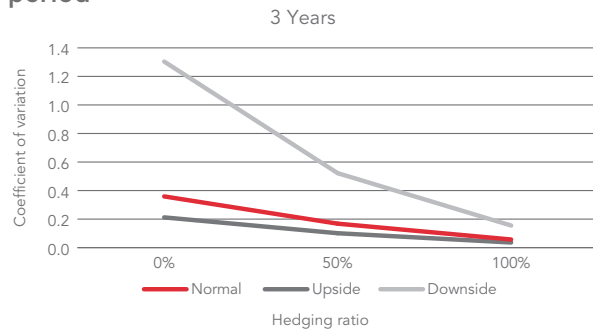
Panel C: Crash/Downside Case

Type of investors	No Hedging	50% Hedging	100% Hedging
Mean	5.1%	4.7%	4.4%
Standard deviation	1.5%	0.8%	0.9%
Coefficient of variation	0.296	0.173	0.214

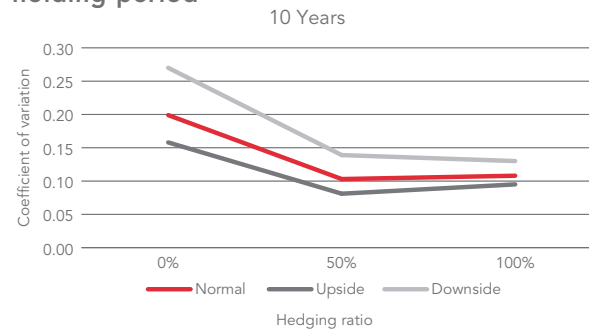
## Appendix 5D: Hedging effectiveness under different real estate return scenarios

The charts show the coefficient of variation under three different return scenarios for the three hedging ratios examined (0%, 50% and 100%).

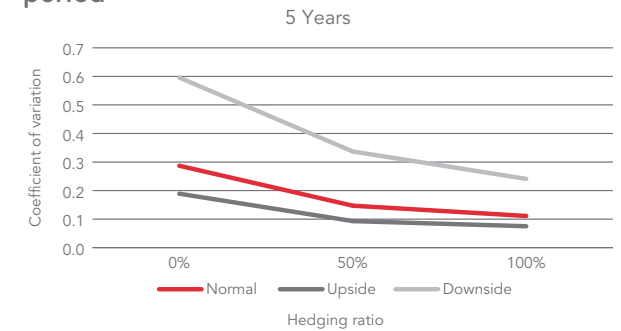
**Figure 5D.1: USD investor with 3 years holding period**



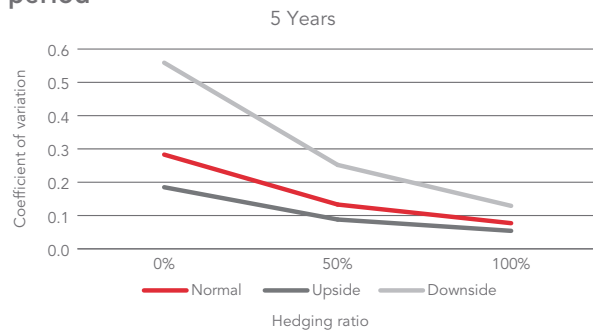
**Figure 5D.3: USD investor with 10 years holding period**



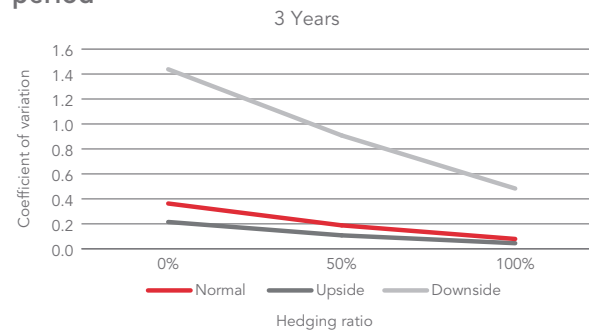
**Figure 5D.5: EUR investor with 5 years holding period**



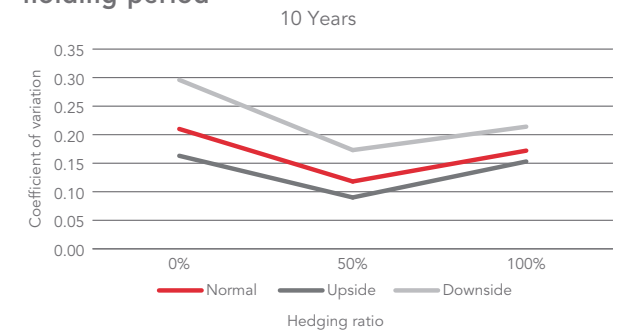
**Figure 5D.2: USD investor with 5 years holding period**



**Figure 5D.4: EUR investor with 3 years holding period**



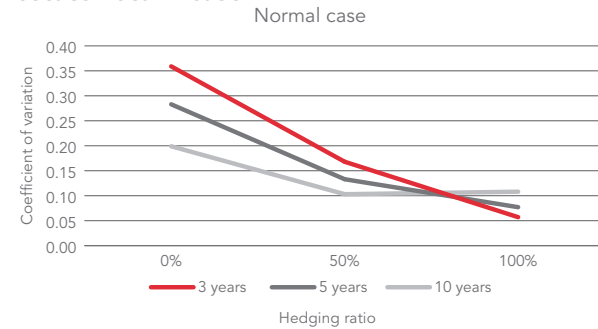
**Figure 5D.6: EUR investor with 10 years holding period**



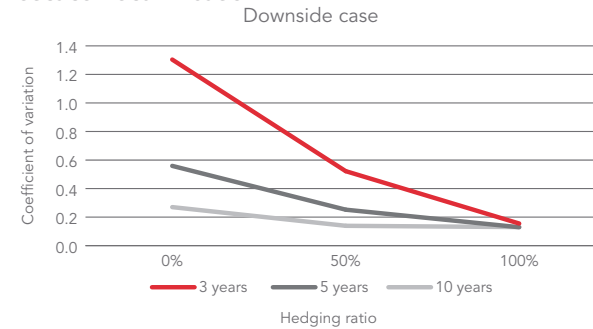
## Appendix 5E: Effectiveness of hedging under different investment holding period

The charts show the coefficient of variation under three different holding periods for the three hedging ratios examined (0%, 50% and 100%).

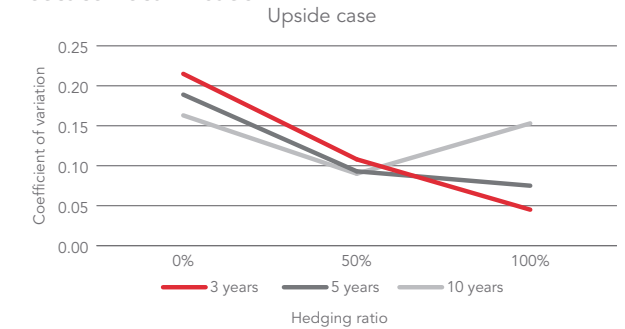
**Figure 5E.1: USD investor with normal real estate return case**



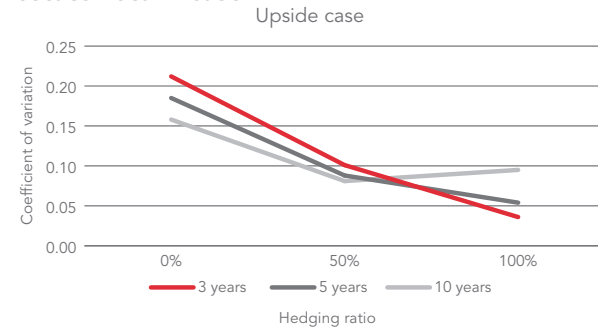
**Figure 5E.3: USD investor with downside real estate return case**



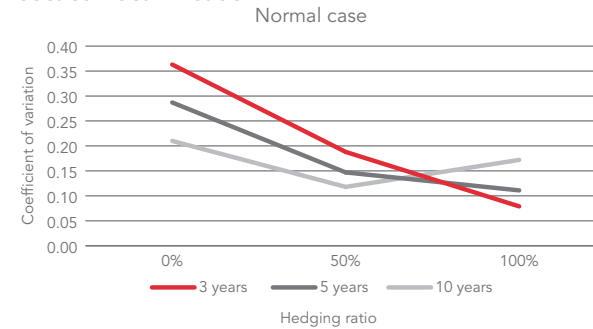
**Figure 5E.5: EUR investor with upside real estate return case**



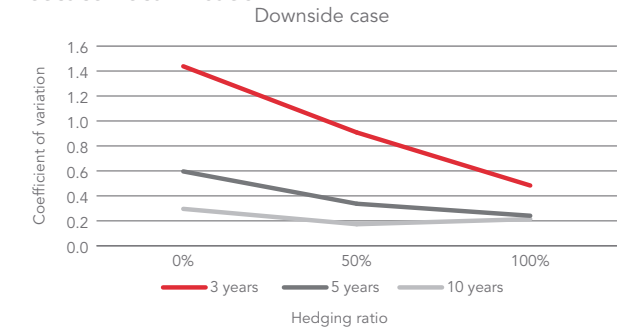
**Figure 5E.2: USD investor with upside real estate return case**



**Figure 5E.4: EUR investor with normal real estate return case**



**Figure 5E.6: EUR investor with downside real estate return case**





ASIAN ASSOCIATION FOR INVESTORS  
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