THE SIGNIFICANCE OF FOREIGN EXCHANGE RISK IN THE INTERNATIONAL REAL ESTATE SECURITIES INVESTMENT

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Submitted to the Department of Urban Studies and Planning on August 2, 2000 in Partial Fulfillment of the Requirements for the Degree of Master of Science in Real Estate Development at the Massachusetts Institute of Technology

ABSTRACT

Traditionally, international real estate investments are mainly conducted through direct investments in foreign properties. Due to the recent securitization and globalization trends in the real estate capital markets, the international real estate securities investment has been growing fast and gaining more popularity than the direct real estate investment because of its absence of the portfolio management and monitoring problems.

Foreign exchange risk exposure is inevitable for the international investments. To minimize the foreign exchange risk and hedge investment returns, investors have been spending a huge amount of time and money on developing and implementing currency hedging strategies without paying enough attention on studying and testing the significance of the foreign exchange risk. Since there is no doubt about the existence of the foreign exchange risk, the importance of studying foreign exchange risk is to avoid unnecessary hedging costs.

By forming 6 study questions, applying the international real estate securities market indexes & U.S. financial market data, structuring Arbitrage Pricing Models, and performing hypothesis testing for 13 countries and 3 regions, the thesis studied the significance of foreign exchange risk in international real estate securities investment from different angles, including:

1. Is the foreign exchange risk significant across time?
2. Does the significance of foreign exchange risk change across time?
3. Is the foreign exchange risk significant on an equally weighted portfolio basis?
4. Does the significance of foreign exchange risk change across time on an equally weighted portfolio basis?
5. Is the foreign exchange risk significant on an optimally weighted portfolio basis?
6. Does the significance of foreign exchange risk change across time on an optimally weighted portfolio basis?

Thesis Advisor: William C. Wheaton
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For My Wife and My Parents

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INTRODUCTION

Evolution of the Global Real Estate Securities Markets

Although the modern portfolio theory provided a conceptual basis and the empirical evidence showed how international investments could lower portfolio risk[1], international portfolio investments was not popular until the end of 1970's due to the tight capital control and strict financial regulation brought by the Bretton Woods system. Beginning from 1980's, international portfolio investments began to experience fast growth while international real estate investments remained inactive, although the diversification benefits were widely observed from the low correlation among real estate and other asset classes. Why? According to Eichholtz [1996][2], there are two reasons. First, monitoring a foreign real estate portfolio is costly and difficult. Second, institutional differences between national capital markets are more cumbersome for direct real estate investments than for stock and bond investments.

Across time, the real estate indirect investments (the real estate securities investments) gradually proved themselves to be better investment vehicles for international investors because the monitoring and portfolio management problems inherent to direct foreign real estate investments do not really play a role for indirect real estate investments. The market for real estate securities finally took off in the early of 1990's. Led by U.S. REITs IPO boom in 1993, the global real estate securities market grew at a remarkable speed. Till to December 1995, this market had a total capitalization of $230 billion with about 430 real estate companies worldwide, comparing to 124 real estate companies in 1983. The development of global real estate securities market has facilitated international real estate diversification on a far larger scale then had been previously possible.

[1] Solnik, B. H. "Why not diversify internationally rather than domestically?" Financial Analysts Journal, 30 (1974), pp. 48-54

[2] Eichholtz, P. M. A and Koedijk, K.G. "The global real estate securities market", Real Estate Finance, Spring 1996, pp. 76

Why Should U.S. Investors Care About the International Real Estate Securities Markets?

In addition to the well-accepted global diversification benefits theory, a significant amount of investment opportunities offered by overseas real estate securities markets is the major reason. By the end of 1995, the number of public traded companies in the global real estate securities markets was almost evenly distributed over North America (138 companies, 29%), Europe (160 companies, 39%), and Asia/Pacific region (131 companies, 32%)[3]. Clearly, international markets account for a much larger portion of the overall global real estate securities market than the U.S. domestic market.

Foreign Exchange Risk in the International Real Estate Securities Investments

Since different currencies are used to facilitate international securities investments, the foreign exchange risk exposure is inevitable to the international investors. Defined as the risk of unanticipated changes in relative currency values, foreign exchange risk creates a number of problems in international investments. First, there is a translation exposure, which arises from the exchange rates volatility during the accounting period. Second, there is an economic exposure, which stems from the changes in the present value of the cash flows in response to currency volatility. Third, there is a transaction exposure, which comes from owning a claim in a foreign currency denominated, time deferred cash flow.[4]

To minimize the foreign exchange risk and hedge investment returns, investors have been spending a huge amount of time and money on developing and implementing currency hedging strategies, which include options, future contracts, currency swaps, overseas financing, financing from home banks, and reinvesting funds in the same country, etc. On the other hand, not many investors have paid enough attention on studying and testing the significance of the foreign exchange risk. There is no doubt about the existence of the foreign exchange risk, which is believed to continue exist as long as the various of financial systems still exist in the world.

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[3] Only consider equity real estate companies with a market capitalization more than $50 million.

[4] Kwame Addae-Dapaah, Goh Li Yong, "Currency risk and office investment in Asia Pacific", Real Estate Finance, Fall 1998, pp. 67

Fully understanding foreign exchange risk is important because foreign exchange risk hedging is costly and time consuming. Real estate securities investors need to know whether the foreign exchange risk is significant enough for them to spend time and sacrifice a portion of their investment return to hedge the downside risk. If the foreign exchange risk tends out to be insignificant, the time and money engaged in foreign exchange risk hedging are wasteful and meaningless.

PREVIOUS RESEARCH

Foreign Exchange Risk and Direct Real Estate Investments

The significance of the foreign exchange risk in international real estate securities investments can be tested at multiple levels. Horizontally, it can be tested both at an individual country level and at a global portfolio level. Vertically, it can be tested across the time.

While little research has been conducted to study the foreign exchange risk in the indirect real estate investments (neither at an individual country level nor at a global portfolio level), some topics have been explored by academics for the direct real estate investments. Although some findings are in conflict and researches are not really comparable due to the facts that the scholars focused on either certain geographic region or specific property or market sector, I listed those previous research to gain some insights.

The overall opinions can be divided into two groups. One group of scholars conducted studies and believed that foreign exchange risk is not significant in the direct real estate investments. These scholars and their studies are listed as follows: Kwame Addae-Dapaah and Goh Li Yong [1997][5] selected 8 Asia/Pacific countries to study the returns on the office sector from a Singapore investor's point of view during the period of 1984 -1997. Their finding is that the hypothesis of "foreign exchange risk has a significant impact on the return of a fully diversified

[5] Kwame Addae-Dapaah, Goh Li Yong, "Currency risk and office investment in Asia Pacific", Real Estate Finance, Fall 1998, pp. 67

international office portfolio" was rejected at 95% confidence interval. They also argued that since real estate investment's capital apperception components do not have fixed returns, which are vulnerable to currency volatility, the foreign exchange risk might not have a profound impact on the international real estate portfolio. Worzala [1994][6] selected a few European countries to examine international property investment and found that foreign exchange risk to be the least important problem of overseas investments. The limitation of the study is that European countries tend to have relatively stable exchange rate across time. Therefore, the findings could be biased. Jorion [1990][7] concluded that the exchange rate exposure would be important only if it represented a systematic component of an asset's risks. This is predicted on the assumption that foreign exchange risk can be diversified away through a broad country diversification.

The other group of scholars conducted studies and believed that foreign exchange risk is significant in the direct real estate investments. Newell and Webb [1996][8] studied the contribution of foreign exchange risk in an international mixed-asset portfolio for the period 1985 to 1993 and found that foreign exchange risk is particularly evident for real estate. After accounting for foreign exchange risk, real estate risk estimates increased significantly for international investors. Solnik [1996][9] studied diversified portfolios and found that foreign exchange risk has never been the major component of total return on a diversified portfolio over a long period of time because the depreciation of one currency is often offset by the appreciation of another. Newell and Worzala [1995][10] covered a few countries in the Far East to study foreign exchange risk and international property investment and found that exchange rate volatility is the most important problem besetting overseas investment and currency hedging is an essential component of overall portfolio management process. The limitation is that the selected countries are predominantly emerging economies that have fluctuate exchange rate across study period and exchange rate volatility is relatively major concern to overseas investors. Therefore, the finding

[6] Worzala, E. "Overseas property investments: how are they perceived by the institutional investor?" Journal of property valuation and investment, 12, 3 (1994), pp. 31-47
[7] Jorison, P. "The exchange rate exposure of U.S. multinationals." Journal of business, 63 (1990), pp. 331-345
[8] Newell, G., and J. Webb. "Assessing risk for international real estate investments." Journal of real estate research, 11, 2 (1996), pp. 103-115
[9] Solnik, B. International Investments. Boston: Addison-Wesley, 1996, 3rd edition
[10] Worzala, E. "Currency risk and international property investments" Journal of property valuation and investment, 13, 5 (1995), pp. 23-28. Newell, G., and Worzala, E. " The role of international property in investment portfolio." Journal of property finance, 6, 1 (1995), pp. 55-63

could be biased. Radcliffe [1994][11] concluded in his book that exchange rate risk of investments made in a single foreign country could be substantial. Ziobrowski and Curcio [1991][12] found that currency conversion consistently amplifies risk and domestic investments appear least risky regardless of asset type or country.

Foreign Exchange Risk and International Equity Securities Investments

Except for real estate securities investment, academics have committed a lot of efforts to study the relation between foreign exchange risk and international equity securities investment. One of the major research focuses is to study whether foreign exchange risk is priced in the equity capital markets. In other words, whether foreign exchange risk is attributable to the overall stock return and whether it is a systematic risk.

Theoretically, the exchange risk might be priced if there are international differences in consumption baskets of investors or if there is a deviation from purchasing power parity. Empirically, Jorion [1991][13] studied U.S. stock market covered the period of the 1970's and 1980's, a time when U.S. dollar appreciated dramatically, by using a multi-factor asset pricing model and found that the foreign exchange risk is not priced for the U.S. stock market. Hamao [1988][14] examined the foreign exchange risk for Japanese market by using a similar framework and found that it is not priced. In another study for the Japanese stock market, Brown and Otsuki [1990][15] found that foreign exchange risk is not priced in the Japanese stock market by using non-linear regression for a multiple factors model.

On the other side, scholars found opposite conclusions in the recent year studies. Dumas and Solnik [1995][16] studied four countries (U.S., Japan, U.K., and Germany) by using national stock

[11] Radcliffe, R.C. "Investment: Concepts, Analysis, and Strategy". New York: Harper Collins College Publishers, 1994, 4th edition
[12] Ziobrowski, A.J., and R.J. Curcio. "Diversification benefits of U.S. real estate to foreign investors." Journal of real estate research, 6, 2 (1991), pp. 119-142
[13] Jorion P., "The pricing of exchange rate risk in the stock market", Journal of financial and quantitative analysis (1991) pp. 363-376
[14] Hamao, Y. "An empirical examination of the arbitrage pricing theory" Jana and the world economy, I (1988)
[15] Brown, S.J. and Otsuki T., "Macroecnomic factors and the Japanese equity markets" Japanese Capital Markets, (1990)
[16] Dumas, B. and Solnik B., "The world price of foreign exchange risk", Journal of finance, 50 (1995), pp.445-477

price indexes rather than individual stock prices and studying the integrated world market as a whole rather than an individual national capital market. They found that foreign exchange risk is priced in the equity market and therefore is a systematic risk. Bruce and Morley [1998] studied the relationship between equity market pricing and foreign exchange risks for G-7 countries. They applied an error correction model to examine the dynamic behavioral relationship between the excess returns of foreign exchange rate and the variables that measure the stock market risk factors. Their study results supported the hypothesis that the excess foreign exchange returns are related to relative risks of the country equity markets and hence supported that foreign exchange risk is systematic. Jongnoo Jay Choi, Takato Hiraki, and Nobuya Takezawa [1998][17] studied the data from 1974 to 1995 and did not assume that world capital market is integrated. They applied conditional and non-conditional multiple factors asset pricing models with the market, the interest rate, and foreign exchange risk factors to industry level data and found that foreign exchange rate is priced in the Japanese stock market and more importantly, the foreign exchange risk pricing is sensitive to the choice of sub-periods, suggesting a time-varying nature to the foreign exchange risk.

[17]Choi, J.J., Hiraki, T., and Takezawa, N., "Is foreign exchange risk priced in the Japanese stock market?" Journal of financial and quantitative analysis, September 1998

THESIS OBJECTIVE

The thesis objective is to study the significance of foreign exchange risk in the international real estate securities investment through the following questions:

1. Is the foreign exchange risk significant across time?
2. Does the significance of foreign exchange risk change across time?
3. Is the foreign exchange risk significant on an equally weighted portfolio basis?
4. Does the significance of foreign exchange risk change across time on an equally weighted portfolio basis?
5. Is the foreign exchange risk significant on an optimally weighted portfolio basis?
6. Does the significance of foreign exchange risk change across time on an optimally weighted portfolio basis?

DATA

1. GPR-LIFE International Real Estate Indexes for 13 Countries and the World

The GPR-LIFE Indexes is provided by Global Property Research in the Netherlands. The indexes contain the historical real estate return in 26 country indexes. Among them, 14 countries begin in January 1984 and 12 countries begin on different dates after January 1984. In my research, I used 13 country indexes that began from 1984 because those data series are more complete.

The GPR-LIFE indexes include all publicly traded companies that have a market capitalization exceeding $50 million for at least 12 months. The indexes include “Investor” companies, for which 75% of more of the profits are derived from real estate investments and “hybrid” companies, for which 75% of more of the profits are derived form investment and development activities. The indexes exclude "developers”, for which 75% or more of the profits are derived form construction and development and “mortgage investors”, for which 75% or more of the

profits are derived from investments in mortgage loans. The distinction between investment and development companies is important, because only the former represent real estate portfolios, which are relevant to an analysis of real estate returns. Of the four major international real estate indexes (GPR-LIFE, Datastream, Morgan Stanley Capital International, and Solomon Brothers), GPR-LIFE offers the only index which makes a distinction between property investment companies and property development companies. The GPR-LIFE indexes are also the most representative indexes, which collects information from 335 companies.[18]

The GPR-LIFE indexes are available in both local currency and U.S. dollar denominations. The indexes provide information regarding monthly total return, dividends, and price. The indexes have a variety of start dates, with the earliest starting with data from the month ending January 31, 1984. The total return indexes assume reinvestment of all dividends. The dollar denominated returns are computed in accordance with the following formula:

$$r^{\$}_{i,t} = \frac{P^{\$}_{i,t} + D^{\$}_{i,t} - P^{\$}_{i,t-1}}{P^{\$}_{i,t-1}}$$

In which

$r^{\$}_{i,t}$ = Return of share i in USD in the period of $(t\text{-}1, t)$

$P^{\$}_{i,t}$ = Price of share i in USD at time t

$D^{\$}_{i,t}$ = Dividend on share i in USD at time t

$P^{\$}_{i,t-1}$ = Price of share i in USD at time t-1

t = Last trading day of the month

The GPR-LIFE indexes are available in market-weighted and equal-weighted formats. For a market capitalization-weighted index, each stock return is weighted by the stock's fraction of the beginning-of-period market capitalization for the total index. The return is computed by

[18] Eicholtz, P and Koedijk, "International Real Estate Securities Indexes", Real Estate Finance, Winter 1996

multiplying each company's return by its' beginning-of-period market capitalization and adding the results. Finally, the sum is divided by the beginning-of-period market capitalization. An equal-weighted index is the arithmetic average of the separate company returns. It is called equal-weighted because each company, regardless of size, exerts the same influence on the index return.[19]

In my analysis, I used U.S. dollar denominated market weighted total return indexes. I used U.S. dollar denominated indexes rather than the local currency denominated indexes because the research is conducted from an American investor's perspective. Also, using U.S. dollar denominated indexes to deduce investment return introduces the return/loss due to the currency fluctuation, which is my research focus. I used the market weighted indexes rather than equally weighted indexes because the market weighted indexes provide a more accurate reflection of the domestic real estate market of a particular country. I used the total return indexes because total return is a more meaningful measure of return than either dividend yield or price appreciation on its own.

The GPR-LIFE indexes for Germany and Switzerland are flawed because the majority of the companies in these indexes consist of "open-end" funds.[20] In the case of open-end funds, shares are typically bought and sold at prices established by the issuing company, based on its appraisals of property values. Shares of open-end funds tend to exhibit lower volatility than shares of closed-end funds, because their value are established by appraisals. Thus, the indexes for Germany and Switzerland exhibit lower volatility than the local real estate markets due to the nature of the securities issued by property companies in these countries. In addition, the German open funds tend to make substantial investments in other European countries. I chose to include the two countries in my research because they represent a significant part of the European economy.

It should also be noted that the companies included in GPR-LIFE indexes have changed since the beginning of the data series. The following table shows the number of companies included in

[19] Giliberto, S. and Sidoroff, F., "Real Estate Stock Indexes", Real Estate Finance, Spring 1995, pp. 56-62

each country's index in January, 1984 compared with the number of companies include in the indexes in April, 1997.

Number of Companies in GPR-LIFE Indexes

	January 1984	*April 1998*
USA	26	126
Canada	2	10
France	10	39
Germany	8	17
Italy	2	5
Norway	1	3
Netherlands	3	9
Switzerland	11	20
Sweden	1	12
UK	31	54
Hong Kong	15	29
Singapore	3	13
Australia	4	26
Japan	7	22

Due to the changes of the GPR-LIFE indexes over time, one should be cautious in interpreting the GPR-LIFE data.

2. Monthly U.S. CPI, 1/84 – 4/98

From Bloomberg, I downloaded the Consumer Price Index (CPI) for U.S. for the period of 1/84 – 4/98. I used the CPI data to deflate the USD denominated GPR-LIFE index returns. By deflating returns, I can separate the impact of inflation from the return. By using real return data, the research is much more meaningful.

[20] Rosenfeld R, "An evaluation of opportunities to improve performance of portfolios of real estate securities through international diversification" 1997.

3. Monthly Foreign Exchange Rate for 13 Countries, 1/84 – 4/98

To deduce the foreign exchange translation gain and loss, I collected 13 countries' monthly foreign exchange rates following the direct method, Foreign Currency/USD.

4. 3-Month U.S. T-Bill Yield, 1/84 – 4/98

To propose the APT model, I ran the regressions by applying return premium instead of return, I used 3-month US T-bill yield as risk free rate to calculate the return premiums. The reason to use 3-month US T-bill yield is that all the return data calculated from GPR-LIFE indexes are on the monthly basis and 3-month horizon is the closest in terms of the timing.

RESEARCH SCOPE AND TIME HORIZON

My research covered 14-year time span (172 monthly observation during 1/84 - 4/98) and included 13 countries and 3 regions:

- 1 American country: Canada;
- 8 European countries: UK, Italy, France, Germany, Sweden, Switzerland, Netherlands, and Norway;
- 4 Asian countries/cities: Hong Kong, Singapore, Australia and Japan.
- 3 regions: North America, Europe, and Asian Pacific.

RESEARCH METHODOLOGY

My starting point is to evaluate the significance of foreign exchange risk from an American investor's view. That is, the American investor converts his USD capital into foreign currencies and invests in foreign currency denominated indexes formed by public traded foreign real estate operating companies at the beginning of each month. The investors realizes the USD denominated returns by selling his holdings and converting it back to USD at the end of each

month. He repeatedly does this for every month during the period of 1/84 - 4/98 in 13 different countries.

The overall research methodology is built on the Arbitrage Pricing Theory (APT) developed by Stephen Ross in 1976[21]. Multiple factors Arbitrage Pricing Model (hereafter APT model) relies on the assumption that a rational equilibrium in capital markets precludes arbitrage opportunities. In contrast to CAPM (Capital Asset Pricing Model), APT yields an expected return-beta relationship using a well-diversified portfolio that practically can be constructed from a large number of securities. That is, APT argues that a security's return can be explained by factors other than the market factor.

Although the differences exist, APT does have close ties with CAPM. CAPM can be viewed as a simple version of APT. The major difference between CAPM and APT is that CAPM assumes that only one systematic factor affects security return. This single systematic factor is the market return. CAPM argues that any individual securities' return can be simply estimated by the movement of the overall market. Normally, the CAPM can be written as follows:

$$E(r_i) = R_f + \beta_i [E(r_M) - R_f]$$

$$\beta_i = \frac{Cov(r_i, r_M)}{\sigma^2{}_M}$$

Where the Beta coefficient is the covariance of the asset with the market portfolio as a fraction of the variance of the market portfolio and measures the extent to which returns on the stock and the market move together.[22]

In my research, the CAPM can be written as follows:

$$E(r)_{USDReal(Country)} = R_f + \beta_{USD\,Real(Country)} [E(r_{USD\,Real(World)}) - R_f]$$

[21] Stephen A. Ross, "Return, Risk and Arbitrage", Cambridge, Massachusetts, Ballinger, 1976
[22] Bodie Z, Kane A, Marcus A, "Investments", Third edition, Irwin McGraw-Hill, 1995, Chapter 8 "The capital asset pricing model" pp 237-265

$$\beta_{USD\,Real\,Country} = \frac{Cov(r_{USD\,Real(Country)}, r_{USD\,Real(World)})}{\sigma^2_{USD\,Real(World)}}$$

According to CAPM, there is only one systematic risk factor and the GPR-LIFE country index return can only be explained by the market index return premium, which is the world index return premium. In my research, I made a hypothesis that in addition to the market factor, there is another systematic risk factor, changes in foreign exchange rate, which might also play an role in explaining the USD denominated GPR-LIFE country index return. To test my hypothesis, instead of using the CAPM, I structured a two-factor APT model as follows:

$$\left(E(r)_{USDReal(Country)} - R_f\right) = \alpha + \beta_{country}\left(E(r)_{USDReal(World)} - R_f\right) + \beta_{\Delta FX}\left(E(r)_{FX(Country)} - R_f\right) + \varepsilon$$

My task is to study the significance of foreign exchange risk through testing the significance of the beta coefficient, $\beta_{\Delta FX}$, of foreign exchange risk factor in the APT model for the following questions:

1. Is the foreign exchange risk significant across time?
2. Does the significance of foreign exchange risk change across time?
3. Is the foreign exchange risk significant on an equally weighted portfolio basis?
4. Does the significance of foreign exchange risk change across time on an equally weighted portfolio basis?
5. Is the foreign exchange risk significant on an optimally weighted portfolio basis?
6. Does the significance of foreign exchange risk change across time on an optimally weighted portfolio basis?

EXPECTED PROBLEMS

Since the overall research methodology is based on the multiple factors APT model and APT model works on the basis of the existence of a rational market equilibrium, I might face problems shown in the research finding results as some other academics faced before when applying the similar methodology.

The Negative Sign of Beta Coefficient

One problem is the negative sign associated with the APT model's beta coefficient. Why is the negative sign problematic? Theoretically, if the market is efficient and the risk factors are significant (systematic), investors should be compensated for taking those risks. If this is true, the sign of the beta coefficient of the significant risk factors should be always positive. This coincides with the traditional understanding about the return-risk relationship. That is, returns go with risks and higher risks need to be compensated by higher returns. Therefore, it seems that it does not make sense when the sign of the risk factor's beta coefficient is actually negative. How can it be possible that increased risks result in decreased returns? But, in the real world, it could happen in many ways.

First, it could be due to the market inefficiency or imperfect market. Efficient market theory tells us that higher risks should always go with higher returns. This means that if my stock portfolio has higher risk than yours, my stock portfolio should have higher return than yours. But, in the real world, we all know it is not true - higher risks do not necessarily go with higher return. We see that some portfolios have higher returns but lower risks while others have lower returns and higher risks. Why? Because the market is not perfectly efficient, for some risks, even they are systematic (or significant), they are not priced or mis-priced by the market. In my research, this could also happen. Due to the existence of the market inefficiency, it is possible that some additional risks actually result in reduced return during a specific period of time. In this case, the sign of the risk factor's beta coefficient will be negative.

Second, it could be due to some special type of correlation between one factor's movements to another factor's movements and some country specific economic reasons might be responsible for that. In my research, there are two possibilities to explain the negative sign from the correlation's perspective. One possible explanation is that there is a negative correlation between a country's USD denominated real estate security index return changes and the USD denominated foreign exchange changes. That is, the two moves in an opposite direction – when the USD denominated foreign exchange rate rises, country's USD denominated real estate security index does exceedingly poorly. The other possible explanation is that for certain countries, such as small countries/cities like Singapore and Hong Kong, big real estate companies that account for large weights in the real estate securities market index usually have large investments in other countries. The return pattern of these companies operation is more likely to be unique due the complicated exposures from their overseas operations. In this case, it is also possible for the real estate securities index return to have negative correlation with the foreign exchange rate changes for a certain period of time.

The Changing Signs of Beta Coefficient

Since some study questions are involved in the testing of sub-periods, I expect to see that the estimated beta coefficients will show significant time variations, which might be reflected as the changing of signs (+ or -). Empirically, it is normal to have changing signs for beta coefficients when the pre-set time horizon changes in the APT model. APT model offers the estimated beta coefficients solely based on the data we provide. Therefore, when the changing signs show up, it does not mean that something wrong with the APT model but means that some changes due to the underlying economic factors are captured by the APT model for that specific period of time. This phenomenon is evidenced by Elton, Gruber, and Mei's [1994][23] study of nine New York Utilities. Elton, Gruber, and Mei conducted the study to estimate the cost of capital by using APT model. They developed 3 multiple factors APT models for 3 study periods, which are 1986, 1988, and 1990 respectively. For the exchange rate risk premium factor's beta coefficient, the sign changes across the 3 study periods. Elton, Gruber, and Mei explained it as: "The positive

[23] Elton, E., Gruber, M.J., Mei, J.P., "Cost of capital using arbitrage pricing theory: a case study of nine New York utilities", Financial markets, institutions & instruments, V.3, N.3, August 1994.

sign implies that firms with characteristics of higher returns when the dollar strengthens are viewed as less desirable by investors. The mixture of signs shows that whether investors prefer positive or negative betas changes over time." Jongnoo Jay Choi, Takato Hiraki, and Nobuya Takezawa's [1998][24] study about the relationship between Japanese stock market and foreign exchange rate for the period of 1974 - 1995 also found that the foreign exchange risk pricing is sensitive to the choice of sub-periods and suggested a time-varying nature to the foreign exchange risk. Therefore, inconsistency of the signs of beta coefficients across time exists.

[24]Choi, J.J., Hiraki, T., and Takezawa, N., "Is foreign exchange risk priced in the Japanese stock market?" Journal of financial and quantitative analysis, September 1998

QUESTION 1: Is the foreign exchange risk significant across time?

Objective

My objective in the Question 1 is to study whether foreign exchange risk is significant across time. In another word, whether the return from currency changes accounts for a significant portion of the USD denominated real return.

Methodology

To study this question, I used U.S. CPI to deflate the USD denominated index returns in the first step. I applied the following equation:

$$RealE(r)_t = NorminalE(r)_t\left(\frac{CPI_t}{CPI_{Base(1/1984)}}\right)$$

In the second step, I proposed a two-factor APT Model because all country indexes are formed by publicly traded real estate operating companies and therefore, the variation of return premium of individual country index can be explained by the variation of the market premium, which is calculated by using the world index.

The two-factor APT model is listed as follows:

$$\left(E(r)_{USDReal(Country)} - R_f\right) = \alpha + \beta_{country}\left(E(r)_{USDReal(World)} - R_f\right) + \beta_{\Delta FX}\left(E(r)_{FX(Country)} - R_f\right) + \varepsilon$$

The two factors under the APT model are:

- The market return premium (USD denominated real world index return – Risk-free rate)
- The foreign exchange return premium (Foreign exchange return – Risk-free rate)

The 90-day U.S. T-bill yield is used as risk free rate for two reasons. One is for the timing issue and the other is that the study is conducted from a U.S. investor's point of view.

The beta coefficients in the APT model are proposed by regressing the USD denominated country index real return premium against the market return premium and the currency return premium.

In the third step, I made a null hypothesis that the beta coefficient of the foreign exchange return equals to zero. That is, the return brought by foreign exchange movement is not attributable to the USD denominated real country index return. The alternative hypothesis is that the beta coefficient does not equal to zero.

$$H_0 : \beta_{\Delta FX} = 0$$
$$H_1 : \beta_{\Delta FX} \neq 0$$

To form the hypothesis testing, I compared the calculated Z-statistics with the critical Z-statistics at 95% C.I. level. The range of critical Z-statistics is (-1.96, +1.96). Using Z-statistics is due to the large sample size of 172 observations. To calculate the Z-statistics, I used the following equation:

$$Calculated\ Z\text{-}score = \left(\frac{\beta_{\Delta FX} - 0}{\delta_{(\beta \Delta FX)}} \right)$$

The standard deviation is referred from the ANOVA table based on 172 observations.

If the calculated Z-score falls within the critical Z range of (-1.96, +1.96), I will accept the null hypothesis. That is, the beta coefficient is not significantly different from 0 and therefore the currency return factor is not statistically significant in the APT model. In another word, the return brought by foreign exchange rate changes is not an attribute factor in the USD denominated real country index return and therefore the foreign exchange risk is not significant in investing in that country's real estate securities market index.

On the other hand, if the calculated Z-score falls beyond the critical Z range of (-1.96, +1.96), I will reject the null hypothesis and accept the alternative hypothesis. That is, the beta coefficient is significantly different from 0 and therefore is statistically significant in the APT model. Said differently, the return brought by foreign exchange rate changes is an attributable factor in the USD denominated real country index return and therefore the foreign exchange risk is significant in investing in that country's real estate securities market index.

The Findings

North America

North America (1/84 - 4/98)

Regression Statistics	
Multiple R	0.624292563
R Square	0.389741204
Adjusted R Square	0.382519207
Standard Error	0.046229109
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.230664113	0.115332057	53.96584528	7.51514E-19
Residual	169	0.361175063	0.002137131		
Total	171	0.591839176			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.001761848	0.010609815	0.166058354	0.868309523	-0.019182979
E(R)(World) - Rf	0.541474206	0.064789603	8.357424323	2.25825E-14	0.413573104
E(R)FX(North America) - Rf	0.384876573	0.178450343	**2.15677127**	0.032436628	0.032597898

Since the Z-statistic for the currency factor's beta coefficient is 2.15, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in North America's real estate securities markets as whole is statistically significant during the period 1/84 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in North America.

Canada

Canada (1/84 - 4/98)

Regression Statistics	
Multiple R	0.394883352
R Square	0.155932861
Adjusted R Square	0.145943901
Standard Error	0.089361137
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.249312888	0.124656444	15.61051982	6.00974E-07
Residual	169	1.349534754	0.007985413		
Total	171	1.598847642			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.047641213	0.020508834	-2.322960599	0.021372773	-0.088127685
E(R)(World) - Rf	0.6606341	0.125238679	5.275000535	4.02196E-07	0.413400526
E(R)FX(Canada) - Rf	-0.174883302	0.344945549	**-0.506988139**	0.61282402	-0.855840027

Since the Z-statistic for the currency factor's beta coefficient is –0.5, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Canada's real estate securities market is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Canada.

Europe

Europe (1/84 - 4/98)

Regression Statistics	
Multiple R	0.650900978
R Square	0.423672083
Adjusted R Square	0.416851635
Standard Error	0.030011247
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.111896108	0.05594805	62.11791931	5.97841E-21
Residual	169	0.152214067	0.00090067		
Total	171	0.264110175			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.024980481	0.004943443	-5.05325563	1.11913E-06	-0.034739327
E(R)(World) - Rf	0.415470417	0.038734567	10.7260892	8.40721E-21	0.339004541
E(R)FX(Europe) - Rf	0.098253127	0.071891946	**1.3666778**	0.173541736	-0.043668705

Since the Z-statistic for the currency factor's beta coefficient is 1.36, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Europe's real estate securities markets as whole is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Europe.

United Kingdom

UK (1/84 - 4/98)

Regression Statistics	
Multiple R	0.534186417
R Square	0.285355128
Adjusted R Square	0.276897792
Standard Error	0.067011929
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.303030499	0.15151525	33.74054623	4.68413E-13
Residual	169	0.758911163	0.004490599		
Total	171	1.061941663			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.010059529	0.009607203	-1.047082019	0.296556975	-0.0290251
E(R)(World) - Rf	0.700531918	0.087113612	8.041589587	1.47853E-13	0.528561007
E(R)FX(UK) - Rf	0.013084072	0.131799129	**0.099272824**	0.921039312	-0.247100481

Since the Z-statistic for the currency factor's beta coefficient is 0.09, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in United Kingdom's real estate securities market is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the UK.

Italy

Italy (1/84 - 4/98)

Regression Statistics	
Multiple R	0.154964097
R Square	0.024013871
Adjusted R Square	0.01246374
Standard Error	0.09678304
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.038949668	0.019474834	2.079099349	0.128229522
Residual	169	1.583015713	0.009366957		
Total	171	1.621965381			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.038820771	0.015647484	-2.480959305	0.014081373	-0.069710456
E(R)(World) - Rf	0.254735738	0.124933959	2.038963142	0.043011485	0.008103712
E(R)FX(Italy) - Rf	-0.074941743	0.220332732	**-0.340129868**	0.734181112	-0.509900409

Since the Z-statistic for the currency factor's beta coefficient is -0.34, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Italy's real estate securities market is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Italy.

France

France (1/84 - 4/98)

Regression Statistics	
Multiple R	0.469417397
R Square	0.220352693
Adjusted R Square	0.211126097
Standard Error	0.045240546
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.097760307	0.04888015	23.8823406	7.33494E-10
Residual	169	0.345893481	0.00204671		
Total	171	0.443653788			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.025455483	0.00676136	-3.76484643	0.000229705	-0.038803079
E(R)(World) - Rf	0.385894844	0.057918382	6.66273525	3.63053E-10	0.271558214
E(R)FX(France) - Rf	0.116126699	0.091474564	**1.26949716**	0.206009187	-0.064453162

Since the Z-statistic for the currency factor's beta coefficient is 1.26, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in France's real estate securities market is insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in France.

Germany

Germany (1/84 - 4/98)

Regression Statistics	
Multiple R	0.547831671
R Square	0.30011954
Adjusted R Square	0.291836931
Standard Error	0.017058185
Observations	172

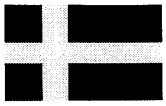
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.021087386	0.010543693	36.23490373	8.02633E-14
Residual	169	0.049175902	0.000290982		
Total	171	0.070263288			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.036582656	0.002493095	-14.67358884	5.7758E-32	-0.041504273
E(R)(World) - Rf	0.116096065	0.021810866	5.322854359	3.21275E-07	0.073039252
E(R)FX(Germany) - Rf	0.208179993	0.033209162	**6.268751784**	2.93E-09	0.142621814

Since the Z-statistic for the currency factor's beta coefficient is 6.26, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Germany's real estate securities market is statistically significant during the period 1/84 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Germany.

Sweden



Sweden (1/84 - 4/98)

Regression Statistics	
Multiple R	0.383627095
R Square	0.147169748
Adjusted R Square	0.137077083
Standard Error	0.151450559
Observations	172

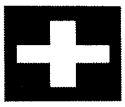
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.668935768	0.334467884	14.58185109	1.43843E-06
Residual	169	3.876398961	0.022937272		
Total	171	4.545334729			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.07184124	0.023252462	-3.089618662	0.002343937	-0.117743906
E(R)(World) - Rf	0.912848753	0.195842572	4.661135439	6.35196E-06	0.526236093
E(R)FX(Sweden) - Rf	-1.119551828	0.32423383	**-3.452914913**	0.000700843	-1.759621566

Since the Z-statistic for the currency factor's beta coefficient is –3.45, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Sweden's real estate security market is statistically significant during the period 1/84 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Sweden.

Switzerland



Switzerland (1/84 - 4/98)

Regression Statistics	
Multiple R	0.453539996
R Square	0.205698528
Adjusted R Square	0.19629851
Standard Error	0.034484484
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.052045116	0.026022558	21.88278155	3.53805E-09
Residual	169	0.200971357	0.00118918		
Total	171	0.253016474			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.029878825	0.004851843	-6.158242588	5.19459E-09	-0.039456844
E(R)(World) - Rf	0.264481861	0.044105112	5.99662598	1.18723E-08	0.177413996
E(R)FX(Switzerland) - Rf	0.147460064	0.062565485	**2.356891579**	0.019573998	0.023949592

Since the Z-statistic for the currency factor's beta coefficient is 2.35, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Switzerland's real estate securities market is statistically significant during the period 1/84 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Switzerland.

Netherlands

Netherlands (1/84 - 4/98)

Regression Statistics	
Multiple R	0.584725099
R Square	0.341903442
Adjusted R Square	0.334115317
Standard Error	0.038388587
Observations	172

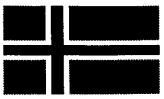
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.129391221	0.06469561	43.90061074	4.42051E-16
Residual	169	0.249052529	0.001473684		
Total	171	0.37844375			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.007753619	0.009819016	0.789653373	0.430836743	-0.011630092
E(R)(World) - Rf	0.315968409	0.051849695	6.093929954	7.22905E-09	0.213611969
E(R)FX(Netherlands) - Rf	0.775386406	0.164241726	**4.721007403**	4.90335E-06	0.451156949

Since the Z-statistic for the currency factor's beta coefficient is 4.72, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Netherlands' real estate securities market is statistically significant during the period 1/84 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Netherlands.

Norway



Norway (1/84 - 4/98)

Regression Statistics	
Multiple R	0.254253859
R Square	0.064645025
Adjusted R Square	0.053575735
Standard Error	0.125911818
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.185173288	0.092586644	5.84003372	0.003527857
Residual	169	2.679289803	0.015853786		
Total	171	2.86446309			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.020689687	0.019456233	-1.063396334	0.289119351	-0.059098221
E(R)(World) - Rf	0.554056691	0.162462338	3.410370035	0.000811462	0.233339922
E(R)FX(Norway) - Rf	-0.197597523	0.27020052	**-0.731299565**	0.465608952	-0.731000147

Since the Z-statistic for the currency factor's beta coefficient is –0.73, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Norway's real estate securities market is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Norway.

Asia

Asia (1/84 - 4/98)

Regression Statistics	
Multiple R	0.942903764
R Square	0.889067508
Adjusted R Square	0.887754697
Standard Error	0.035077673
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1.666572571	0.833286285	677.2245261	2.02986E-81
Residual	169	0.207944894	0.001230443		
Total	171	1.874517465			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.012697453	0.007094961	1.78964377	0.075301799	-0.001308704
E(R)(World) - Rf	1.700039777	0.047943361	35.45933688	3.45417E-80	1.605394828
E(R)FX(Asia) - Rf	-0.419093339	0.118677175	**-3.531372729**	0.000532975	-0.653373853

Since the Z-statistic for the currency factor's beta coefficient is –3.53, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Asia's real estate securities markets as whole is statistically significant during the period 1/84 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Asia.

Hong Kong

Hong Kong (1/84 - 4/98)

Regression Statistics	
Multiple R	0.632465135
R Square	0.400012147
Adjusted R Square	0.392911699
Standard Error	0.118272363
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1.576100738	0.788050369	56.33618447	1.79076E-19
Residual	169	2.364031459	0.013988352		
Total	171	3.940132197			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.019491235	0.030286525	0.643561297	0.5207323	-0.040297369
E(R)(World) - Rf	1.646815419	0.159825959	10.30380438	1.26053E-19	1.331303124
E(R)FX(HongKong) - Rf	-0.501985756	0.506296018	**-0.991486675**	0.322865445	-1.501464309

Since the Z-statistic for the currency factor's beta coefficient is –0.99, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Hong Kong's real estate securities market is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Hong Kong.

Singapore

Singapore (1/84 - 4/98)

Regression Statistics	
Multiple R	0.568036286
R Square	0.322665222
Adjusted R Square	0.314649425
Standard Error	0.120621972
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1.17135447	0.58567723	40.25367087	5.04528E-15
Residual	169	2.458892582	0.01454966		
Total	171	3.630247052			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.065179494	0.024771346	2.63124552	0.009294127	0.0162784
E(R)(World) - Rf	1.246408018	0.162906301	7.65107312	1.44654E-12	0.924814824
E(R)FX(Singapore) - Rf	0.796493488	0.41584188	**1.91537583**	0.057133182	-0.024419625

Since the Z-statistic for the currency factor's beta coefficient is 1.91, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Singapore's real state securities market is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Singapore.

Australia

Australia (1/84 - 4/98)

Regression Statistics	
Multiple R	0.565565249
R Square	0.319864051
Adjusted R Square	0.311815105
Standard Error	0.043695504
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.151750426	0.075875213	39.73986728	7.15055E-15
Residual	169	0.322671209	0.001909297		
Total	171	0.474421635			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.003691917	0.006690467	-0.551817458	0.581802366	-0.016899562
E(R)(World) - Rf	0.419300282	0.058559289	7.160269301	2.35877E-11	0.303698437
E(R)FX(Australia) - Rf	0.277213617	0.096871637	**2.861659256**	0.004747122	0.085979398

Since the Z-statistic for the currency factor's beta coefficient is 2.86, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Australia's real estate securities market is statistically significant during the period 1/84 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Australia.

Japan

Japan (1/84 - 4/98)

Regression Statistics	
Multiple R	0.697117101
R Square	0.485972253
Adjusted R Square	0.479889084
Standard Error	0.090192511
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1.299728285	0.649864142	79.88801311	3.7876E-25
Residual	169	1.374762443	0.008134689		
Total	171	2.674490728			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.026774991	0.012401734	2.158971459	0.032262685	0.002292737
E(R)(World) - Rf	1.43768576	0.118583103	12.12386691	9.65872E-25	1.203590954
E(R)FX(Japan) - Rf	0.094862168	0.177111167	**0.535608059**	0.592933615	-0.254772841

Since the Z-statistic for the currency factor's beta coefficient is –0.53, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Japan's real estate securities market is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Japan.

Question 1 Summary Chart

Region/Country	*1/1984 – 4/1998*
North America	**Significant**
Canada	Insignificant
Europe	**Insignificant**
UK	Insignificant
Italy	Insignificant
Norway	Insignificant
France	Insignificant
Germany	Significant
Sweden	Significant
Switzerland	Significant
Netherlands	Significant
Asia/Pacific Region	**Significant**
Hong Kong	Insignificant
Singapore	Insignificant
Japan	Insignificant
Australia	Significant

QUESTION 2: Does the significance of foreign exchange risk change across time?

Objective

My objective in the Question 2 is to study whether the significance of foreign exchange risk changes across time. If it does change across time, whether a consistent trend can be observed in different countries.

Methodology

For the first part of the question, I divided the time span (1/1984 - 4/1998) into three 5-year sub-periods, which are 1/1984 - 12/1988, 1/1989-12/1993, and 1/1994 – 4/1998 respectively. I applied the method listed in the "Question 1" to perform hypothesis testing for each of the 13 countries under the three study sub-periods. For the second part of the question, I summarized the hypothesis testing results and compared the results across time span, countries, and regions for the trend observation purpose.

The Findings

North America

North America (1/84 - 12/88)

Regression Statistics	
Multiple R	0.570100015
R Square	0.325014027
Adjusted R Square	0.301330308
Standard Error	0.04255173
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.049695453	0.024847727	13.72309963	1.36427E-05
Residual	57	0.103207035	0.00181065		
Total	59	0.152902488			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.023020763	0.018032077	-1.276656165	0.206900451	-0.05912939
E(R)(World) - Rf	0.484681045	0.105849926	4.578945513	2.5831E-05	0.272720133
E(R)FX(North America) - Rf	0.13875168	0.258189794	**0.537401877**	0.593081939	-0.378264687

Since the Z-statistic for the currency factor's beta coefficient is 0.53, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in North America's real

estate securities markets is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in North America.

North America (1/89 - 12/93)

Regression Statistics	
Multiple R	0.702996372
R Square	0.4942039
Adjusted R Square	0.476456668
Standard Error	0.052926893
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.156012125	0.078006062	27.84681641	3.65848E-09
Residual	57	0.159671594	0.002801256		
Total	59	0.315683719			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.012831641	0.019662306	0.652600987	0.516636973	-0.026541466
E(R)(World) - Rf	0.645782865	0.117454295	5.49816303	9.39189E-07	0.410584594
E(R)FX(North America) - Rf	0.55866152	0.357646541	**1.562049276**	0.123811876	-0.157513631

Since the Z-statistic for the currency factor's beta coefficient is 1.56, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in North America's real estate securities markets is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange

return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in North America.

North America (1/94 - 4/98)

Regression Statistics	
Multiple R	0.537564251
R Square	0.288975324
Adjusted R Square	0.259953909
Standard Error	0.039605611
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.031238172	0.015619086	9.957313274	0.000235058
Residual	49	0.076861618	0.001568604		
Total	51	0.10809979			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.029580702	0.024826914	-1.191477212	0.239205543	-0.079472224
E(R)(World) - Rf	0.483636235	0.112533175	4.297721408	8.16923E-05	0.25749249
E(R)FX(North America) - Rf	-0.341797982	0.495789639	**-0.689401219**	0.493822754	-1.33812396

Since the Z-statistic for the currency factor's beta coefficient is –0.68, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in North America's real estate securities markets is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both.

Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in North America.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Canada

Canada (1/84 - 12/88)

Regression Statistics	
Multiple R	0.502378632
R Square	0.25238429
Adjusted R Square	0.22615216
Standard Error	0.06321489
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.0768949	0.03844745	9.621189299	0.000251093
Residual	57	0.227778975	0.003996122		
Total	59	0.304673875			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.023941623	0.026788471	-0.89372863	0.375225225	-0.077584634
E(R)(World) - Rf	0.628038545	0.157250751	3.993866752	0.00018837	0.313149213
E(R)FX(Canada) - Rf	0.036635806	0.383567003	**0.095513446**	0.924242017	-0.731444197

Since the Z-statistic for the currency factor's beta coefficient is 0.09, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Canada's real estate securities market is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the

foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Canada.

Canada (1/89 - 12/93)

Regression Statistics	
Multiple R	0.390491675
R Square	0.152483748
Adjusted R Square	0.122746336
Standard Error	0.114326709
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.134043507	0.067021753	5.127673733	0.008958164
Residual	57	0.74502399	0.013070596		
Total	59	0.879067497			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.068663801	0.042472298	-1.616672605	0.111470689	-0.153713147
E(R)(World) - Rf	0.747588688	0.253711529	2.946609053	0.004647362	0.239539897
E(R)FX(Canada) - Rf	-0.318983813	0.772547741	**-0.412898512**	0.681230068	-1.865984643

Since the Z-statistic for the currency factor's beta coefficient is –0.41, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Canada's real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar

weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Canada.

Canada (1/94 - 4/98)

Regression Statistics	
Multiple R	0.333800186
R Square	0.111422564
Adjusted R Square	0.075154098
Standard Error	0.083867801
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.04321798	0.02160899	3.072160867	0.055339391
Residual	49	0.344656596	0.007033808		
Total	51	0.387874576			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.026942293	0.05257282	-0.512475692	0.610620591	-0.132591267
E(R)(World) - Rf	0.516598601	0.238297292	2.167874404	0.035054017	0.037722553
E(R)FX(Canada) - Rf	0.203998133	1.049871104	**0.194307789**	0.846738235	-1.905795561

Since the Z-statistic for the currency factor's beta coefficient is 0.19, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Canada's real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Canada.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Europe

Europe (1/84 - 12/88)

Regression Statistics	
Multiple R	0.62444438
R Square	0.389930784
Adjusted R Square	0.368524846
Standard Error	0.029852874
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.032468002	0.016234	18.21601065	7.64372E-07
Residual	57	0.050798063	0.00089119		
Total	59	0.083266064			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.024668564	0.008895588	-2.77312352	0.007490081	-0.042481679
E(R)(World) - Rf	0.375703976	0.068431645	5.49020816	9.67249E-07	0.238671912
E(R)FX(Europe) - Rf	0.231918278	0.109471619	**2.11852424**	0.038501722	0.012705048

Since the Z-statistic for the currency factor's beta coefficient is 2.11, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Europe's real estate securities markets is statistically significant during the period 1/84 – 12/88. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated

total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Europe.

Europe (1/89 - 12/93)

Regression Statistics	
Multiple R	0.806400496
R Square	0.650281759
Adjusted R Square	0.638010944
Standard Error	0.027301135
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.078998626	0.03949931	52.99417644	9.90766E-14
Residual	57	0.042485061	0.00074535		
Total	59	0.121483687			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.028753402	0.00683168	-4.20883353	9.20241E-05	-0.042433611
E(R)(World) - Rf	0.553074493	0.055462293	9.97208136	4.16577E-14	0.442013121
E(R)FX(Europe) - Rf	-0.102261444	0.107716213	**-0.94935982**	0.346445615	-0.317959533

Since the Z-statistic for the currency factor's beta coefficient is –0.94, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Europe's real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is significant and systematic

during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Europe.

Europe (1/94 - 4/98)

Regression Statistics	
Multiple R	0.490269772
R Square	0.240364449
Adjusted R Square	0.209358917
Standard Error	0.028301321
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.012418651	0.00620933	7.752308339	0.001188035
Residual	49	0.039247273	0.00080096		
Total	51	0.051665924			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.048532221	0.011374839	-4.26662927	9.0424E-05	-0.071390802
E(R)(World) - Rf	0.242195756	0.073729909	3.28490512	0.001888339	0.094030046
E(R)FX(Europe) - Rf	-0.334785901	0.19132183	**-1.7498573**	0.086403338	-0.719261279

Since the Z-statistic for the currency factor's beta coefficient is –1.74, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Europe's real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Europe.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

United Kingdom

UK (1/84 - 12/88)

Regression Statistics	
Multiple R	0.492156548
R Square	0.242218068
Adjusted R Square	0.215629228
Standard Error	0.0675269
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.083078906	0.041539453	9.109764503	0.000368987
Residual	57	0.259913286	0.004559882		
Total	59	0.342992192			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.012104586	0.017140058	-0.706216154	0.482930464	-0.046426974
E(R)(World) - Rf	0.640562996	0.155306594	4.124506107	0.00012213	0.329566773
E(R)FX(UK) - Rf	0.126628483	0.194450715	**0.651211197**	0.517527056	-0.262752524

Since the Z-statistic for the currency factor's beta coefficient is 0.65, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in UK's real estate securities market is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar

weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the UK.

UK (1/89 - 12/93)

Regression Statistics	
Multiple R	0.660115683
R Square	0.435752715
Adjusted R Square	0.415954565
Standard Error	0.068966235
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.209371957	0.104685979	22.00976897	8.2581E-08
Residual	57	0.271111468	0.004756342		
Total	59	0.480483426			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.01715527	0.015282985	-1.122507837	0.266352709	-0.047758932
E(R)(World) - Rf	0.921179974	0.140827301	6.541203081	1.84263E-08	0.639178048
E(R)FX(UK) - Rf	-0.276916269	0.221619684	**-1.24951116**	0.216584712	-0.720702222

Since the Z-statistic for the currency factor's beta coefficient is –1.24, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in UK's real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the UK.

UK (1/94 - 4/98)

Regression Statistics	
Multiple R	0.381780223
R Square	0.145756139
Adjusted R Square	0.110889042
Standard Error	0.063253797
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.033451398	0.016725699	4.180334866	0.021074425
Residual	49	0.1960511	0.004001043		
Total	51	0.229502498			

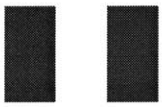
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.018293524	0.022752107	-0.804036493	0.425259586	-0.064015567
E(R)(World) - Rf	0.47025004	0.163544145	2.875370688	0.005956516	0.141595976
E(R)FX(UK) - Rf	-0.107512197	0.399799853	**-0.26891505**	0.789124124	-0.910939596

Since the Z-statistic for the currency factor's beta coefficient is –0.26, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in UK real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the UK.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's

characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Italy



Italy (1/84 - 12/88)

Regression Statistics	
Multiple R	0.12899813
R Square	0.016640517
Adjusted R Square	-0.017863324
Standard Error	0.082914323
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.006631145	0.003315572	0.482280139	0.619870311
Residual	57	0.391862745	0.006874785		
Total	59	0.39849389			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.038706697	0.026690902	-1.450183182	0.152488082	-0.092154329
E(R)(World) - Rf	0.151181613	0.190580493	0.793269083	0.430910862	-0.230449405
E(R)FX(Italy) - Rf	0.168755927	0.340427076	**0.495718289**	0.621999138	-0.512937825

Since the Z-statistic for the currency factor's beta coefficient is 0.49, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Italy's real estate securities market is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study

period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Italy.

Italy (1/89 - 12/93)

Regression Statistics	
Multiple R	0.384345728
R Square	0.147721639
Adjusted R Square	0.117817135
Standard Error	0.065927643
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.042941045	0.021470523	4.93977895	0.010509249
Residual	57	0.247747886	0.004346454		
Total	59	0.290688932			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.05180048	0.015414307	-3.360545432	0.001393261	-0.08266711
E(R)(World) - Rf	0.394996616	0.130390335	3.029339687	0.003679478	0.133894362
E(R)FX(Italy) - Rf	-0.340228551	0.215240383	**-1.58069107**	0.119482439	-0.771240168

Since the Z-statistic for the currency factor's beta coefficient is –1.58, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Italy's real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Italy.

Italy (1/94 - 4/98)

Regression Statistics	
Multiple R	0.089250157
R Square	0.007965591
Adjusted R Square	-0.03252561
Standard Error	0.135654059
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.007240239	0.00362012	0.196723992	0.822062879
Residual	49	0.901699159	0.018402024		
Total	51	0.908939398			

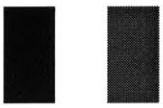
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.037271398	0.048470082	-0.768956787	0.4456097	-0.134675616
E(R)(World) - Rf	0.170728907	0.350769811	0.486726341	0.628622385	-0.534168992
E(R)FX(Italy) - Rf	-0.308843761	0.798963373	**-0.386555594**	0.700758838	-1.914419797

Since the Z-statistic for the currency factor's beta coefficient is –0.38, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Italy's real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the Italy.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's

characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

France



France (1/84 - 12/88)

Regression Statistics	
Multiple R	0.388202614
R Square	0.15070127
Adjusted R Square	0.120901314
Standard Error	0.042849925
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.018570835	0.00928542	5.057097141	0.009510942
Residual	57	0.104658616	0.00183612		
Total	59	0.12322945			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.027291433	0.011480332	-2.37723385	0.020821735	-0.05028041
E(R)(World) - Rf	0.227088895	0.097985173	2.31758427	0.024085116	0.030876887
E(R)FX(France) - Rf	0.283576233	0.130374402	**2.17509135**	0.033786265	0.022505886

Since the Z-statistic for the currency factor's beta coefficient is 2.17, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in French real estate securities markets is statistically significant during the period 1/84 – 12/88. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign

exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in France.

France (1/89 - 12/93)

Regression Statistics	
Multiple R	0.756603456
R Square	0.57244879
Adjusted R Square	0.557446993
Standard Error	0.034358923
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.090095362	0.04504768	38.1586817	3.04202E-11
Residual	57	0.067290528	0.00118054		
Total	59	0.15738589			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.019377321	0.00779329	-2.48641077	0.015857697	-0.034983122
E(R)(World) - Rf	0.570617331	0.068513883	8.32849206	1.96188E-11	0.433420588
E(R)FX(France) - Rf	0.0207713	0.117646479	**0.17655692**	0.860482267	-0.214811812

Since the Z-statistic for the currency factor's beta coefficient is 0.17, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in French real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in France.

France (1/94 - 4/98)

Regression Statistics	
Multiple R	0.355198215
R Square	0.126165772
Adjusted R Square	0.090499069
Standard Error	0.053254195
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.02006394	0.01003197	3.53735448	0.036729225
Residual	49	0.138964455	0.00283601		
Total	51	0.159028395			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.062860821	0.018363881	-3.42306846	0.001259232	-0.099764399
E(R)(World) - Rf	0.215598802	0.140107451	1.53881039	0.130283918	-0.065957491
E(R)FX(France) - Rf	-0.513644601	0.278147847	**-1.84666035**	0.070840154	-1.072603289

Since the Z-statistic for the currency factor's beta coefficient is –1.84, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in French real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the France.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's

characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Germany

Germany (1/84 - 12/88)

Regression Statistics	
Multiple R	0.64735958
R Square	0.419074426
Adjusted R Square	0.398691072
Standard Error	0.012320249
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.006241435	0.003120718	20.55964079	1.89424E-07
Residual	57	0.008651946	0.000151789		
Total	59	0.014893382			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.049835297	0.003163418	-15.75362441	1.98627E-22	-0.056169935
E(R)(World) - Rf	0.103065226	0.028184347	3.656825045	0.000558436	0.04662702
E(R)FX(Germany) - Rf	0.188511304	0.035103257	**5.37019406**	1.50607E-06	0.118218214

Since the Z-statistic for the currency factor's beta coefficient is 5.37, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in German real estate securities markets is statistically significant during the period 1/84 – 12/88. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Germany.

Germany (1/89 - 12/93)

Regression Statistics	
Multiple R	0.621972406
R Square	0.386849674
Adjusted R Square	0.365335627
Standard Error	0.018694382
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.012568179	0.006284089	17.98126043	8.82386E-07
Residual	57	0.019920355	0.00034948		
Total	59	0.032488534			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.029678262	0.0041746	-7.109247661	2.09237E-09	-0.038037758
E(R)(World) - Rf	0.158061101	0.037370947	4.229518193	8.58191E-05	0.083227038
E(R)FX(Germany) - Rf	0.177690965	0.062584716	**2.83920702**	0.00625759	0.052367179

Since the Z-statistic for the currency factor's beta coefficient is 2.83, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in German real estate securities market is statistically significant during the period 1/89 – 12/93. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Germany.

Germany (1/94 - 4/98)

Regression Statistics	
Multiple R	0.192102901
R Square	0.036903525
Adjusted R Square	-0.002406536
Standard Error	0.011842764
Observations	52

ANOVA

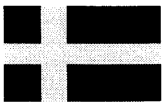
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.00026333	0.000131665	0.938780666	0.398024625
Residual	49	0.006872301	0.000140251		
Total	51	0.007135631			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.042471946	0.004143554	-10.25012585	8.8087E-14	-0.050798724
E(R)(World) - Rf	0.035814017	0.03141674	1.139966038	0.259842217	-0.027320248
E(R)FX(Germany) - Rf	0.06150619	0.061724501	**0.996463142**	0.323920717	-0.062533764

Since the Z-statistic for the currency factor's beta coefficient is 0.99, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in German real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Germany.

Although the results show some time variations due to the involvement of 3 sub-periods, the signs of the beta coefficient for the foreign exchange risk premium are consistently positive. This implies that the U.S. investors continuously view the index investment's characteristics of higher returns when dollar weakens more desirably and this preference to the positive betas has not changed across the study periods.

Sweden



Sweden (1/84 - 12/88)

Regression Statistics	
Multiple R	0.408559907
R Square	0.166921197
Adjusted R Square	0.137690362
Standard Error	0.077928843
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.069358024	0.034679012	5.710449128	0.005489761
Residual	57	0.346155556	0.006072904		
Total	59	0.415513581			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.032258362	0.02336178	-1.380817775	0.172725365	-0.07903954
E(R)(World) - Rf	0.593566606	0.178959491	3.316765175	0.001589172	0.235206254
E(R)FX(Sweden) - Rf	-0.277536205	0.291988408	**-0.950504188**	0.345869142	-0.862233156

Since the Z-statistic for the currency factor's beta coefficient is –0.95, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Swedish real estate securities market is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the Sweden.

Sweden (1/89 - 12/93)

Regression Statistics	
Multiple R	0.580817731
R Square	0.337349236
Adjusted R Square	0.314098332
Standard Error	0.189425514
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1.041230384	0.520615192	14.50908045	8.06518E-06
Residual	57	2.045275444	0.035882025		
Total	59	3.086505829			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.162792326	0.044348269	-3.670770739	0.000534388	-0.25159824
E(R)(World) - Rf	1.477230921	0.377579289	3.912372751	0.00024602	0.721141113
E(R)FX(Sweden) - Rf	-2.895554302	0.622193406	**-4.653784936**	1.98764E-05	-4.141475641

Since the Z-statistic for the currency factor's beta coefficient is –4.65, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Swedish real estate securities market is statistically significant during the period 1/89 – 12/93. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in the Sweden.

Sweden (1/94 - 4/98)

Regression Statistics	
Multiple R	0.348964448
R Square	0.121776186
Adjusted R Square	0.085930316
Standard Error	0.136178885
Observations	52

ANOVA

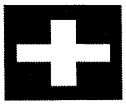
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.126000651	0.063000325	3.397216635	0.04152672
Residual	49	0.908689753	0.018544689		
Total	51	1.034690404			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.03662906	0.041165383	0.889802484	0.377919866	-0.046095824
E(R)(World) - Rf	0.75534296	0.35214715	2.144964001	0.03693948	0.047677196
E(R)FX(Sweden) - Rf	0.95577723	0.666164987	**1.434745519**	0.157711737	-0.38293062

Since the Z-statistic for the currency factor's beta coefficient is 1.43, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Swedish real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Sweden.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Switzerland



Switzerland (1/84 - 12/88)

Regression Statistics	
Multiple R	0.569918932
R Square	0.324807589
Adjusted R Square	0.301116627
Standard Error	0.020414674
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.011427688	0.005713844	13.71019008	1.37621E-05
Residual	57	0.023755258	0.000416759		
Total	59	0.035182946			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.041368451	0.005015966	-8.247354189	2.67259E-11	-0.051412755
E(R)(World) - Rf	0.166759609	0.046694062	3.571323666	0.000730063	0.073256322
E(R)FX(Switzerland) - Rf	0.204304787	0.054501917	**3.748579812**	0.000417372	0.095166534

Since the Z-statistic for the currency factor's beta coefficient is 3.74, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Swiss real estate securities market is statistically significant during the period 1/84 – 12/88. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Switzerland.

Switzerland (1/89 - 12/93)

Regression Statistics	
Multiple R	0.595016902
R Square	0.354045114
Adjusted R Square	0.33138003
Standard Error	0.03759505
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.044156293	0.022078146	15.62072824	3.89729E-06
Residual	57	0.080563103	0.001413388		
Total	59	0.124719396			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.01428657	0.008286784	-1.724018641	0.090124683	-0.030880576
E(R)(World) - Rf	0.330975205	0.074570802	4.438402122	4.20632E-05	0.181649686
E(R)FX(Switzerland) - Rf	0.25399142	0.12084265	**2.101835899**	0.039998352	0.012008084

Since the Z-statistic for the currency factor's beta coefficient is 2.1, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Swiss real estate securities market is statistically significant during the period 1/89 – 12/93. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Switzerland.

Switzerland (1/94 - 4/98)

Regression Statistics	
Multiple R	0.443437426
R Square	0.19663675
Adjusted R Square	0.163846414
Standard Error	0.036239158
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.015750887	0.007875443	5.996789608	0.004681047
Residual	49	0.064350552	0.001313277		
Total	51	0.080101439			

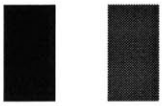
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.060116826	0.011280414	-5.329310283	2.47806E-06	-0.082785652
E(R)(World) - Rf	0.151711087	0.095778025	1.583986373	0.119630423	-0.040761944
E(R)FX(Switzerland) - Rf	-0.427013308	0.159119224	**-2.683606027**	0.009905474	-0.746775167

Since the Z-statistic for the currency factor's beta coefficient is –2.68, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Swiss real estate securities market is statistically significant during the period 1/94 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in the Switzerland.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's

characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Netherlands



Netherlands (1/84 - 12/88)

Regression Statistics	
Multiple R	0.763765063
R Square	0.583337072
Adjusted R Square	0.56871732
Standard Error	0.013509579
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.014564419	0.00728221	39.90061376	1.45837E-11
Residual	57	0.010402997	0.000182509		
Total	59	0.024967416			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.000708877	0.008273646	0.08567897	0.93202187	-0.01585882
E(R)(World) - Rf	0.098467099	0.032177318	3.060140011	0.003369881	0.034033103
E(R)FX(Netherlands) - Rf	0.831069097	0.115403846	**7.201398645**	1.46902E-09	0.599976784

Since the Z-statistic for the currency factor's beta coefficient is 7.20, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Netherlands' real estate securities market is statistically significant during the period 1/84 – 12/88. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign

exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Netherlands.

Netherlands (1/89 - 12/93)

Regression Statistics	
Multiple R	0.652907539
R Square	0.426288254
Adjusted R Square	0.406158018
Standard Error	0.047345596
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.094938781	0.047469391	21.17651476	1.3267E-07
Residual	57	0.12777151	0.002241605		
Total	59	0.222710291			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.004266081	0.017392831	0.245278103	0.807122063	-0.030562478
E(R)(World) - Rf	0.448691314	0.105960456	4.234516619	8.43816E-05	0.236509069
E(R)FX(Netherlands) - Rf	0.662261168	0.326958868	**2.025518289**	0.047505389	0.007537047

Since the Z-statistic for the currency factor's beta coefficient is 2.02, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Netherlands' real estate securities market is statistically significant during the period 1/89 – 12/93. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Netherlands.

Netherlands (1/94 - 4/98)

Regression Statistics	
Multiple R	0.433705449
R Square	0.188100417
Adjusted R Square	0.154961658
Standard Error	0.044062432
Observations	52

ANOVA

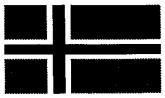
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.022040449	0.011020225	5.676145551	0.006064665
Residual	49	0.095133397	0.001941498		
Total	51	0.117173846			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.016165486	0.045366404	-0.356331667	0.723121969	-0.107332633
E(R)(World) - Rf	0.382606394	0.113976436	3.356890313	0.001530551	0.153562309
E(R)FX(Netherlands) - Rf	0.158663559	0.885179461	**0.179244511**	0.858484852	-1.620170086

Since the Z-statistic for the currency factor's beta coefficient is 0.17, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Netherlands' real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Netherlands.

Although the results show some time variations due to the involvement of 3 sub-periods, the signs of the beta coefficient for the foreign exchange risk premium are consistently positive. This implies that the U.S. investors continuously view the index investment's characteristics of higher returns when dollar weakens more desirably and this preference to the positive betas has not changed across the study periods.

Norway



Norway (1/84 - 12/88)

Regression Statistics	
Multiple R	0.132832719
R Square	0.017644531
Adjusted R Square	-0.016824082
Standard Error	0.095654218
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.009367518	0.004683759	0.511901397	0.602083904
Residual	57	0.521534572	0.009149729		
Total	59	0.53090209			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.024000367	0.026472548	-0.906613432	0.368428022	-0.077010752
E(R)(World) - Rf	0.144034299	0.220000979	0.654698445	0.515295213	-0.296510251
E(R)FX(Norway) - Rf	0.217942708	0.312760742	**0.696835243**	0.488738175	-0.408350143

Since the Z-statistic for the currency factor's beta coefficient is 0.69, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Norway's real estate securities market is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Norway.

Norway (1/89 - 12/93)

Regression Statistics	
Multiple R	0.369255482
R Square	0.136349611
Adjusted R Square	0.106046088
Standard Error	0.165213135
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.245629163	0.122814581	4.49946408	0.01533318
Residual	57	1.555836653	0.02729538		
Total	59	1.801465815			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.050287739	0.040125456	-1.253262746	0.215226691	-0.130637613
E(R)(World) - Rf	0.969217147	0.332763446	2.91263105	0.005109579	0.302869553
E(R)FX(Norway) - Rf	-0.973352835	0.610624898	**-1.594027428**	0.116460505	-2.196108625

Since the Z-statistic for the currency factor's beta coefficient is –1.59, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Norway's real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the Norway.

Norway (1/84 - 4/98)

Regression Statistics	
Multiple R	0.294003043
R Square	0.086437789
Adjusted R Square	0.049149536
Standard Error	0.097378333
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.043962895	0.021981447	2.318097025	0.109165172
Residual	49	0.464644449	0.00948254		
Total	51	0.508607344			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.011912089	0.03279475	-0.363231577	0.717994263	-0.077815567
E(R)(World) - Rf	0.499399378	0.253058839	1.973451627	0.054097573	-0.00914109
E(R)FX(Norway) - Rf	-0.33896487	0.516204941	**-0.656647859**	0.514479612	-1.376316908

Since the Z-statistic for the currency factor's beta coefficient is –0.65, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Norway's real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in the Norway.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's

characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Asia

Asia (1/84 - 12/88)

Regression Statistics	
Multiple R	0.950573546
R Square	0.903590066
Adjusted R Square	0.900207261
Standard Error	0.031498623
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.530038775	0.265019388	267.1126909	1.1155E-29
Residual	57	0.056553304	0.000992163		
Total	59	0.586592079			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.023527373	0.011851901	1.985113866	0.051951268	-0.00020566
E(R)(World) - Rf	1.698390859	0.074566439	22.77688041	2.62371E-30	1.549074077
E(R)FX(Asia) - Rf	-0.345940332	0.1649793	**-2.096871139**	0.040453265	-0.676305823

Since the Z-statistic for the currency factor's beta coefficient is –2.09, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Asia's real estate securities markets is statistically significant during the period 1/84 – 12/88. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Asia.

Asia (1/89 - 12/93)

Regression Statistics	
Multiple R	0.962026567
R Square	0.925495115
Adjusted R Square	0.922880909
Standard Error	0.029706332
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.624830618	0.312415309	354.0252537	7.19889E-33
Residual	57	0.050300572	0.000882466		
Total	59	0.67513119			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.011198496	0.009429256	1.187632988	0.239903553	-0.007683272
E(R)(World) - Rf	1.58562979	0.06833943	23.20226829	1.01087E-30	1.448782383
E(R)FX(Asia) - Rf	-0.370799289	0.180156446	**-2.058207165**	0.044152566	-0.731556505

Since the Z-statistic for the currency factor's beta coefficient is –2.05, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Asia's real estate securities markets is statistically significant during the period 1/89 – 12/93. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Asia.

Asia (1/94 - 4/98)

Regression Statistics	
Multiple R	0.929561102
R Square	0.864083843
Adjusted R Square	0.858536245
Standard Error	0.040973012
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.522969862	0.261484931	155.758187	5.82293E-22
Residual	49	0.082260598	0.001678788		
Total	51	0.60523046			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.044439175	0.020508984	2.166815018	0.035139298	0.003224853
E(R)(World) - Rf	1.858536327	0.107604653	17.27189555	1.77107E-22	1.642296812
E(R)FX(Asia) - Rf	0.208117584	0.385716171	**0.53956147**	0.591943089	-0.567007611

Since the Z-statistic for the currency factor's beta coefficient is 0.53, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Asian real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Asia.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Hong Kong

Hong Kong (1/84 - 12/88)

Regression Statistics	
Multiple R	0.336153704
R Square	0.112999313
Adjusted R Square	0.081876482
Standard Error	0.115485918
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.096846685	0.048423343	3.630753012	0.032796897
Residual	57	0.76020884	0.013336997		
Total	59	0.857055525			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.011849931	0.069697101	0.170020429	0.865596092	-0.127716167
E(R)(World) - Rf	0.701691686	0.272708334	2.573048194	0.012708177	0.155602433
E(R)FX(HongKong) - Rf	0.128520385	0.964741693	**0.133217405**	0.894490656	-1.803342361

Since the Z-statistic for the currency factor's beta coefficient is 0.13, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Hong Kong's real estate securities market is statistically insignificant during the period 1/88 – 12/89. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Hong Kong.

Hong Kong (1/89 - 12/93)

Regression Statistics	
Multiple R	0.717398183
R Square	0.514660152
Adjusted R Square	0.497630684
Standard Error	0.107554223
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.699204768	0.349602384	30.22173929	1.128E-09
Residual	57	0.659370915	0.011567911		
Total	59	1.358575682			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.06388739	0.039211246	1.629312934	0.108761604	-0.014631809
E(R)(World) - Rf	1.622123093	0.242218173	6.696950415	1.01609E-08	1.13708936
E(R)FX(HongKong) - Rf	-0.133986431	0.74224859	**-0.180514228**	0.857389167	-1.620314231

Since the Z-statistic for the currency factor's beta coefficient is –0.18, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Hong Kong's real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Hong Kong.

Hong Kong (1/94 - 4/98)

Regression Statistics	
Multiple R	0.829973594
R Square	0.688856167
Adjusted R Square	0.676156418
Standard Error	0.102515735
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1.140104051	0.570052025	54.24171806	3.7805E-13
Residual	49	0.514964316	0.010509476		
Total	51	1.655068367			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.130495234	0.121558514	-1.073517848	0.288297225	-0.374776065
E(R)(World) - Rf	2.756882309	0.2657665	10.37332513	5.87924E-14	2.222804856
E(R)FX(HongKong) - Rf	-4.038311434	2.371685197	**-1.702718151**	0.09495722	-8.804388386

Since the Z-statistic for the currency factor's beta coefficient is –1.70, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Hong Kong's real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Hong Kong.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's

characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Singapore

Singapore (1/84 - 12/88)

Regression Statistics	
Multiple R	0.370358817
R Square	0.137165653
Adjusted R Square	0.106890764
Standard Error	0.149392731
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.202232869	0.10111643	4.530673975	0.014925593
Residual	57	1.272136728	0.02231819		
Total	59	1.474369597			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.086997382	0.065890236	1.320338	0.191999615	-0.044945596
E(R)(World) - Rf	0.778294732	0.347973765	2.23664774	0.029238086	0.08148899
E(R)FX(Singapore) - Rf	1.393882772	0.897965593	**1.55226746**	0.126133415	-0.404263082

Since the Z-statistic for the currency factor's beta coefficient is 1.55, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Singapore's real estate securities market is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study

period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Singapore.

Singapore (1/89 - 12/93)

Regression Statistics	
Multiple R	0.706294475
R Square	0.498851885
Adjusted R Square	0.48126774
Standard Error	0.082501207
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.386189961	0.19309498	28.36941472	2.81212E-09
Residual	57	0.387967605	0.00680645		
Total	59	0.774157565			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-4.09534E-05	0.025932265	-0.00157925	0.998745459	-0.051969441
E(R)(World) - Rf	1.284981042	0.178750953	7.1886668	1.5426E-09	0.927038279
E(R)FX(Singapore) - Rf	-0.695235663	0.500215029	**-1.3898736**	0.169971828	-1.696899409

Since the Z-statistic for the currency factor's beta coefficient is –1.38, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Singapore's real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Singapore.

Singapore (1/94 - 4/98)

Regression Statistics	
Multiple R	0.811929175
R Square	0.659228985
Adjusted R Square	0.645319964
Standard Error	0.097057733
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.89295591	0.44647795	47.39578617	3.51022E-12
Residual	49	0.461589976	0.0094202		
Total	51	1.354545885			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.189297224	0.041212852	4.59316003	3.07282E-05	0.106476948
E(R)(World) - Rf	1.941164245	0.267510264	7.25641035	2.6605E-09	1.40358257
E(R)FX(Singapore) - Rf	2.934539948	0.821188308	**3.57352865**	0.000802521	1.284301261

Since the Z-statistic for the currency factor's beta coefficient is 3.57, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Singapore' real estate securities market is statistically significant during the period 1/94 – 4/98. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Singapore.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Australia

Australia (1/84 - 12/88)

Regression Statistics	
Multiple R	0.55209458
R Square	0.304808426
Adjusted R Square	0.280415739
Standard Error	0.049027924
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.060073693	0.030036847	12.49589388	3.16212E-05
Residual	57	0.137013028	0.002403737		
Total	59	0.197086722			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.011925561	0.012610712	-0.94566912	0.348309068	-0.037178086
E(R)(World) - Rf	0.488325365	0.1159822	4.210347482	9.15556E-05	0.256074916
E(R)FX(Australia) - Rf	0.225933329	0.147972066	**1.526864731**	0.132325004	-0.070375749

Since the Z-statistic for the currency factor's beta coefficient is 1.52, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Australia's real estate securities market is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Australia.

Australia (1/89 - 12/93)

Regression Statistics	
Multiple R	0.627616967
R Square	0.393903057
Adjusted R Square	0.372636498
Standard Error	0.037198113
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.051258268	0.025629134	18.52218077	6.34526E-07
Residual	57	0.078870878	0.0013837		
Total	59	0.130129146			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.004438739	0.0099569	0.445795292	0.657433872	-0.015499618
E(R)(World) - Rf	0.263047033	0.079432653	3.311573073	0.001614061	0.103985822
E(R)FX(Australia) - Rf	0.505755612	0.163023125	**3.102355026**	0.002984955	0.179307295

Since the Z-statistic for the currency factor's beta coefficient is 3.10, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Australia's real estate securities market is statistically significant during the period 1/89 – 12/93. This means that foreign exchange risk is priced into the USD denominated real estate security market index and is attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is significant and systematic during this study period and therefore, the foreign exchange risk hedging is necessary for U.S. investors to invest in Australia.

Australia (1/94 - 4/98)

Regression Statistics	
Multiple R	0.59663457
R Square	0.35597281
Adjusted R Square	0.329685986
Standard Error	0.04177463
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.047264377	0.023632188	13.54187212	2.08043E-05
Residual	49	0.085510867	0.00174512		
Total	51	0.132775243			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.013534313	0.014125967	-0.958115812	0.342708119	-0.041921489
E(R)(World) - Rf	0.574167012	0.110601569	5.19130982	4.00117E-06	0.351904972
E(R)FX(Australia) - Rf	-0.190851335	0.250580151	**-0.761637881**	0.449926535	-0.694410696

Since the Z-statistic for the currency factor's beta coefficient is –0.76, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Australia's real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Australia.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's

characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Japan

Japan (1/84 - 12/88)

Regression Statistics	
Multiple R	0.842851835
R Square	0.710399215
Adjusted R Square	0.700237784
Standard Error	0.076200578
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.811884271	0.405942136	69.91133558	4.5845E-16
Residual	57	0.330972103	0.005806528		
Total	59	1.142856374			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.079573032	0.018658794	4.264639509	7.62006E-05	0.042209425
E(R)(World) - Rf	2.039708932	0.17662838	11.54802494	1.48255E-16	1.686016551
E(R)FX(Japan) - Rf	0.145866979	0.235612901	**0.619095888**	0.538319814	-0.32593992

Since the Z-statistic for the currency factor's beta coefficient is 0.61, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Japanese real estate securities market is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study

period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Japan.

Japan (1/89 - 12/93)

Regression Statistics	
Multiple R	0.745782176
R Square	0.556191054
Adjusted R Square	0.54061881
Standard Error	0.085610537
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.523548889	0.261774445	35.7168218	8.81226E-11
Residual	57	0.417762348	0.007329164		
Total	59	0.941311238			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.008447672	0.018470939	0.457349333	0.649158439	-0.028539762
E(R)(World) - Rf	1.31348239	0.186599463	7.039046983	2.73921E-09	0.93982325
E(R)FX(Japan) - Rf	0.228395876	0.312458794	**0.730963188**	0.46779585	-0.397292335

Since the Z-statistic for the currency factor's beta coefficient is 0.73, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Japanese real estate securities market is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also increase. In another word, the USD denominated total return is partially driven by the foreign exchange return. The positive sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Japan.

Japan (1/84 - 4/98)

Regression Statistics	
Multiple R	0.435427083
R Square	0.189596745
Adjusted R Square	0.156519061
Standard Error	0.095866055
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.105355084	0.052677542	5.731862773	0.005796673
Residual	49	0.450324729	0.009190301		
Total	51	0.555679813			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.014193303	0.026922488	-0.527191374	0.600439603	-0.068296035
E(R)(World) - Rf	0.831127353	0.24795564	3.351919538	0.00155303	0.332842142
E(R)FX(Japan) - Rf	-0.138777856	0.367768659	**-0.37735096**	0.707542308	-0.877836198

Since the Z-statistic for the currency factor's beta coefficient is –0.37, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in Japanese real estate securities market is statistically insignificant during the period 1/94 – 4/98. This means that foreign exchange risk is not priced into the USD denominated real estate security market index and is not attributable to the USD denominated total return. The sign of beta coefficient for the foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange return and USD denominated total return. That is, as foreign exchange return increases, the USD denominated total return will also decrease. In another word, the USD denominated total return is partially offset by the foreign exchange return. The negative sign also implies that the securities index investment's characteristics of higher returns when dollar weakens is viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period and therefore, the foreign exchange risk hedging is not necessary for U.S. investors to invest in Japan.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index investment's

characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Question 2 Summary Chart

Region/Country	*1/1984 – 12/1998*	*1/1989 – 12/1993*	*1/1994 – 4/1998*
North America	**Insignificant**	**Insignificant**	**Insignificant**
Canada	Insignificant	Insignificant	Insignificant
Europe	**Significant**	**Insignificant**	**Insignificant**
UK	Insignificant	Insignificant	Insignificant
Italy	Insignificant	Insignificant	Insignificant
Norway	Insignificant	Insignificant	Insignificant
France	Significant	Insignificant	Insignificant
Germany	Significant	Significant	Insignificant
Netherlands	Significant	Significant	Insignificant
Switzerland	Significant	Significant	Significant
Sweden	Insignificant	Significant	Insignificant
Asia/Pacific Region	**Significant**	**Significant**	**Insignificant**
Hong Kong	Insignificant	Insignificant	Insignificant
Japan	Insignificant	Insignificant	Insignificant
Singapore	Insignificant	Insignificant	Significant
Australia	Insignificant	Significant	Insignificant

QUESTION 3: Is the foreign exchange risk significant on an equally weighted portfolio basis?

Objective

My objective in the Question 3 is to study whether the foreign exchange risk is significant on an equally weighted portfolio basis.

Methodology

In the first step, to structure an equally weighed real country index portfolio, I calculated the monthly portfolio return based on the equally weighted real returns of the 13 country indexes under the period of 1/1984 – 4/1998. I applied following equations:

$$E(r)_{USDReal(Portfolio)} = \sum w_{(Country)} E(r)_{USDReal(Country)}$$

$$E(r)_{\Delta FX(Portfolio)} = \sum w_{(Country)} E(r)_{\Delta FX(Country)}$$

In the second step, I proposed a two-factor APT Model as follows:

$$\left(E(r)_{USDReal(Portfolio)} - R_f\right) = \alpha + \beta_{USDReal(Portfolio)}\left(E(r)_{USDReal(World)} - R_f\right) + \beta_{\Delta FX(Portfolio)}\left(E(r)_{FX(Portfolio)} - R_f\right) + \varepsilon$$

The two factors under the APT model are:

- The market return premium (USD denominated real world index return – Risk-free rate)
- The foreign exchange return premium (Portfolio of currency return – Risk-free rate)

The beta coefficients in the APT model are proposed by regressing the USD denominated portfolio return premium against the market premium and the currency portfolio return premium.

In the third step, I made a null hypothesis that the beta coefficient of the currency return portfolio equals to zero. That is, the return brought by foreign exchange movements is not significantly attributable to the return of an equally weighted real estate securities index portfolio. The alternative hypothesis is that the beta coefficient does not equal to zero.

$$H_0 : \beta_{\Delta FX(Portfolio)} = 0$$
$$H_1 : \beta_{\Delta FX(Portfolio)} \neq 0$$

To form the hypothesis testing, I compared the calculated Z-statistics with the critical Z-statistics at 95% C.I. level. The range of critical Z-statistics is (-1.96, +1.96). Using Z-statistics is due to the large sample size, 172 observations. To calculate the Z-statistics, I used the following equation:

$$Calculated\ Z\text{-}score = \left(\frac{\beta_{\Delta FX(Portfolio)} - 0}{\delta(\beta_{\Delta FX})} \right)$$

The standard deviation is referred from the ANOVA table based on 172 observations.

If the calculated Z-score falls within the critical Z range of (-1.96, +1.96), I will accept the null hypothesis. That is, the beta coefficient is not significantly different from 0 and therefore the currency return factor is not statistically significant in the APT model. In another word, the return brought by foreign exchange rate changes is not an attribute factor in the USD denominated real return on an equally weighted portfolio basis and therefore the foreign exchange risk is not significant in investing in an equally weighted real estate securities index portfolio. On the other hand, if the calculated Z-score falls beyond the critical Z range of (-1.96, +1.96), I will reject the null hypothesis and accept the alternative hypothesis. That is, the beta coefficient is significantly different from 0 and therefore is statistically significant in the APT model. Said differently, the return brought by foreign exchange rate fluctuations is not an attribute factor in the USD denominated real return on an equally weighted portfolio basis and therefore the foreign exchange risk is significant even in investing in an equally weighted real estate securities index portfolio.

The Findings

Equally Weighted Portfolio (1/84 - 4/98)

Regression Statistics	
Multiple R	0.825553936
R Square	0.6815393
Adjusted R Square	0.677770535
Standard Error	0.02846467
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.293044843	0.146522421	180.8388632	1.0191E-42
Residual	169	0.136930131	0.000810237		
Total	171	0.429974973			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.015546068	0.005291637	-2.937856287	0.003766551	-0.025992284
E(R)(World) - Rf	0.693496909	0.037372814	18.55618642	1.26064E-42	0.619719267
E(R)FX(Portfolio) - Rf	-0.028436737	0.082975036	**-0.342714372**	0.732239237	-0.192237687

Since the Z-statistic for the currency factor's beta coefficient is –0.34, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in an equally weighted portfolio of real estate securities market indexes is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is priced into the equally weighted USD denominated real estate security market index portfolio and is attributable to the USD denominated portfolio return. The sign of beta coefficient for the portfolio's foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange portfolio return and USD denominated portfolio return. That is, as foreign exchange portfolio return increases, the USD denominated portfolio return will decrease. In another word, the USD denominated portfolio return is partially driven by the foreign exchange portfolio return. The negative sign also implies that the securities index portfolio's characteristics of higher returns when dollar weakens are viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant nor systematic during this study period on the equally weighted portfolio basis and therefore, the foreign exchange risk hedging is not necessary for U.S. investors.

QUESTION 4: Does the significance of foreign exchange risk change across time on an equally weighted portfolio basis?

Objective

My objective in the Question 4 is to study whether the significance of foreign exchange risk changes across time on an equally weighted portfolio basis.

Methodology

I divided the time span (1/1984 - 4/1998) into three 5-year study periods, which are 1/1984 - 12/1988, 1/1989 - 12/1993, and 1/1994 - 4/1998 respectively. I applied the method listed in the "Question 3" to perform hypothesis testing for the equally weighted portfolios under the three study periods and summarized the hypothesis testing results.

The Findings

Equally Weighted Portfolio (1/84 - 12/88)

Regression Statistics	
Multiple R	0.760309554
R Square	0.578070618
Adjusted R Square	0.563266078
Standard Error	0.026976746
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.056832286	0.028416143	39.04684843	2.08609E-11
Residual	57	0.041481457	0.000727745		
Total	59	0.098313742			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.016398094	0.009001295	-1.821748459	0.073741551	-0.034422884
E(R)(World) - Rf	0.530466994	0.062323808	8.511466387	9.78401E-12	0.405665669
E(R)FX(Portfolio) - Rf	0.134498753	0.118022189	**1.139605641**	0.259217035	-0.101836706

Since the Z-statistic for the currency factor's beta coefficient is 1.13, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in an equally weighted portfolio of real estate securities market indexes is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the equally weighted USD denominated real estate security market index portfolio and is not attributable to the USD denominated portfolio return. The sign of beta coefficient for the portfolio's foreign exchange

return premium is positive, which implies a positive correlation between the foreign exchange portfolio return and USD denominated portfolio return. That is, as foreign exchange portfolio return increases, the USD denominated portfolio return will also increase. In another word, the USD denominated portfolio return is partially driven by the foreign exchange portfolio return. The positive sign also implies that the securities index portfolio's characteristics of higher returns when dollar weakens are viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period on the equally weighted portfolio basis and therefore, the foreign exchange risk hedging is not necessary for U.S. investors.

Equally Weighted Portfolio (1/89 - 12/93)

Regression Statistics	
Multiple R	0.874270743
R Square	0.764349332
Adjusted R Square	0.756080888
Standard Error	0.029669814
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.162752516	0.081376258	92.44173234	1.28723E-18
Residual	57	0.050176977	0.000880298		
Total	59	0.212929494			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	-0.026442069	0.0085998	-3.074730726	0.003231876	-0.043662879
E(R)(World) - Rf	0.82282477	0.063147063	13.03029354	9.76669E-19	0.696374903
E(R)FX(Portfolio) - Rf	-0.333636038	0.150182694	**-2.221534516**	0.030301613	-0.634371823

Since the Z-statistic for the currency factor's beta coefficient is -2.22, which falls beyond the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in an equally weighted portfolio of real estate securities market indexes is statistically significant during the period 1/89 – 12/93. This means that foreign exchange risk is priced into the equally weighted USD denominated real estate security market index portfolio and is attributable to the USD denominated portfolio return. The sign of beta coefficient for the portfolio's foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange portfolio return and USD denominated portfolio return. That is, as foreign exchange portfolio return increases, the USD denominated portfolio return will decrease. In another word, the USD denominated portfolio return is partially offset by the foreign exchange portfolio return. The

positive sign also implies that the securities index portfolio's characteristics of higher returns when dollar weakens are viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is still significant and systematic during this study period on the equally weighted portfolio basis and therefore, the foreign exchange risk hedging is still necessary for U.S. investors.

Equally Weighted Portfolio (1/94 - 4/98)

Regression Statistics	
Multiple R	0.854186766
R Square	0.729635032
Adjusted R Square	0.718599727
Standard Error	0.025324746
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.084808923	0.042404461	66.11824897	1.21E-14
Residual	49	0.031425796	0.000641343		
Total	51	0.116234719			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.009664578	0.014313769	0.675194528	0.502726048	-0.019099999
E(R)(World) - Rf	0.736885281	0.066104969	11.14719963	4.84399E-15	0.604042453
E(R)FX(Portfolio) - Rf	0.349452831	0.277546311	**1.259079358**	0.21396689	-0.208297024

Since the Z-statistic for the currency factor's beta coefficient is 1.26, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in an equally weighted portfolio of real estate securities market indexes is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the equally weighted USD denominated real estate security market index portfolio and is not attributable to the USD denominated portfolio return. The sign of beta coefficient for the portfolio's foreign exchange return premium is positive, which implies a positive correlation between the foreign exchange portfolio return and USD denominated portfolio return. That is, as foreign exchange portfolio return increases, the USD denominated portfolio return will also increase. In another word, the USD denominated portfolio return is partially driven by the foreign exchange portfolio return. The positive sign also implies that the securities index portfolio's characteristics of higher returns when dollar weakens are viewed more desirable by the U.S. investors. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic

during this study period on the equally weighted portfolio basis and therefore, the foreign exchange risk hedging is not necessary for U.S. investors.

The results show significant time variations due to the involvement of 3 sub-periods. The signs of the beta coefficient for the foreign exchange portfolio risk premium changes across time. This mixture of signs implies that the U.S. investors didn't continuously view the index portfolio's characteristics of higher returns when dollar weakens desirably and their preference to the positive or negative betas has changed across the study periods.

Question 4 Summary Chart

Region/Country	*1/1984 – 12/1998*	*1/1989 – 12/1993*	*1/1994 – 4/1998*
Equally Weighted Portfolio	**Significant**	**Significant**	**Insignificant**

QUESTION 5: Is the foreign exchange risk significant on an optimally weighted portfolio basis?

Objective

My objective in the Question 5 is to study whether the foreign exchange risk is significant on an optimally weighted portfolio basis.

Methodology

To structure the optimal-weighted country indexes return portfolio, I used the following equations:

Portfolio Return Calculation

$$E(r_{Portfolio}) = \sum_{j=1}^{n} w_i E(r_i)$$

Portfolio Variance Calculation

$$\sigma^2{}_{Porfolio} = \sum w_i{}^2 \sigma^2{}_i + \sum_{i=1, i \neq j}^{n} \sum_{j=1}^{n} w_i w_j Cov(r_i, r_j)$$

Portfolio Optimization

$$\underset{w_i}{\text{Max}}(SharpeRatio)_{Portfolio} = \frac{E(r_{Porfolio}) - r_f}{\sigma_{Porfolio}}$$

Note:

- **E(r)**: Expected USD denominated real returns on GPR-LIFE country indexes.
- r_f : The risk-free interest rate. I use the U.S. 3-Month Treasury-Bill yield.
- **Sharpe Ratio**: Reward-to-volatility ratio; measures return premium on per unit of risk.
- β: Systematic risk.
- δ: Standard Deviation.
- **Cov(r*i*, r*j*):** Covariance between returns on country index ***i*** and country index ***j***.

To structure the optimal-weighted country index return portfolio, I followed the following steps:

- Perform mean-variance analysis
- Develop covariance matrix
- Determine the constraints of weight allocation
- Developed optimization model by applying Sharpe Ratio (maximizing return per unit of risk the portfolio bears)
- Apply the allocated weights to achieve the optimally weighted portfolio

Screenshot Samples of the Covariance Matrix and the Portfolio Optimization Model

Covariance Matrix						
	Canada	**UK**	**Italy**	**Norway**	**France**	**Germany**
Canada	0.00965	0.00192	0.00169	0.00203	0.00117	0.00010
UK	0.00192	0.00557	0.00118	0.00278	0.00125	0.00008
Italy	0.00169	0.00118	0.00950	0.00144	0.00190	0.00007
Norway	0.00203	0.00278	0.00144	0.01629	0.00151	0.00000
France	0.00117	0.00125	0.00190	0.00151	0.00237	0.00005
Germany	0.00010	0.00008	0.00007	0.00000	0.00005	0.00005

Portfolio Asset Allocation Optimization Model							
		Canada	**UK**	**Italy**	**Norway**	**France**	**Germany**
Weights	*Country*	**1%**	**1%**	**1%**	**28%**	**1%**	**1%**
1%	**Canada**	9.65219E-07	1.922E-07	1.686E-07	5.686E-06	1.169E-07	9.954E-09
1%	**UK**	1.92239E-07	5.568E-07	1.184E-07	7.766E-06	1.251E-07	7.643E-09
1%	**Italy**	1.68607E-07	1.184E-07	9.501E-07	4.018E-06	1.895E-07	7.236E-09
28%	**Norway**	5.6856E-06	7.766E-06	4.018E-06	0.0012749	4.214E-06	-1.028E-08
1%	**France**	1.169E-07	1.251E-07	1.895E-07	4.214E-06	2.367E-07	4.839E-09
1%	**Germany**	9.9544E-09	7.643E-09	7.236E-09	-1.028E-08	4.839E-09	5.158E-09
1%	**Sweden**	3.15634E-07	2.782E-07	2.401E-08	1.627E-05	1.756E-07	2.37E-09
1%	**Switzerland**	3.15634E-07	2.782E-07	2.401E-08	1.627E-05	1.756E-07	2.37E-09
1%	**Netherlands**	1.25209E-07	8.873E-08	7.637E-08	5.229E-06	7.965E-08	-4.198E-10
35%	**Hong Kong**	1.06677E-05	1.16E-05	2.907E-06	0.0003092	3.786E-06	4.778E-07
1%	**Singapore**	2.55514E-07	3.907E-07	1.159E-07	1.067E-05	9.949E-08	9.043E-09
27%	**Australia**	3.63501E-06	3.889E-06	2.094E-06	0.0001134	1.291E-06	9.881E-08
1%	**Japan**	2.97548E-07	1.223E-07	-7.98E-09	1.12E-06	1.548E-07	3.967E-09
100%	**Sum**	0.000023	0.000025	0.000011	0.001769	0.000011	0.000001
	Portfolio Variance	0.60%					
	Portfolio SD	7.73%					
	Portfolio Mean Return	8.98%					
	Risk-free Rate	6.00%					
	Sharpe-Ratio	**0.39**					
Weight Allocation Constraints:		- The sum of weights equals to 100%					
		- No country has weight less than 2% and more than 100%					

After structuring the optimally weighted portfolio, I calculated the monthly portfolio return based on the optimally weighted real returns of the 13 country indexes during the period of 1/1984 – 4/1998.

$$E(r)_{USDReal(Portfolio)} = \sum w_{(Country)} E(r)_{USDReal(Country)}$$

$$E(r)_{\Delta FX(Portfolio)} = \sum w_{(Country)} E(r)_{\Delta FX(Country)}$$

After that, I proposed a two-factor APT Model as follows:

$$\left(E(r)_{USDReal(Portfolio)} - R_f\right) = \alpha + \beta_{USDReal(Portfolio)}\left(E(r)_{USDReal(World)} - R_f\right) + \beta_{\Delta FX(Portfolio)}\left(E(r)_{FX(Portfolio)} - R_f\right) + \varepsilon$$

The two factors under the APT model are:

- The market return premium (USD denominated real world index return – Risk-free rate)
- The foreign exchange return premium (Portfolio of currency return – Risk-free rate)

The beta coefficients in the APT model are proposed by regressing the USD denominated portfolio return premium against the market premium and the currency portfolio return premium.

In the third step, I made a null hypothesis that the beta coefficient of the currency return portfolio equals to zero. That is, the return brought by foreign exchange movements is not significantly attributable to the return of the optimally weighted portfolio. The alternative hypothesis is that the beta coefficient does not equal to zero.

$$H_0 : \beta_{\Delta FX(Portfolio)} = 0$$
$$H_1 : \beta_{\Delta FX(Portfolio)} \neq 0$$

To form the hypothesis testing, I compared the calculated Z-statistics with the critical z-statistics at 95% C.I. level. The range of critical Z-statistics is (-1.96, +1.96). Using Z-statistics is due to the large sample size, 172 observations. To calculate the Z-statistics, I applied the following equation:

$$Calculated\ Z\text{ - }score = \left(\frac{\beta_{\Delta FX(Portfolio)} - 0}{\delta(_{\beta\Delta FX})} \right)$$

The standard deviation is referred from the ANOVA table based on 172 observations.

If the calculated Z-score falls within the critical Z range of (-1.96, +1.96), I will accept the null hypothesis. That is, the beta coefficient is not significantly different from 0 and therefore the currency return factor is not statistically significant in the APT model. In another word, the return brought by foreign exchange rate changes is not an attribute factor in the USD denominated real return on an optimally weighted portfolio basis and therefore the foreign exchange risk is not significant in investing in an optimized real estate index portfolio. On the other hand, if the calculated Z-score falls beyond the critical Z range of (-1.96, +1.96), I will reject the null hypothesis and accept the alternative hypothesis. That is, the beta coefficient is significantly different from 0 and therefore is statistically significant in the APT model. Said differently, the return brought by foreign exchange rate changes is not an attribute factor in the USD denominated real return on a optimally weighted portfolio basis and therefore the foreign exchange risk is significant even in investing in an optimized real estate securities index portfolio.

The Findings

Optimally Weighted Portfolio (1/84 - 4/98)

Regression Statistics	
Multiple R	0.293821151
R Square	0.086330869
Adjusted R Square	0.075518217
Standard Error	0.059823192
Observations	172

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.057148262	0.028574131	7.98424526	0.000486034
Residual	169	0.604819613	0.003578814		
Total	171	0.661967875			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.030176413	0.012358665	2.441721003	0.015648138	0.005779182
E(R)(World) - Rf	-0.137009479	0.080088126	-1.710733984	0.088965141	-0.295111383
E(R)FX(Portfolio) - Rf	-0.582950759	0.299474438	**-1.946579359**	0.003948593	-0.976733082

Since the Z-statistic for the currency factor's beta coefficient is –1.94, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in an optimally weighted portfolio of real estate securities market indexes is statistically insignificant during the period 1/84 – 4/98. This means that foreign exchange risk is not priced into the equally weighted USD denominated real estate security market index portfolio and is not attributable to the USD denominated portfolio return. The sign of beta coefficient for the portfolio's foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange portfolio return and USD denominated portfolio return. That is, as foreign exchange portfolio return increases, the USD denominated portfolio return will decrease. In another word, the USD denominated portfolio return is partially offset by the foreign exchange portfolio return. The negative sign also implies that the securities index portfolio's characteristics of higher returns when dollar weakens are viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is still neither significant and nor systematic during this study period on the optimally weighted portfolio basis and therefore, the foreign exchange risk hedging is not necessary for U.S. investors.

QUESTION 6: Does the significance of foreign exchange risk change across time on an optimally weighted portfolio basis?

Objective

My objective in the Question 6 is to study whether the significance of foreign exchange risk changes across time on an optimally weighted portfolio basis.

Methodology

I divided the time span (1/1984 - 4/1998) into three 5-year study periods, which are 1/1984 - 12/1988, 1/1989 - 12/1993, and 1/1994 - 4/1998 respectively. I applied the method listed in the "Question 5" to perform hypothesis testing for the optimally weighted portfolios under the three study periods and summarized the hypothesis testing results.

The Findings

Optimally Weighted Portfolio (1/84 - 12/88)

Regression Statistics	
Multiple R	0.48337082
R Square	0.23364735
Adjusted R Square	0.206757783
Standard Error	0.062138405
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.067100732	0.033550366	8.689145234	0.000508413
Residual	57	0.22008734	0.003861181		
Total	59	0.287188072			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.03518438	0.023008001	1.529223672	0.131740049	-0.010888367
E(R)(World) - Rf	-0.561157241	0.145809599	-3.848561725	0.00030267	-0.853136051
E(R)FX(Portfolio) - Rf	-0.214697743	0.307674836	**-0.697807286**	0.488134595	-0.830806239

Since the Z-statistic for the currency factor's beta coefficient is –0.69, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in an optimally weighted portfolio of real estate securities market indexes is statistically insignificant during the period 1/84 – 12/88. This means that foreign exchange risk is not priced into the optimally weighted USD denominated real estate security market index portfolio and is not attributable to the USD denominated portfolio return. The sign of beta coefficient for the portfolio's foreign exchange

return premium is negative, which implies a negative correlation between the foreign exchange portfolio return and USD denominated portfolio return. That is, as foreign exchange portfolio return increases, the USD denominated portfolio return will decrease. In another word, the USD denominated portfolio return is partially offset by the foreign exchange portfolio return. The negative sign also implies that the securities index portfolio's characteristics of higher returns when dollar weakens are viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period on the optimally weighted portfolio basis and therefore, the foreign exchange risk hedging is not necessary for U.S. investors.

Optimally Weighted Portfolio (1/89 - 12/93)

Regression Statistics	
Multiple R	0.329115926
R Square	0.108317293
Adjusted R Square	0.07703018
Standard Error	0.062427466
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.026984459	0.01349223	3.462041852	0.038106127
Residual	57	0.222139743	0.003897188		
Total	59	0.249124202			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.028682217	0.021235104	1.35069822	0.182130151	-0.013840363
E(R)(World) - Rf	-0.08208663	0.139194055	-0.589727989	0.55770355	-0.360818036
E(R)FX(Portfolio) - Rf	-0.733706256	0.386777622	**-1.896971838**	0.062902264	-1.508215415

Since the Z-statistic for the currency factor's beta coefficient is –1.89, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in an optimally weighted portfolio of real estate securities market indexes is statistically insignificant during the period 1/89 – 12/93. This means that foreign exchange risk is not priced into the optimally weighted USD denominated real estate security market index portfolio and is not attributable to the USD denominated portfolio return. The sign of beta coefficient for the portfolio's foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange portfolio return and USD denominated portfolio return. That is, as foreign exchange portfolio

return increases, the USD denominated portfolio return will decrease. In another word, the USD denominated portfolio return is partially offset by the foreign exchange portfolio return. The negative sign also implies that the securities index portfolio's characteristics of higher returns when dollar weakens are viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period on the optimally weighted portfolio basis and therefore, the foreign exchange risk hedging is not necessary for U.S. investors.

Optimally Weighted Portfolio (1/94 - 4/98)

Regression Statistics	
Multiple R	0.425953903
R Square	0.181436728
Adjusted R Square	0.148025982
Standard Error	0.04385616
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.020889606	0.010444803	5.430490204	0.007409352
Residual	49	0.094244777	0.001923363		
Total	51	0.115134383			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.027639082	0.025535336	1.082385692	0.284379102	-0.023676065
E(R)(World) - Rf	0.312339477	0.113560578	2.750421696	0.008315547	0.08413109
E(R)FX(Portfolio) - Rf	-0.944562128	0.490266346	**-1.926630565**	0.054889141	-1.909692899

Since the Z-statistic for the currency factor's beta coefficient is –1.92, which falls within the critical Z range of (-1.96, +1.96), the foreign exchange risk of investing in an optimally weighted portfolio of real estate securities market indexes is statistically insignificant during the period 1/89 – 4/98. This means that foreign exchange risk is not priced into the optimally weighted USD denominated real estate security market index portfolio and is not attributable to the USD denominated portfolio return. The sign of beta coefficient for the portfolio's foreign exchange return premium is negative, which implies a negative correlation between the foreign exchange portfolio return and USD denominated portfolio return. That is, as foreign exchange portfolio return increases, the USD denominated portfolio return will decrease. In another word, the USD denominated portfolio return is partially offset by the foreign exchange portfolio return. The

negative sign also implies that the securities index portfolio's characteristics of higher returns when dollar weakens are viewed less desirable by the U.S. investors. The factors that lead to the negative sign might be the market inefficiency or the existence of some special types of correlation, or both. Based on the above observation, it seems that foreign exchange risk is neither significant and nor systematic during this study period on the optimally weighted portfolio basis and therefore, the foreign exchange risk hedging is not necessary for U.S. investors.

Although the results show some time variations due to the involvement of 3 sub-periods, the signs of the beta coefficient for the foreign exchange risk premium are consistently negative. This implies that the U.S. investors continuously view the index investment's characteristics of higher returns when dollar weakens less desirably and this preference to the positive betas has not changed across the study periods.

Question 6 Summary Chart

Region/Country	*1/1984 – 12/1998*	*1/1989 – 12/1993*	*1/1994 – 4/1998*
Optimally Weighted Portfolio	**Insignificant**	**Insignificant**	**Significant**

FINAL SUMMARY

Final Summary Chart

Region/Country	*1/1984 – 4/1998*	*1/1984 – 12/1998*	*1/1989 – 12/1993*	*1/1994 – 4/1998*
Equally Weighted Portfolio	**Insignificant**	**Insignificant**	**Significant**	**Insignificant**
Optimally Weighted Portfolio	**Insignificant**	**Insignificant**	**Insignificant**	**Insignificant**
North America	**Significant**	**Insignificant**	**Insignificant**	**Insignificant**
Canada	Insignificant	Insignificant	Insignificant	Insignificant
Europe	**Insignificant**	**Significant**	**Insignificant**	**Insignificant**
UK	Insignificant	Insignificant	Insignificant	Insignificant
Italy	Insignificant	Insignificant	Insignificant	Insignificant
Norway	Insignificant	Insignificant	Insignificant	Insignificant
France	Insignificant	Significant	Insignificant	Insignificant
Germany	Significant	Significant	Significant	Insignificant
Netherlands	Significant	Significant	Significant	Insignificant
Switzerland	Significant	Significant	Significant	Significant
Sweden	Significant	Insignificant	Significant	Insignificant
Asia/Pacific Region	**Significant**	**Significant**	**Significant**	**Insignificant**
Hong Kong	Insignificant	Insignificant	Insignificant	Insignificant
Japan	Insignificant	Insignificant	Insignificant	Insignificant
Singapore	Insignificant	Insignificant	Insignificant	Significant
Australia	Significant	Insignificant	Significant	Insignificant

At the regional level, the foreign exchange risk is significant in the most time across the overall study period. The results are mixed and follow different patterns across sub-periods. At the individual country's level, the results are mixed and follow different patterns for both overall study period and individual sub-period. For the equally weighted portfolio, the results are mixed across time. For the optimally weighted portfolio, the foreign exchange risk is insignificant across time.

Summaries of the Study Questions

Q1: Is foreign exchange risk significant across time?

The answers can be found at two levels. At the regional level, the results are mixed. North America and Asia/Pacific show that the foreign exchange risk is significant across time and therefore, foreign exchange risk hedging is necessary to U.S. investors. On the other hand, Europe shows that the foreign exchange risk is insignificant across time and therefore, foreign exchange risk hedging is not necessary to U.S. investors. At the individual country level, the findings are also mixed. It seems that it is a more likely for U.S. investors to experience significant foreign exchange risk in Germany, Netherlands, Switzerland, Sweden, and Australia, while it is less likely for U.S. investors to experience significant foreign exchange risk in Canada, UK, Italy, Norway, France, Hong Kong, Japan, and Singapore.

Q2: Does the significance of foreign exchange risk change across time?

The finding results are mixed. The significance of foreign exchange risk for Canada does not change across time. Among European countries, it seems that the foreign exchange risk is consistently insignificant across time for UK, Italy and, Norway. For the rest of European countries, the significance of foreign exchange risk changes across time. Among them, Germany and Netherlands follow a same pattern while France, Switzerland, and Sweden follow their own patterns. For Asian countries, Hong Kong and Japan follow a same pattern, while Singapore and Australia follow their own patterns. It seems that it is a more likely for U.S. investors to see the changing significance of foreign exchange risk across time in France, Germany, Netherlands, Switzerland, Sweden, Singapore, and Australia, while it is less likely for U.S. investors to see the changing significance of foreign exchange risk across time in Canada, UK, Italy, Norway, Hong Kong, and Japan.

Q3: Is the foreign exchange risk significant on an equally weighted portfolio basis?

According to the Modern Portfolio Theory, risks (securities return variance) can be categorized as either systematic risk or unsystematic risk. By simply putting individual securities together to form a portfolio, certain portion of the total variance of individual portfolios can be offset. This is due to the fact that a portion of the variation of different foreign exchange rate movements

offsets each other within a portfolio. The reduced portion of risk (variance) is the unsystematic risk (the variance of the foreign exchange return). This is supported by my testing results for an equally weighted portfolio. Even the equally weighted portfolio can not totally unload the unsystematic risk, we still see the diversification benefits realized by forming a portfolio - the foreign exchange risk for the equally weighted portfolio is insignificant across the overall study period. Therefore, U.S. investors don't need to use hedging strategies.

Q4: Does the significance of foreign exchange risk change across time on an equally weighted portfolio basis?

Theoretically, unsystematic risk can be totally diversified away through optimal asset allocation. Since equally weighted portfolio is not optimized, only a portion of the unsystematic risk gets offset. When this happens, the portfolio's diversification benefits are limited. The leftover unsystematic risk might still play an important role in the APT model across time. This is evidenced by my findings: the significance of foreign exchange risk for an equally weighted portfolio still changes across time. The variation might also be due to the different foreign exchange rate movement patterns captured by the 3 sub study periods. In addition to the changes in the significance of the beta coefficient for the foreign exchange risk factor, the signs of the beta coefficients also change across the time. This time variation is considered normal when studies cover several sub-periods. The mixture of signs implies that the U.S. investors didn't continuously view the index portfolio's characteristics of higher returns when dollar weakens desirably and U.S. investors' preference to the positive or negative betas has changed across the study periods.

Q5: Is the foreign exchange risk significant on an optimally weighted portfolio basis?

After optimally allocate the weights within the portfolio, the foreign exchange risk is almost fully diversified away. Comparing to the testing results of the equally weighted portfolio, it shows that the foreign exchange risk is not a systematic risk and is not an attributable factor to the total portfolio return. Said differently, U.S. investors are not rewarded for taking the foreign exchange risk on the portfolio basis. Therefore, since foreign exchange risk is not significant on an optimally weighted portfolio basis, U.S. investors should fully take advantage of the

diversification benefits brought by the optimization techniques and not worry about hedging the foreign exchange risk.

Q6: Does the significance of foreign exchange risk change across time on an optimally weighted portfolio basis?

The significance of the foreign exchange risk no longer changes across time and the foreign exchange risk has successfully been diversified away for all 3 sub study periods.

In sum, the foreign exchange risk still matters to the U.S. investors as long as they don't hold optimized portfolios. With optimal portfolios, the foreign exchange risk no longer matters because the risk exposure can be fully diversified away through the portfolio asset allocation optimization process given the findings that foreign exchange risk is not systematic on a portfolio basis.

Finally, after comparing my research results with the previous researches conducted for the direct real estate investments and the international equity securities investments, I found that my findings support some academics' conclusions on the individual country/region basis. That is, on the individual country/region basis, the foreign exchange risk exposure is still substantial, represents a systematic component of the total risk, and is priced in the total return. On the other hand, my findings argue that the significance of foreign exchange risk behaves quite differently on a worldwide diversified portfolio basis comparing to that on the single country/region basis. On an optimally diversified portfolio basis, the foreign exchange risk exposure is not significant, does not represent a systematic component of the total risk, and is not priced in the portfolio return.

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