

Hedging Private International Real Estate

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Abstract

The performance of an international real estate investment can be critically affected by currency fluctuations. The growth and maturation of currency derivative markets offers an international investor expanded options to reduce variability in returns. Survey work suggests large international investors with multi-asset portfolios tend to hedge the overall currency exposure at portfolio rather than asset class or asset level. By contrast, smaller and specialist investors are more likely to hedge individual investments and face considerable specific risk. This model simulates the situation faced by this latter class of investors in a Monte Carlo framework, by allowing both the real estate cash flows and exchange rates to vary in a forward-looking expectations framework. From the simulations, the results of remaining unhedged, hedging the rental income and initial purchase price with a currency swap, and hedging the rental income and the expected terminal value with a currency swap are analyzed. In contrast to some of the existing work, this study suggests that the currency swap strategy results in considerable reduction of the downside risk associated with the currency fluctuations and produces superior risk-adjusted returns.

Hedging Private International Real Estate

1. Introduction

International investment in property has become a persistent feature of real estate markets in the developed economies. In the last 15 years, interest has grown dramatically. In 1991, there were only 11 identifiable investment funds in the US that had an international investment strategy (Worzala 1992). In contrast, in June 2004 there were 73 active investment funds that had been established to invest in international real estate (Institutional Real Estate, Inc) with a total planned investment of \$69.8 billion. Over this time period, investors have seen a ten fold increase in funds focused on international real estate investment. For the funds that provided allocations, close to 60% were invested 100% in international real estate whereas 20% indicated they had a portion of the portfolio allocated to US real estate investments.

It is clear that real estate investors and advisors increasingly act in a global capacity. Cross border activity means that real estate investment must focus not only on cash flow patterns - changes in rents and capital values - but also on the impact of currency movement. Incorporating exchange rate fluctuations into the analysis of an international investment can substantially alter the expected risk and return characteristics. With fluctuating exchange rates, the value of a profitable real estate investment could be adversely affected when converted to an investor's domestic currency. This risk should be recognized and incorporated into the international investment decision.¹

Many (but not all) studies exploring international real estate as an investment alternative only briefly acknowledge the currency risk associated with these investments. Some authors use unadjusted rent or return data (for example Sweeney, 1988 and Giliberto, 1990) and suggest currency risk can simply be hedged away (without considering the impact of the costs of hedging on returns) or can be ignored. Another study simulated real estate investments into the US and illustrated the significant risk associated with currency fluctuations but did not examine the impact of hedging the real estate investments (Nelson 1989). Other researchers used a portfolio approach and adjusted the returns data for currency on a period-by-period basis that, in effect, models period-by-period repatriation of funds (Ziobrowski & Ziobrowski, 1993 and 1995; Ziobrowski & Boyd, 1991; Ziobrowski & Curcio, 1991). In these latter studies, returns for all of the international investments are adjusted on a periodic basis. While this might be consistent with market practice on performance reporting and appropriate for major portfolio investments, it does not accord with actual international investment cash flows faced by individual investors. This has implications for the assessment of the value of an international investment. As one might expect, adjusting international real estate investments for currency fluctuations has an impact on the financial performance, particularly as it related to the risk associated with the investment.

Although many researchers have examined currency hedging for international stocks and bonds, little existing research examines hedging techniques for the currency risk associated with making an international real estate investment. Worzala (1995) explores the possibilities of mitigating the currency risk through the use of alternative hedging instruments. However, due to the longer holding period/investment horizon of real estate, it is very difficult to fully hedge an international real estate investment. Using a common rolling-forward contract, the risk associated with the fully hedged investment is much greater than if the investor had adjusted returns for currency fluctuations on a period-by-period basis (the Ziobrowski *et al.* model). These results indicate that conventional hedging techniques may not be the most appropriate for hedging a multi-

¹ For an early but detailed description of the strategic issues which must be considered while trying to hedge currency exposure see Showers (1988). Also see Jorion (1990) and Bodnar and Gentry (1993) for additional discussions on currency exposure.

period asset like real estate. This study explores the use of a different hedging strategy, a currency swap, to eliminate some of the exchange rate exposure associated with an international investment.

For major institutional and professional investors, international real estate assets will simply form part of an overall international portfolio of assets and liabilities. For such investors, hedging will generally be based on a currency overlay basis – the net exposure to particular currencies considered and, where appropriate, hedged as a specialist treasury function. Indeed, in such a model, currency exposure may be seen as an asset class². Larger, specialist real estate investors may hold portfolios of properties in different countries with associated portfolio cash flow characteristics. For the majority of international real estate investors, however, acquisitions will be piecemeal, with no guarantee that property returns will track local performance benchmarks and with far greater specific risk. It is those piecemeal investments that are the focus of this paper.

In an individual real estate investment, there are three sets of cash flows that an investor must consider: the initial investment, the periodic cash flows, and the sale at the end of the holding period. If periodic cash flows are known with certainty or are relatively stable, then the initial investment and the periodic flows can be swapped into the home currency of the investor.

The currency swap market, along with other financial derivatives products, has grown substantially over the last decade and this hedging technique is becoming readily available to the international investor. According to the Bank for International Settlement, in June 2004 the notional amount of outstanding OTC single currency interest rate derivatives was almost \$165 trillion. The vast majority of these contracts, 77%, were currency swap contracts.³ New contracts written in a given year has increased from only \$182 billion contracts written in 1987 to over \$7 trillion in mid year 2004. This paper assumes the use of a British sterling swap which, according to the BIS statistics, was the fourth largest in terms of the amount of activity, capturing 7% of the currency swap market, behind the Euro (39% of market), the US dollar (33% of market), and Japanese yen (15%).

The most difficult cash flow in an international real estate investment to protect is the uncertain sales price or terminal value at the end of the holding period. With the plain vanilla currency swap, the initial investment is protected but any appreciation or depreciation that has occurred over the holding period will still be subject to the risks associated with currency fluctuations. An alternative strategy would be to swap the *anticipated* terminal value of the asset at the end of the investor's holding period rather than the initial acquisition price. This would be useful in protecting the expected appreciation from variation in exchange rates. The value of this strategy, however, will be dependent on the ability to estimate the terminal value and leaves the investor exposed to the difference between anticipated and actual sales proceeds.

This study builds on an approach adopted in two earlier studies, Worzala *et al.* (1997) and Lizieri *et al.* (1998). In the first study, a Monte Carlo simulation framework was used to compare a single UK real estate investment made by a US investor with no currency hedging to a scenario where a plain vanilla currency swap was used to mitigate the currency risk. The only variable that was allowed to vary in the simulation was the exchange rate. In the second study, a more realistic scenario framework assumed currency fluctuations around the mean and both positive and negative trends were explored. In both studies, the swap proved to be an effective tool for reducing the volatility (risk) associated with the currency adjusted income

² See, for example, the special issue of *Professional Investor*, September 2004 for a series of articles on institutional approaches to currency investment.

³ These statistics can be found in the detailed tables of the quarterly report provided by the Bank for International Settlements (BIS) located at http://www.bis.org/statistics/otc_hy0412det.pdf. In particular, Table 19 and the Detailed Table D.2 were used.

flows of the investment but the effectiveness of the swap was highly sensitive to changes in the variables determining the terminal (exit) value.

In this paper, the researchers have expanded the realistic nature of the simulation model, particularly as it pertains to the terminal (exit) value at the end of the holding period. Both the rental growth rate and the capitalization rate are modelled as random variables. The simulation of the rental growth rate series is based on rolling five year average growth rates, a more realistic scenario than the quarterly rental growth rate series that were used in the previous studies cited. In addition, the exchange rate fluctuations are modelled as a random variable but the mean and standard deviation are based on a separate series constructed from the differentials between the exchange rate in one period and the exchange rate for lags of one, two, three ... twenty periods. Again, this is more realistic than using a simple time series of quarterly exchange rates. The volatility of the exchange rate deviations increase significantly as the time period for holding the investment increases. Finally, a risk free discount rate from the perspective of a US investor was used instead of basing the net present value analysis entirely on return parameters from a UK investment perspective. The risk free rate recognizes that the rental payments are known with relative certainty. Using a US investor's perspective recognizes that the international investor is comparing the international investment performance with alternatives in his/her own domestic country. Previous studies used nominal discount rates from the country where the investment was located.

The remainder of the paper is organized as follows: section two reviews the limited existing research on hedging international real estate investments. Section three describes the data and model simulations incorporated in the analysis while section four reports results from the various simulations. The final section provides conclusions and implications of the research findings, stressing areas for future research.

2. Prior Research on Currency Hedging of International Real Estate and Currency Hedging Literature Investment

Any international investment is accompanied by currency risk. An extensive literature has developed dealing with exchange rate management.⁴ Researchers typically find that currency hedges can play a role in mitigating the risk associated with an international investment. The majority of work in this area of exchange rate management focuses on traditional financial assets, such as stocks and bonds, which are marketable investments held for a relatively short time horizon.

International real estate investment has long been a feature of property markets, and in recent years, has generated both academic and professional interest. Extensive reviews and references can be found in Baum (1995), Lizieri and Finlay (1995), Lizieri *et al.* (1998) and Sirmans & Worzala, (2003). Early empirical studies examining international real estate tended to ignore currency fluctuations (Sweeney, 1988; Giliberto, 1990; Gordon, 1991) or illustrated that a hedge in effect implies annual repatriation of funds. In practice, while rental income might be repatriated, the capital gain component can only be realized upon sale of the property and is, thus, dependent upon the aggregate currency movement over the expected holding period. Previous research explore the use of leverage (Ziobrowski & Boyd, 1991), options (Ziobrowski & Ziobrowski 1993), and forward contracts (Ziobrowski & Ziobrowski, 1995a). In all cases, *ex post* data is used to show that no diversification benefits could significantly alter returns but

⁴ For example, see Madura and Reiff (1985), Eun and Resnick (1988), Black (1989) and Hunter and Coggin (1990) for studies analysing the hedging benefits for stock-only portfolios; Burik and Ennis (1990) and Hauser and Levy (1991) for examples of hedging benefits for bond-only portfolios; and, finally, Arnott and Henriksson (1989), Benari (1990), Jorion (1989), Odier & Solnik (1993) for studies considering hedged and unhedged portfolios of stocks and bonds.

no attempt was made to mitigate the currency fluctuations (Nelson 1989). Later researchers attempted to acknowledge the risk by adjusting for currency fluctuations on a quarterly or annual basis but did not explicitly address the possibility of hedging the currency risk (for an extensive review of this literature, see Sirmans & Worzala, 2003). Apart from Worzala *et al.* (1997) and Lizieri *et al.* (1998), only the studies headed by Ziobrowski (Ziobrowski & Boyd 1991, Ziobrowski & Curcio 1993; Ziobrowski & Ziobrowski 1993 and 1995a; and Ziobrowski *et al.* 1997, Cheng *et al.*, 1999) and a paper by Hoesli *et al.* (2004) have explicitly attempted to examine currency hedging for real estate investments.⁵

Of these later Ziobrowski *et al.* studies, the majority are framed with a mixed-asset portfolio context. They typically utilize appraisal-based real estate index returns to proxy the real estate investment. Returns are exchange rate adjusted on a periodic (generally annual) basis. While this is consistent with reporting standards, the use of a hedge with such figures in effect implies annual repatriation of funds. In practice, while rental income might be repatriated, the capital gain component can only be realized on sale of the property and is, thus, dependent upon aggregate currency movement over the expected holding period rather than on the sub-period movements. The studies explore the use of leverage (Ziobrowski & Boyd, 1991), options (Ziobrowski & Ziobrowski 1993), and forward contracts (Ziobrowski & Ziobrowski, 1995a). In all cases, *ex post* data is used to back their conclusions that no diversification benefits would be gained by the US, Japanese or British international real estate investors. Since most direct (private) international real estate investment is relatively small scale, results derived from using diversified portfolio returns may understate the amount of currency risk facing international investors. Therefore, hedging techniques based on annual contracts may be misleading.

In Ziobrowski *et al.* (1997) the researchers do attempt to address the inherent problems of trying to model real estate - a capital intensive and relatively illiquid investment that requires a long holding period (not least to amortize high transaction costs). Their results suggest that a currency swap may well reduce the risk of currency fluctuations on the income return of foreign property. Hoesli *et al.* (2004) use a forward contract to partially hedge currency exposure: intriguingly, their results suggest that while performance for US and UK investors is not improved by hedging, there are advantages for investors from other countries. Worzala *et al.* (1997) and Lizieri *et al.* (1998) have argued that results based on portfolio-based indices may be misleading for all but the largest institutional investors. 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. Moreover, they argue that *ex post* data is historically contingent and hence ignores uncertainty (this problem is also addressed in Cheng *et al.*, 1999, who introduce a bootstrapping procedure). As a result, they suggest that the appropriate test of the efficacy of hedging techniques for individual investors is to use a forward-looking simulation approach with realistic expectation and volatility inputs for key variables that impact the risk and return characteristics of the real estate investment.

This present study adopts that approach and develops a simulation model. The study is couched in a forward-looking, expectations framework. A common criticism of the currency swap is that the appreciation or depreciation of the investment is not protected. Therefore we have explored the use of two different swap contracts. One that is based on the initial purchase price of the property; the second is based on the *expected* terminal value of the property at the end of the holding period. This second scenario could potentially add volatility to the return from the investment if the actual sales price is different from the expected terminal value. In this case, the project would be over-hedged or under-hedged. The impact of the imperfect hedge may be small considering the long-term nature of the investment.

⁵ Numerous studies have also examined securitized (or indirect) real estate investments on an international basis. For a detailed review of this literature see Worzala and Sirmans (2003). However, this present study is focused exclusively on the individual direct international real estate investment alternative.

In practice, an investor has to decide whether to repatriate the periodic cash flows or keep them in the foreign country until the entire investment is sold. For this project, for the unhedged scenario, a relatively conservative position was chosen with the quarterly cash flows repatriated every period. An investor making the second choice would face more uncertainty as not only would they have cash from the sale to repatriate at an unknown exchange rate, but will also have the accumulated cash flows and any local interest earned. With the swap, periodic cash flows are converted into the investor's domestic currency, with only the terminal value subject to exchange rate risk on repatriation.

3. Data and Methods

The focus of this research is to use simulation analysis to assess the impact of different currency hedging strategies on the risk and return characteristics of an international real estate investment. The model is based on the acquisition of a recently rented London-based office building by a US investor, with a target holding period of five years.⁶ The exogenous and calculated/estimated values for the real estate investment are detailed in Exhibit 1.

The UK data are based on a typical office building in the City of London with the rent set just below the prime, class A rent, at £400 per square metre (~£37 per square foot). UK "institutional" leases are unusual in that the rent is agreed upon at the beginning of the lease and remains fixed for the first five year period. The rent is then reviewed and adjusted to the higher of the then market rent or the existing contract rent. This is often referred to as the "upward only rent review clause". Although typical lease lengths have fallen since the 1990s, the average remains around 15 years, meaning that the typical investor will sell before lease termination (Office of the Deputy Prime Minister, 2004). In this simulation analysis, the first rent review coincides with an investor's five year holding period. Therefore, we need to estimate a new market rent over a five year holding period to be able to estimate the terminal value of the office building.

This lease effect was modelled by calculating the percentage change in the Jones Lang LaSalle (JLL) index for rolling five-year (20 quarter) periods. The mean and standard deviation of this series (87 observations) are used as the basis for the expected growth rate for rents for the next five-year review (17.14%) and the standard deviation of that growth rate (20.33%). The JLL index is based on a portfolio of institutionally-held property in the City of London.

For the entry and exit capitalization rates, we use the monthly equivalent yield series for City of London offices provided by Investment Property Databank. From 1987-2003, the average capitalization rate was 8.8% and the standard deviation was 1.02%. The swap origination fees and periodic costs are identified from current products available to US investors.

Three hedging scenarios are simulated.

- a. *Do not hedge any of the cash flows or terminal value of the project. This serves as a base case scenario to be used to compare with the risk/return characteristics of hedging scenarios.*
- b. *Swap the original investment and the quarterly cash flows and leave the difference between the expected sale price of the property and the swapped purchase cost, unhedged.*

⁶ Please see Collett, Lizieri, and Ward (2003) for a review of holding periods by institutional investors in the UK. The mean was found to be 7 years but the data set included all types of real estate with the lower quality having a longer holding period. Therefore our subject should have a slightly longer holding period.

- c. *Swap the expected terminal value and the quarterly cash flows. This option essentially converts the expected sale value of the property to be received in foreign currency units, into domestic currency units. The difference between the purchase cost and the terminal value is simply added to the NPV, since it represents swapped value that is not spent on the purchase of the asset. The cost of this hedge is simply the swap origination fee (1%) times the difference between the initial investment cost and the expected terminal value.*

The cash flows from the alternative simulations are discounted using the U.S. Federal Government treasury security interest rates. Quarterly discount rates are calculated and interpolated from published one, two, four, eight, twelve, and twenty-quarter rates. Risk adjusted discount rates were not used in order to prevent the risk/return characteristics of each hedging scenario from being masked and to avoid potential distortions that can arise with the use of the risk adjusted discount rate approach. Investors can use the Certainty Equivalent Adjustment Technique (CEAT) or similar techniques to compare scenarios with different risk/return characteristics. This paper compares the expected, non-risk adjusted NPV from three hedging scenarios with the coefficient of variation (as a measure of relative risk) alongside other risk metrics including the standard deviation of the NPV estimates and the probability of obtaining a negative NPV.

For this analysis, the exchange rates, cash flow growth rates, and capitalization rates are random variables in a Monte Carlo simulation of the five-year London commercial real estate investment by our U.S investor. The assumptions relating to the estimation and construction of these random series are detailed below.

While the assumptions outlined relate to a specific investment, similar methods could be used for an investment in another country. The advantage of the UK lease form is it allows us to focus on the benefits of the swap, without the noise effects of random periodic rental movements. Similarly, tax consequences and exit sale timing issues are not considered, in order to concentrate on the central issues of easing the impact of currency fluctuations on the risk/return characteristics of the investment. That is, we want to isolate and analyze the magnitude of risk facing foreign real estate investors from currency fluctuations and the extent to which that risk can be hedged using currency swap contracts.

To eliminate unnecessary noise, the simulation program was constructed so that all of the randomized cash flow series are identical for all three models. In other words, the exchange rate, cash flow growth rate, and capitalization rate series were randomized and the same values were used to calculate the NPV for each of the three models described in a through c above. This process is repeated for each of the 10,000 sample simulations. Therefore, any difference in risk-return characteristics from the three models can be attributed *solely* to the hedging strategy employed for that scenario.

To calculate the exchange rate volatility, quarterly exchange rates for the US dollar versus the British pound sterling (\$/£) were analyzed from 1975:4 – 2004:3. Separate series were constructed for differentials between the exchange rate in one period and the exchange rate for lags of 1, 2, 3,...20 quarters. The standard deviation for each change series (116 observations) was evaluated. The volatility of exchange rate deviations increases significantly as the number of quarters between observations increases, as evidenced in Exhibit 2. The standard deviation of all exchange rate changes one quarter apart (1975:4 – 2004:3) was only about 9%. The volatility increased steadily as the number of quarters between exchange rate changes increased, levelling off at just under 40% for exchange rate changes that

were 16 quarters or more apart. This extreme volatility will have a significant impact on the risk associated with investments held for long time-periods, a typical scenario for a real estate investment. To reflect historical currency fluctuations, the exchange rates used to convert quarterly cash flows and the terminal value from British pounds to US dollars were randomized using the estimated standard deviations represented in Exhibit 2.

The terminal value of a commercial real estate investment project is often a major contributor to the overall risk and return associated with a real estate investment. Two sources of random effects on the terminal value of the project are considered in the simulation models:

1. the rental cash flow growth rate for the investment, and
2. the exit capitalization rate used to determine the terminal value or sale price at the end of the investor's holding period.

As noted above, the randomized rental growth rate is used to simulate the expected net operating income for the next five-year contract. This is a major determinant for calculating the sales value for the property at the termination of this real estate investment. The expected capitalization rate is also randomized in the simulation by adding a random factor based on the standard deviation of the historical quarterly equivalent yield series. The initial rent and purchase price, however, are not stochastic. The latter is calculated as the initial rental income capitalized at the average equivalent yield.

In modeling currency and property markets, it is important to be mindful of the relationship between currency, inflation, and economic performance. There are many conflicting opinions concerning the relationship between exchange rates, inflation, and property market performance and the validity of the various parity relationships in the short and long terms. Empirical research on international stock returns typically reports weak contemporaneous relationships between exchange rates and returns.⁷ Bodnar & Gentry (1993), De Gregorio & Wolff (1994), He & Ng (1998) and Engel (1999) find differences between traded and non-traded sectors. For the traded sector, competitiveness effects mean that an appreciation of the domestic currency adversely affects competitive position, adversely affecting profitability and suppressing returns. For non-traded goods, the currency effects are much weaker. Given locational fixity, absence of a central market, and lack of substitutability, real estate investments can be considered as, at least in part, non-traded. Thus, the relationship between currency movements and real estate returns may be weak. Furthermore, with parity relationships likely to hold only in the long run, property market and exchange rate movements are unlikely to have strong contemporaneous links.

To test this, potential correlations between the random variables in the three simulation model variables are explored. The three variables are percent change in the exchange rate, the 5 year rental growth rate and the capitalization rate for properties located in London city. The capitalization rate series was available for the period 1987:1 – 2003:4 so all three data series were truncated to incorporate that time series. First, the simple correlation coefficients were calculated between the three variables: -0.178 between the percent change in the exchange rate and the capitalization rate, 0.024 between the percent change in the exchange rate and the five year rental growth rate, and -0.151 , between the five year rental growth rate and the capitalization rate, for the period 1987:1 – 2003:4. However, in all three cases the

⁷ See, for example, Ammer & Mei (1996), Griffin & Stultz (1997), Heston & Rouwenhorst (1994), Jorion (1990), and Roll (1992).

results are statistically insignificant, so that the null hypothesis that the correlations are zero cannot be rejected.

Further analysis was conducted to examine whether significant correlations might exist on a sub-period basis. With a five year holding period used for the UK investment, rolling five-year correlations between the variables were calculated and graphed over the time series. The results are detailed in Exhibit 3 where the first observation represents the simple correlation coefficient for the first sub-period 1987:1 – 1991:4. Each subsequent observation represents the simple correlation coefficient for the sub-period formed by dropping one observation from the beginning date and adding one to the ending date. The simple correlation coefficient values for the percent change in the exchange rate versus the capitalization rate (xrcr) and the percent change in the exchange rate versus the rental growth rate (xrrg) are relatively small. The simple correlation coefficient values for rental growth versus the capitalization rate (rgcr) also ranges above and below the zero line but the values are significantly larger than the correlation coefficients that incorporate exchange rate fluctuations.

As illustrated in Exhibit 3, that details the critical range for the correlation's statistical significance, the rolling simple correlation values for the percent change in the exchange rate versus the caprate (xrcr) and the percent change in the exchange rate versus the rent growth rate (xrrg) are low and the null hypothesis that the random variables are unrelated cannot be rejected. Thus, there seems to be no significant correlation between these variables over the entire range or for the five-year sub-periods. However, this result does not hold for the simple correlation coefficient values for rent growth versus the caprate (rgcr). For these variables, the null hypothesis (i.e., $\rho_{rgcr} = 0$) can be rejected two-thirds of the time at the 5% level of significance. While this might suggest that the correlation structure should be modeled in the simulation analysis, Exhibit 3 illustrates that the values fall both above and below the zero line ranging from -0.90 to +0.80. Since the focus of this research is to isolate the impact of the exchange rate fluctuations, rather than explore the relationship between the random variables, we have not modelled in the correlation structure. This is certainly an area for future research.

The swapped quarterly payments are equal to the capitalization rate multiplied by the purchase price of the investment (the principal amount of the swap for Model 2). However, when the terminal value is used as the principal amount of the swap, the swapped quarterly payments represent 7.52% of the principal swap amount. The costs for the currency swap were a 1% origination fee based on the original principal or investment amount and a charge of 25 basis points per quarter on the swap payments. While the actual cost of the swap is influenced by a number of factors, the assumed costs are at the high end of the reported range of actual costs (Kolb, 1994).

Model Descriptions:

Exchange rates (\tilde{ER}_t), cash flow growth rates (\tilde{rg}), and capitalization rates (\tilde{c}) are set as random variables in a Monte Carlo simulation of a five-year real estate investment. The simulations are run with 10,000 iterations. Additionally, all scenarios are modelled simultaneously so that results for any given scenario are not an artefact of that particular simulation run. The choice of a large number of iterations was made to assure that the estimates from the simulation were stable. The equations describing the three models insert a tilde (\sim) above each variable with a random component.

Model 1: No Hedge for the Currency Risk

$$NPV_{US\$} = \sum_{t=0}^{19} \frac{NOINS_t * \tilde{ER}_t}{(1+r)^t} + \frac{\tilde{TV}_{20} * \tilde{ER}_{20}}{(1+r)^{20}} - P_0 * ER_0$$

Where,

- $NPV_{US\$}$ = the net present value of the investment for a US investor,
 $NOINS_t$ = quarterly net operating income (not swapped) in period t,
 \tilde{ER}_t = the \$/£ exchange rate in period t,
 \tilde{ER}_{20} = the \$/£ exchange rate at period 20,
 ER_0 = the \$/£ exchange at period 0,
 P_0 = the initial purchase price in £s,
 \tilde{TV}_{20} = the exit terminal value of the investment, and
 r = the quarterly risk free interest rate for US treasury securities

$$\tilde{TV}_{20} = \frac{NOINS_0 \left(1 + \tilde{r}g\right)}{\tilde{c}}$$

Where,

- $NOINS_0$ = the net operating income not swapped in the first period,
 $\tilde{r}g$ = the five year cash flow growth rate, and
 \tilde{c} = the exit capitalization rate.

Model 2: Hedge the Initial Purchase and Rental Income

$$NPV_{swapUS\$} = \sum_{t=0}^{19} \frac{(NOIS_t * ER_0)_t}{(1+r)^t} + \frac{P_0 * ER_0 + (\tilde{TV}_{20} - P_0) * \tilde{ER}_{20}}{(1+r)^{20}} - (P_0 * ER_0) - SC_0$$

Where,

- $NPV_{swapUS\$}$ = the net present value of the investment with a currency swap,
 $NOIS_t$ = quarterly net operating income (net of swap cost) in period t (value equal to 8.81% principle swap amount divided by four minus the swap cost),
 $(\tilde{TV}_{20} - P_0)$ = the change in the value of the property in £s,
 SC_0 = the costs for originating the currency swap,

P_o = the initial purchase price in £s, and
 r = the quarterly risk free interest rate for US treasury securities

Model 3: Hedge the Expected Terminal Value and Rental Income

$$\begin{aligned}
 NPV_{SwapTV} &= \sum_{t=0}^{19} \frac{(NOIS_t * ER_0)}{(1+r)^t} + \dots \\
 &\frac{\overline{TV}_{20} * ER_0 + (\tilde{TV}_{20} - \overline{TV}_{20}) * \tilde{ER}_{20}}{(1+r)^{20}} - (\overline{TV}_{20} * ER_0) + (\overline{TV}_{20} - P_0) * ER_0 - SC_0
 \end{aligned}$$

Where,

NPV_{swapTV} = the net present value of the investment with currency swap based on the expected terminal value,
 $(\overline{TV}_{20} * ER_0)$ = the principle swap amount based on the expected TV,
 ER = the exchange rate in the swap contract calculated net of cost,
 \overline{TV}_{20} = the expected terminal value in period 20,
 SC_0 = the costs for originating the currency swap based on \overline{TV}_{20} ,
 P_o = the initial purchase price in £s,
 r = the quarterly risk free interest rate for US treasury securities
 $(\overline{TV}_{20} - P_0) * ER_0$ = the portion of the swap not spent on the initial investment,
 $(\tilde{TV}_{20} - \overline{TV}_{20}) * \tilde{ER}_{20}$ = the net gain/loss on sale after the swap contract settlement.

4. Simulation Results

The models described above are intended to test whether a currency hedging strategy based on swapping the capital sum (either the initial purchase price or the expected terminal value) and the periodic rental income results in superior risk adjusted performance to not hedging against the currency exposure. To judge the swap a success, one would look for the mean (or median) net present value from the simulations to be relatively similar to the no hedge strategy, while the appropriate risk metrics should be lower. The standard risk metric used to compare performance results is the standard deviation (and, in simultaneously considering returns, the coefficient of variation). This measure, however, treats upside and downside risk as equally important. Most investors are likely to be more concerned with potential downside risk. Therefore, as a proxy for the potential risk of losing money, we also report the percentage of times the simulation produced a negative NPV.

Exhibit 4 sets out the results from the simulation process for the three models. Full details of the results for each model including a histogram of return distributions are shown in Exhibit 5. Exhibits 6 and 7 illustrate the risk-return profile of the three results graphically. It is immediately evident that while the swaps reduce the expected cash return on the investment, they greatly reduce the volatility of the cash flows, reducing the standard deviations significantly. This produces much more favourable risk-adjusted

returns. As expected, the swap does reduce the upside potential of the investment and the swapped returns are much more peaked around the mean value. However, the major benefit for the investor of foregoing high potential gains is the very sharp reduction in downside risk. The probability of a negative NPV is reduced from over 16% in the unhedged scenario to less than 3.0% in Model 2. The benefits of Model 3, where the expected terminal value rather than the purchase price is swapped, are similar to Model 2 but not as good. While the median NPV is higher than that of both Model 1 and Model 2, the mean value is lower. In addition, there is a truncation of upside potential (that is the benefits of currency gain are dampened) and the downside risk is higher by over \$5 million. Finally, the risk of a negative NPV is slightly higher (3.36%). Given the complexities of estimating and establishing the Model 3 swap structure, the gains seem marginal.

The Certainty Equivalent Technique (CET) for analyzing the alternative investment scenarios and the reduction of risk associated with employing the currency swaps is illustrated in Exhibit 6.

The NPV's and CV's are plotted so that the origin is at zero, the return – risk characteristics of models 2 & 3 are almost identical. In addition, the expected NPV of model 1 is only slightly above models 2 & 3 (\$13,019,178 versus \$12,604,436), but the coefficient of variation is almost double (1.05 versus 0.58). This makes it very likely that risk averse investors will find models 2 & 3 superior to model 1. Of course risk neutral investors will always find the investment with the highest expected return superior, regardless of risk and risk takers investors may actually select an investment with a lower expected return superior if it offers a chance at extremely high returns associated with greater risk alternatives.

The Coefficient of Variation (CV) is equal to the standard deviation of the expected returns (NPV) (σ_{npv}) divided by the mean (i.e., expected value) of the expected returns (μ_{npv}) or $CV = \sigma_{npv} / \mu_{npv}$. The CV is a measure of relative risk and as such can be used to compare the risk of investments with different NPV's. The certainty equivalent value of a risky investment is defined as an “assured sum that equals an expected risky amount in utility terms,” (Hirschey 2003, p.578). The certainty equivalent for three types of investors can be shown graphically with indifference curves that have been added to Exhibit 7. The indifference curve for Model 1 for a risk neutral investor is simply a vertical line drawn through the risk-return plot for Model 1. The certainty equivalent value is equal to the value where this curve intersects the horizontal axis (equal to the expected return for a risk neutral investor). The indifference curve for Model 1 for a risk taker investor is a line drawn through the risk-return plot for Model 1 falling to the right of the expected return for Model 1 (i.e., the small dashed line in Exhibit 7). The certainty equivalent value is equal to the value where this curve intersects the horizontal axis. This value is greater than the expected return for a risk taker investor and the more of a risk taker the greater the certainty equivalent value for a risky investment. The indifference curve for Model 1 for a risk-averse investor is a line drawn through the risk-return plot for Model 1 falling to the left of the expected return for Model 1 (i.e., the large dashed line in Exhibit 7). The certainty equivalent value is equal to the value where this curve intersects the horizontal axis. This value is less the expected return for a risk averse investor and the more risk averse, the less the certainty equivalent value for a risky investment.

If the model 1 indifference curve for a risk averse investor falls to the left of the risk/return metrics for models 2 & 3 it is inferior and the investor will select model 2 or 3, whichever has the higher certainty equivalent value. Note that individual indifference curves cannot intersect because to do so would violate the transitivity condition of indifference curves.

Conclusions and Extensions

Many investors considering direct international real estate acquisitions make piecemeal investments, exposing themselves to specific risk from both the real estate cash flow and from unexpected currency

fluctuations. Such investors cannot use conventional hedging techniques designed for multi-asset portfolios or for securities markets. However, most individual hedging techniques are ill-suited for lengthy multi-period cash flows such as those found in real estate markets. This research uses a Monte Carlo simulation framework to demonstrate the benefits of employing currency swaps to hedge the exchange rate exposure in a single international real estate investment. Unlike earlier studies that often rely on period-by-period adjustments for currency fluctuations, this study assumes only quarterly rental cash flows are repatriated as received. These rental cash flows, along with the original purchase price, are hedged initially with a plain vanilla currency swap. Then, the expected appreciation of the investment is partially hedged by swapping the anticipated terminal value of the investment at the point of acquisition.

The results suggest that, for individual investors, the swap strategy is highly effective in dampening downside risk from the combination of property market and currency market fluctuations. Not only is the standard deviation far lower in the two swap models; the risk of negative NPVs is reduced considerably. Of course, there are costs with this strategy. In addition to the direct negative impact of the swap costs on NPV, the returns are more tightly grouped around the mean value reducing the upside potential from favourable exchange rate movements. Nonetheless, proxy measures of the risk-adjusted returns suggest that the swapped strategies are superior – for the initial investment at least. It is less clear that the swap strategy based on the expected terminal value of the building is superior to the more conventional swap based on the acquisition cost and rental income.

As the interest in international real estate investment continues to grow and the fluctuations of the currency markets remain relatively uncertain and difficult to predict, there are a number of additional issues that could be explored and potentially provide very fruitful ground for further research. The UK lease structure used in this analysis is somewhat unusual and the resultant stable income pattern is well-suited for a currency swap. An extension might examine the impact of analysing a more volatile set of cash flows resulting from a multi-tenanted building with annually fluctuating rents. In addition, the full implications of using this hedging technique in a portfolio context have not been explored. Theoretically, the rationale for investing internationally is to gain diversification benefits for the whole portfolio. The scenarios modelled in this paper apply to an investor making restricted and specific real estate investments in different countries, rather than considering the overall impact on that investor's end wealth. While the analysis here may be valuable in informing the individual investment decision (and survey evidence suggests that many investors are chasing returns rather than seeking diversification benefits), an extension to consider wider impacts could be revealing.

Finally, an investor in real estate still has to face the uncertainty involved with the holding period. Market conditions may not be good for the property to be sold at the end of the five years. If the property were not sold, gains or losses from the swap contract would be realized without the accompanying cash flow. Even if the property were sold, illiquidity might lead to a divergence between timing of sale and expiry of contract (see Bond *et al.* 2004 for a review of liquidity in UK commercial real estate markets). To protect an international investor with an uncertain holding period, alternative hedging tools, such as an option, may be more successful in protecting the investor from this additional uncertainty. However, as noted above, existing option markets seem to be relatively thin for contract maturities that are greater than one year. So, options would probably be costly and ill-suited for a direct real estate investment.

All of these issues, along with the accounting exposure of holding an international real estate investment can be explored in future research. This paper, in examining realistic cash flows with fluctuating exchange rate scenarios based on meaningful historic rates of variation and fully incorporating transaction costs, demonstrates that some elements of exchange rate risk faced by individual investors can be hedged. In particular, a currency swap contract results in improved, risk-adjusted performance for an individual international real estate investment.

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Exhibit 1: Variables Used in the Simulation Models

Value	Description
1.78	Initial Exchange Rate: U.S. dollars per U.K. pound (1975:4 - 2004:3, average)
£380,000	Net Operating Income
£379,050	Net Operating Income – Swap Cost
£17,249,602	Net Initial Purchase Price = Outlay in Period 0 for Model 1*
£17,422,098	Net Initial Purchase Price + Swap Cost = Outlay in Period 0 for Model 2*
£400	Rent per Square Meters per year
4,000	Size in Square Meters
5.00%	Management Fee
17.14%	Average 20 Quarter Growth Rate-JLL ERV (1977:2 – 2003:4)
20.33	St. Dev. 20 Quarter Growth Rate-JLL ERV (1977:2 - 2003:4)
8.81%	Initial Capitalization Rate-IPD: London City Offices (1987:1-2003:4)
8.81%	Exit (reversion) Capitalization Rate-IPD: London City Offices (1987:1 - 2003:4)
1.02%	St. Dev. Exit (reversion) Capitalization Rate-IPD: London City Offices (1987:1 - 2003:4)
£20,205,654	TV: Terminal Value @ Expected Rent Growth Rate
1.00%	Swap Origination Fee
0.25%	Swap Cost per Period
£20,407,711	TV (@ Expected Rent Growth Rate + Swap Cost) = Outlay in Period 0 for Model 3*

* Acquisition, sales, and marketing costs for the purchase and sale of the property are the same for all three models. UK yields (cap rates) are quoted for the gross purchase price, with the purchaser offering a net price to the vendor. The impact of costs on the outcomes would be minor, so they are not explicitly accounted for in the simulations.

Exhibit 2: Standard Deviations of Exchange Rate Fluctuations by Quarter
(\$/bp 1975:4 – 2004:3)

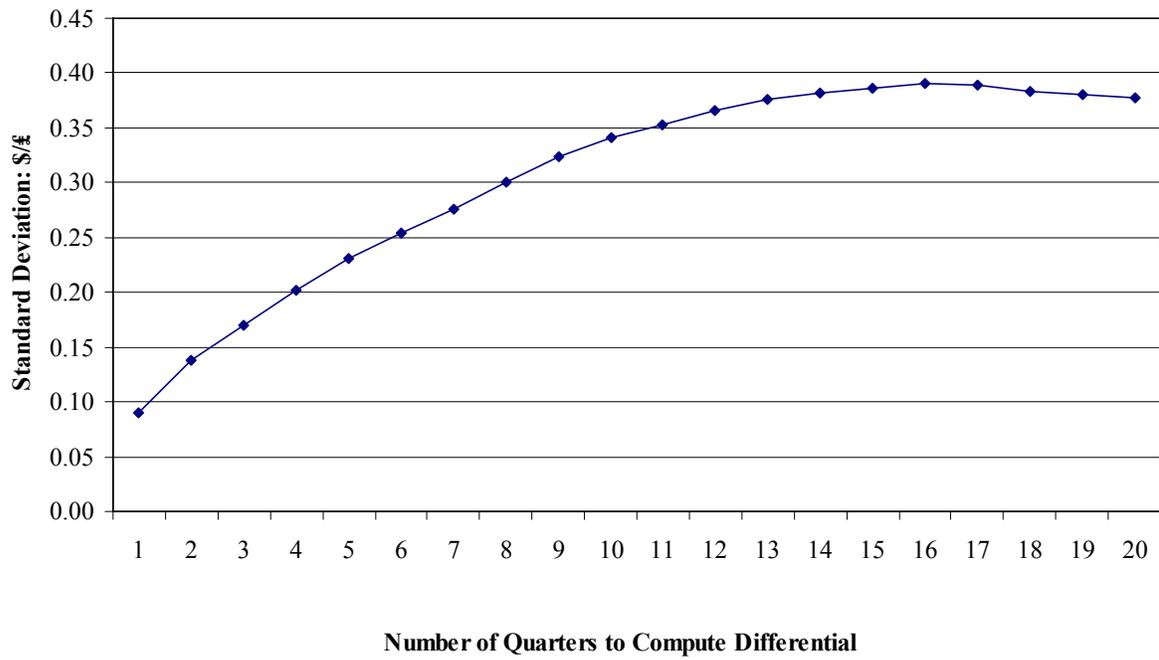
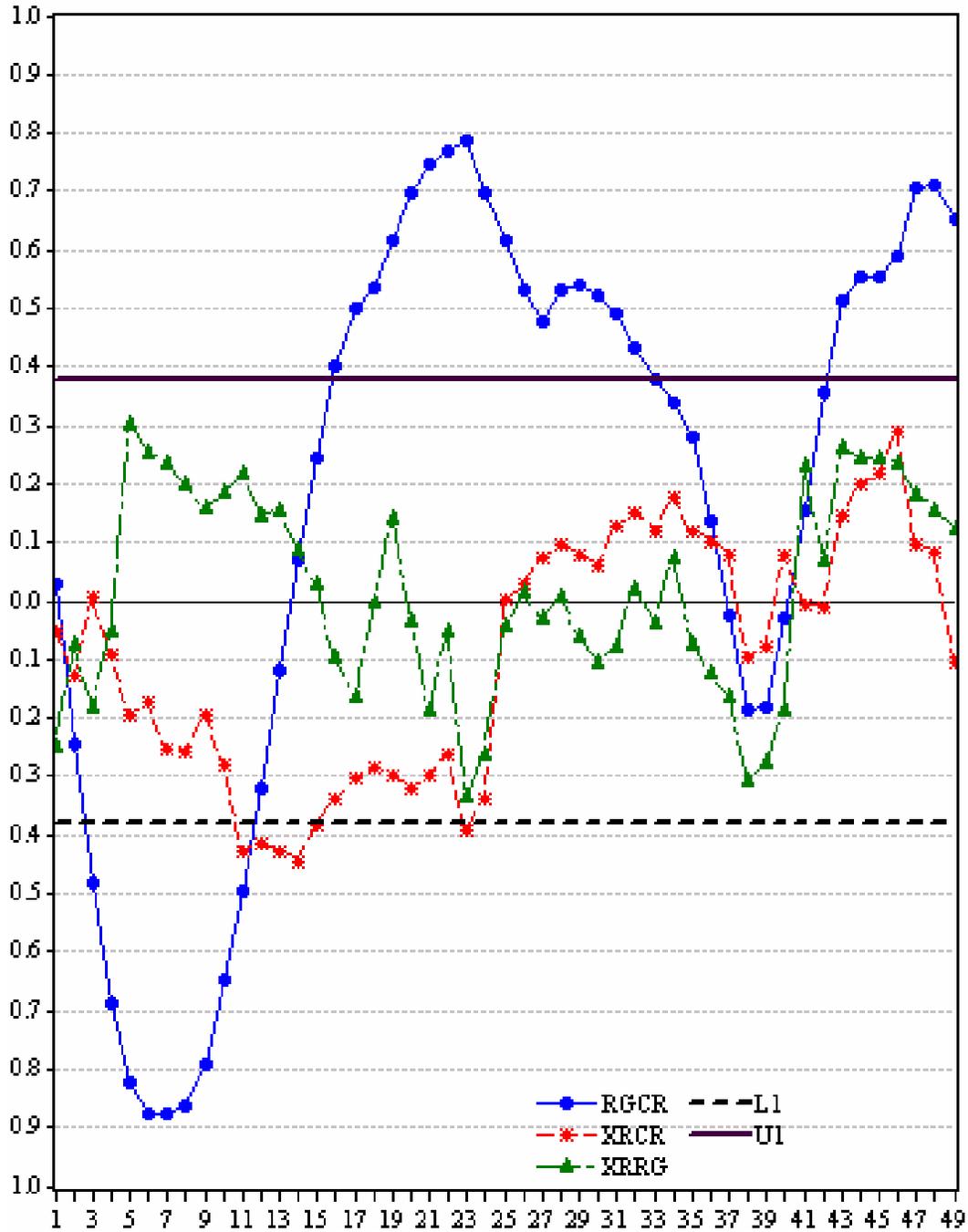


Exhibit 3: Simple Correlation Coefficient Values for Rolling Five Year Periods
(1987:1 – 2003:4, One-Tailed Significance Test)



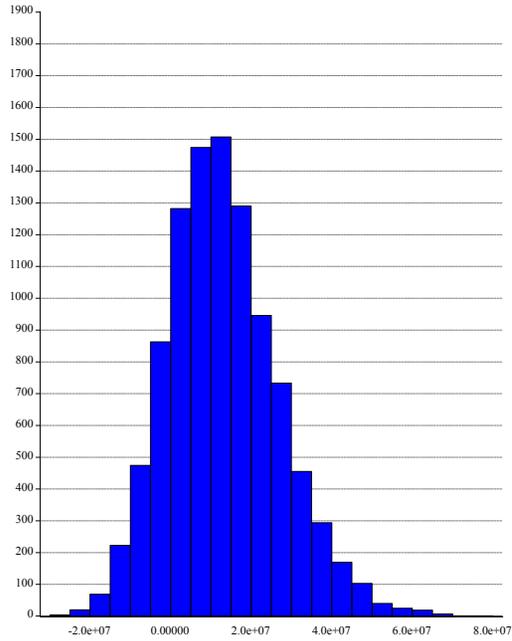
Where RGCR represents the simple correlation coefficient between the rent growth rate and the caprate, XRRCR represents the simple correlation coefficient between the percent change in the exchange rate and the caprate, XRRG represents the simple correlation coefficient between the percent change in the exchange rate and the rental growth rate, and L1 & U1 represent the lower and upper critical values for the one tailed t-test of the simple correlation coefficient. The null hypothesis that a simple correlation coefficient is equal to zero can be rejected when it falls outside of the interval formed by L1 & U1.

Exhibit 4: Descriptive Statistics of the Net Present Values (NPVs) for the Simulations

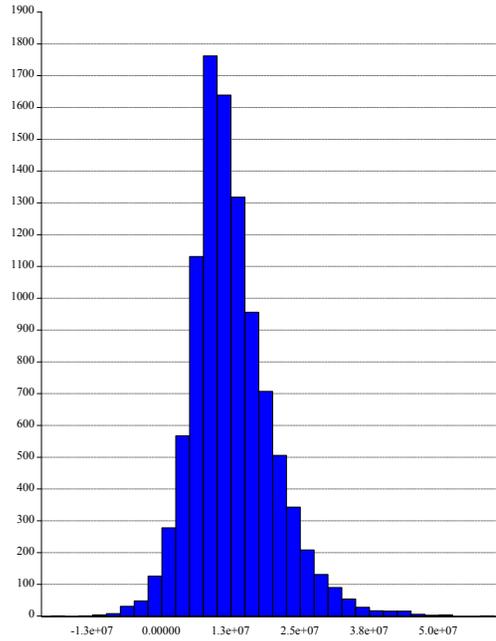
Descriptive Statistic	No Hedge	Hedge the Initial Purchase Price	Hedge the Expected Terminal Value
Mean NPV	\$13,019,178	\$12,604,436	\$12,536,700
Median NPV	\$11,939,672	\$11,534,114	\$12,120,244
Maximum NPV	\$79,985,368	\$59,657,058	\$56,294,869
Minimum NPV	-\$29,579,956	-\$19,606,864	-\$24,125,032
Std. Dev. NPV	\$13,712,198	\$7,290,032	\$7,073,287
Coefficient of Variation	1.05	0.58	0.56
Chance of a Negative NPV	16.53%	2.90%	3.36%
Std. Dev. of Semi-Variance	\$9,069,111	\$4,158,770	\$4,734,620
Skewness	0.47	0.85	0.45
Kurtosis	3.41	5.00	4.93
Jarque-Bera	433	2860	1891

Exhibit 5: Histograms of Expected NPV Simulations for Models 1, 2, and 3

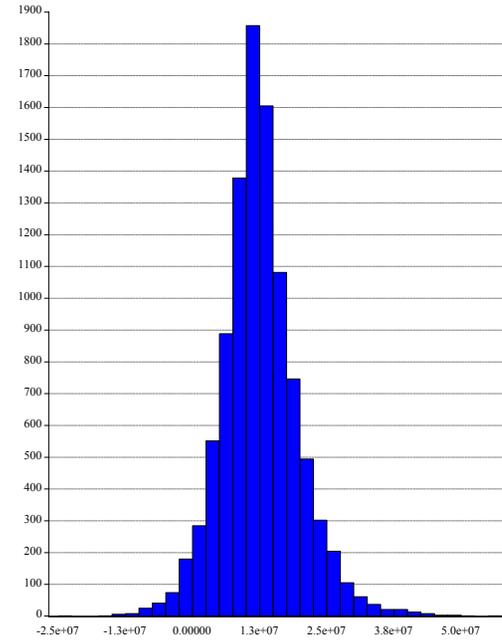
Model 1



Model 2



Model 3



Expected Return (NPV)

Exhibit 6: Comparison of Return (NPV) and Risk (CV) for Simulation Models

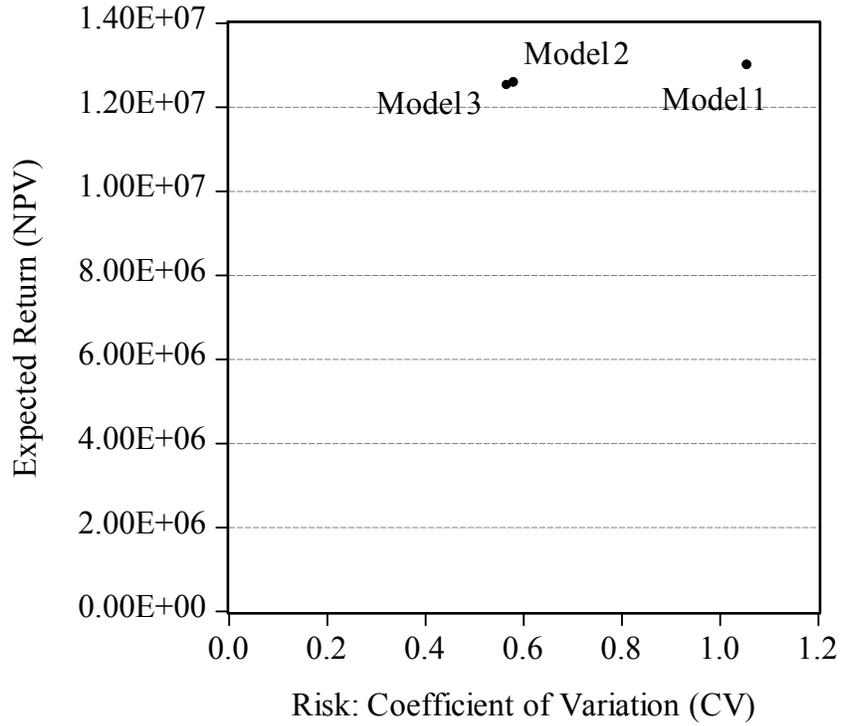


Exhibit 7: Comparison of Risk (CV) and Return (NPV) for Simulation Models

