Securitized Real Estate and its Link with Financial Assets and Real Estate : An International Analysis

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Abstract

This paper provides cross-country evidence of the link between securitized real estate and stocks, bonds, and direct real estate. First, we investigate the behavior of betas in 16 countries and identify the causes of their variation. Second, securitized real estate returns are regressed on "pure" stock, bond and real estate factors. The betas are generally found to decrease over the 1990-2004 period, but the causes for such decline differ across countries. Furthermore, securitized real estate returns are found to be positively associated with stock and direct real estate returns, but negatively related with bond returns. Ultimately, financial assets contribute greatly to the variance of securitized real estate, while the impact of direct real estate is limited. However, a large fraction of the variance is not accounted for by these factors, especially in the U.S., suggesting that other factors are at play.

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1. Introduction

The importance of securitized real estate as an asset class has grown considerably in the last decades and so has its market capitalization which is estimated at US$609 billion as of September 2005 (Bigman and Chiu, 2005). Accordingly, much research has been devoted to studying the behavior and to unmasking the driving factors of publicly traded real estate.[1] As for any other asset class, there are many important reasons for studying the return generating process of securitized real estate, such as to examine whether returns can be forecasted (Liu and Mei, 1992; Bharati and Gupta, 1992; Brooks and Tsolacos, 2003), to ascertain the diversification benefits of the asset class (Gordon, Canter, and Webb, 1998; Mull and Soenen, 1997), and to analyze the inflation-hedging effectiveness of such vehicles (Liu, Hartzell, and Hoesli, 1997; Adrangi, Chatrath, and Raffiee, 2004).

The aims of this paper are twofold. The primary objective is to expand the investigation done by Khoo, Hartzell, and Hoesli (1993) on the behavior of REIT betas in the United States by employing a similar procedure to securitized real estate in 16 countries from 1990 to 2004 and by providing a cross-country analysis of the causes underlying the variations in the betas. Second, this research expands Clayton and MacKinnon (2003) paper on the importance of stock, bond and real estate "pure factors" in explaining securitized real estate returns by doing the analysis for five countries. In sum, we want to expand the literature by depicting the dynamics that underpin different markets and analyze if the previous findings for the U.S. can be generalized for other markets.

The paper is organized as follows. Section 2 discusses related work on securitized real estate's betas and on their hybrid nature. The two subsequent sections present the methodologies employed and the data, respectively, while the results are discussed in Section 5. The final section contains our concluding remarks.

[1] For a review of the financial economics literature on the environment and performance of REITs, see Corgel, McIntosh, and Ott (1995) and Zietz, Sirmans, and Friday (2003).

2. Literature Review

An important question addressed by the literature concerning securitized real estate returns has been whether or not they outperform other asset classes. Chan, Hendershott, and Sanders (1990), Glascock (1991) and Peterson and Hsieh (1997) find that REITs do not display higher risk-adjusted returns with respect to stocks. On an international basis, this result is confirmed by Ling and Naranjo (2002). Contrasting evidence for the U.S. is provided by Liu and Mei (1992) who show that EREITs outperform large caps and small caps on a risk-adjusted basis but not bonds. Lying in between and probably settling the differences, Chen, Hsieh, and Jordan (1997) derive a Jensen measure for each EREIT using excess returns and conclude that EREITs outperform other investments during some periods but not always.

To better understand the asset class, the analysis of the time-varying nature of securitized real estate betas constitutes another stream of research. Eichholtz (1997) shows a high correlation between securitized real estate and stocks on an international basis, but there is evidence from several countries that this correlation has been declining (Ghosh, Miles, and Sirmans, 1996; Brounen and Eichholtz, 2003). Khoo, Hartzell, and Hoesli (1993) identify a clear declining tendency in EREIT betas and attribute it to the increasing information about securitized real estate as an asset class. More recently, Chiang, Lee, and Wisen (2005) find weak evidence for a decline in EREIT betas with a single-factor model; however, the declining trend in EREIT betas disappears when they use a three-factor model. They observe, however, a sharp decline in market beta in 2002 but cannot identify whether it is random or significant. During bull and bear markets, the variation in betas is examined by Glascock (1991) and Conover, Friday, and Howton (2000) who find that when betas are allowed to change across bull markets, they behave procyclically and explain cross-sectional returns.

In search of a more accurate determination of the hybrid nature of securitized real estate, many authors have depicted its relationship with stocks, bonds and direct real estate. Liu and Mei (1992) report that the risk premiums of EREITs are similar in nature to those of small caps and to a lesser extent to those of large caps and bonds. Glascock, Lu, and So (2000) find that before 1992 REITs were cointegrated with bonds and inflation, while after 1992 they were cointegrated with stocks and more so with small caps. For the Swiss market, Cauchie and Hoesli (2006) find that real estate funds are integrated with both stocks and bonds.

The relationship between securitized and direct real estate is analyzed by Giliberto (1990), Gyourko and Keim (1992) and Mei and Lee (1994) who find that both sets of returns are determined by a common real estate factor that links their performances. Karolyi and Sanders (1998) acknowledge that other than the stock and bond market risk premiums, a significant risk premium for REIT returns was not being captured by traditional multiple beta asset pricing models. This is also ascertained by Clayton and MacKinnon (2001 and 2003) and Newell (2005) who report a steady increase over time in the proportion of volatility not accounted for by stock, bond and real estate factors. Nonetheless, Clayton and MacKinnon observe that REITs went from being driven by the same economic factors as large caps in the 1970s and 1980s, to being more strongly related to both small caps and real estate related factors in the 1990s. However, Newell finds that the contribution of property only marginally increased in recent years, while the importance of stocks decreased significantly, and bond-like features gained more importance. Anderson, Clayton, and Sharma (2004) distinguish between value and growth small cap stocks and find that REITs behave more like small cap value stocks than like small cap growth stocks or large cap stocks.

3. Methodology

3.1. Betas Behavior

The first goal of this paper is to observe the behavior of securitized real estate betas. A market model is employed in which publicly traded real estate's excess returns are regressed on a constant and on the common stock market's excess returns (Khoo, Hartzell, and Hoesli, 1993):

$$r_{it} - r_{fit} = \alpha_i + \beta_{im}\left(r_{mit} - r_{fit}\right) \qquad (1)$$

where

r_{it} = the *i*th country's securitized real estate total return for month *t*;

r_{mit} = the *i*th country's stock total return for month *t*;

r_{fit} = the *i*th country's three-month risk free rate for month *t*.[2]

In order to calculate a monthly beta, equation (1) is estimated for month *t* by using the previous five years (60 months) of data. Therefore, a rolling window is created where each new window for month *t*+1 drops the oldest observation and incorporates a new observation until the whole sample is exhausted.

[2] The three-month rate was transformed to a monthly rate.

3.2. Betas Decomposition

Subsequently, the sample is divided into two equal sub-samples and equation (1) is run for each sub-period. Sub-period 1 begins in January 1990 and ends in June 1997, while sub-period 2 starts in July 1997 and finishes in December 2004. The objective here is to compare the two betas calculated for each sample and determine if they are statistically different. This is done by a *t*-test in which the null hypothesis tested is that securitized real estate's market betas remained constant over the two sub-periods:

$$t = \frac{\hat{\beta}_1 - \hat{\beta}_2}{\sqrt{V(\hat{\beta}_1) + V(\hat{\beta}_2)}} \qquad (2)$$

where

$\hat{\beta}_i$ = the average estimated beta in sub-period *i*;

$V(\hat{\beta}_i)$ = the variance of the estimated coefficient, $\hat{\beta}_i$, in sub-period *i*;

$H_0 : \hat{\beta}_1 = \hat{\beta}_2$ and $H_A : \hat{\beta}_1 \neq \hat{\beta}_2$

The market betas are then decomposed into their three components to examine the cause of the variation in the betas. For the *i*th country, the betas are decomposed as follows:

$$\beta_{im} = \frac{\rho_{im}\sigma_i}{\sigma_m} \qquad (3)$$

where

β_{im} = the *i*th country's market beta;

σ_i = the *i*th country's publicly traded real estate's standard deviation;

σ_m = the *i*th country's stock market's standard deviation;

ρ_{im} = the *i*th country's correlation between publicly traded real estate returns and stock market returns.

To test if the publicly traded real estate's variance or the stock market's variance changed in each country from one sub-period to the next, the following test is performed:

$$F = \frac{\sigma^2_{\text{larger}}}{\sigma^2_{smaller}}, \text{ with degrees of freedom } \nu_1 = n_1 - 1 \text{ and } \nu_2 = n_2 - 1 \qquad (4)$$

where

n_i = the number of observations in sample *i*;

$H_0 : \sigma_1^2 = \sigma_2^2$ versus $H_A : \sigma_1^2 \neq \sigma_2^2$

Note that the larger variance goes in the numerator and the smaller in the denominator. The statistical significance of the statistic is then determined by calculating its p-value. Finally, the variation of the third component is tested using Fisher's z' transformation. This procedure transforms correlations (r) into the normally distributed variable z' as follows:

$$z' = 0.5[\ln(1+r) - \ln(1-r)] \quad (5)$$

The z' statistic may then be constructed as: $z' = \frac{z_1' - z_2'}{\sigma_{z_1'-z_2'}} \sim N(0,1)$ (6)

This statistic is normally distributed and its standard error is: $\sigma_{z_1'-z_2'} = \sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}$ (7)

where n_1 is the number of pairs used to calculate r_1 and n_2 the number of pairs used to calculate r_2. The p-value is then used to determine the statistical significance.

3.3. Pure Factors

Following Clayton and MacKinnon (2003), this research also focuses on the importance of stock, bond and real estate "pure factors" in explaining securitized real estate returns. The idea behind this is to determine the strength to which these "pure factors" drive real estate stock returns. These three factors are chosen because securitized real estate returns have stock-like characteristics since they are stocks, real estate characteristics since the underlying assets of these stocks are direct real estate and bond-like characteristics since real estate's generally long term fixed leases generate a fixed income.

To examine the hybrid nature of publicly traded real estate, for each country *i*, a multi-factor model is specified in which the total return on securitized real estate for period *t*, r_{SREit}, is expressed as a linear function of stock, bond and real estate returns. The model is as follows:

$$r_{SREit} = \beta_0 + \beta_S r_{Sit} + \beta_B r_{Bit} + \beta_{RE} r_{REit} + v_{it} \quad (8)$$

where

r_{Sit} = the *i*th country's stock total return for year *t*;

r_{Bit} = the *i*th country's government bond total return for year *t*;

r_{REit} = the *i*th country's direct real estate total return for year *t*;

v_{it} = the *i*th country's securitized real estate idiosyncratic return for year *t*.

Nevertheless, equation (8) is not used in the empirical analysis because we are interested in the independent or "pure factors" (Clayton and MacKinnon, 2003). Equation (8) would yield biased estimates because redundant factors would be taken into account. That is, common drivers between the three factors would be accounted for more than once. To obtain "pure factors" that are uncorrelated with each other, the regressors in equation (8) are orthogonalized in first stage regressions as follows:

$$r_{REit} = \delta + \eta r_{Bit} + \phi r_{Sit} + \varepsilon_{it}, \tag{9}$$

$$r_{Bit} = \tau + \lambda \hat{\varepsilon}_{it} + \gamma r_{Sit} + \mu_{it}, \tag{10}$$

where ε_{it} and μ_{it} are mean zero terms which, by construction, are orthogonal to the regressors in the respective equations. Note that the residuals from the OLS estimation of equation (9) are included on the right-hand side of equation (10). These residuals constitute the "pure" real estate and the "pure" bond factors respectively, that are in turn independent from the stock market return factor. Hence, by replacing the bond and real estate returns in equation (8) by their respective orthogonalized error terms, the following return generating process for real estate stocks based on uncorrelated stock, bond and real estate factors is obtained:

$$r_{SREit} = b_0 + b_S r_{Sit} + b_B \hat{\mu}_{it} + b_{RE} \hat{\varepsilon}_{it} + v_{it} \tag{11}$$

Therefore, the real estate stock return's variance is:

$$Var[r_{SRE}] \equiv \sigma^2_{SRE} = b_S^2 \sigma^2_{r_S} + b_B^2 \sigma^2_{\mu} + b_{RE}^2 \sigma^2_{\varepsilon} + \sigma^2_v \tag{12}$$

This allows us to decompose the variance and find the relative impact of each factor on the variability of securitized real estate returns:

$$\text{stock} = \frac{b_S^2 \sigma^2_{r_S}}{\sigma^2_{SRE}}, \quad \text{bond} = \frac{b_B^2 \sigma^2_{\mu}}{\sigma^2_{SRE}}, \quad \text{RE} = \frac{b_{RE}^2 \sigma^2_{\varepsilon}}{\sigma^2_{SRE}}, \quad \text{idiosyncratic} = \frac{\sigma^2_v}{\sigma^2_{SRE}} \tag{13}$$

As noted by Clayton and Mackinnon (2003), a potential econometric problem that could result from the preceding empirical approach is that the asset returns series in the first stage regression could be "overpurged".[3] The above orthogonalization takes the stock market returns, r_{Sit}, as numeraire and as the reader may surmise, the chosen numeraire picks up the state variables common to the three asset classes that influence securitized real estate returns. To overcome this problem, the procedure is repeated and bond returns as well as unsecuritized real estate returns are

[3] A second potential problem is induced by using the residuals from the first stage regressions as regressors in the second stage return regression. In this case, standard errors are downward biased therefore leading to an upward bias in standard t-tests of statistical significance and spurious significance of the coefficients. Clayton and Mackinnon (2003) took this into account by estimating the nonorthogonalized (raw) equation and then comparing the t-statistics. According to their results, no spurious significance problem was found so we will not estimate the raw equation and assume that the t-statistics are not upwardly biased.

also employed as numeraires in the first stage regressions. This creates an upper and lower bound to the importance of each asset class in determining the returns of publicly traded real estate. On the other hand, the range of this interval represents the effect that the state variables common to the other asset classes have in securitized real estate's volatility.

4. Data

All of the data used in this paper were obtained from Datastream except the direct real estate data that were sourced from the Investment Property Data Bank (IPD), NCREIF, and the Property Council of Australia. The first model uses monthly data and is applied to 16 countries. It was constrained to start in 1990 given that the GPR 250 indices are only available since this date. These indices are total return indices of securitized real estate calculated by Global Property Research which is part of Kempen & Co, an important Dutch merchant bank that provides specialized financial services. The stock market variables used are the total market total return indices computed by Datastream. As a risk free variable, the Euro-Currency three-month middle rate was chosen. For Australia, Hong Kong and New Zealand this variable is not available since 1990 so the Interbank three-month middle rate is used.[4]

The second model uses yearly data and is calculated for five countries for the period 1987-2004. The GPR 250 indices are not available since 1987 so they are replaced by Datastream's Real Estate indices. Datastream's Real Estate series are securitized real estate total return indices computed by Datastream and the correlation between the Datastream returns and the GPR returns are 0.98 for Australia and 0.99 for Canada, France, the U.K. and the U.S. over the 1990-2004 period. Datastream's total return indices are used for stocks, whereas J.P. Morgan's government bond return indices for each country are used for bonds. Finally, for direct real estate, IPD indices are used for Canada, France and the U.K., the Australian Property Council index is used for Australia and the NCREIF Property Index (NPI) for the U.S.

Descriptive statistics of the returns on securitized real estate and stocks for each of the 16 countries over the 1990-2004 are displayed in Table 1. The mean monthly return is negative in Canada (-0.88%), Germany (-0.70%), New Zealand (-0.54%), and Japan (-0.20%), whereas the best results are found in Hong Kong (1.19%), Sweden (1.18%), Singapore (0.81%), Spain (0.77%), and

[4] The two interest rate variables were found to be highly correlated over the shorter time periods for which both series were available. The respective correlations were 0.98 for Australia and 0.99 for Hong Kong and New Zealand.

the U.S. (0.66%). On the other hand, the countries with the largest variability of returns are Singapore (11.53%), Hong Kong (11.44%), Sweden (9.34%), and Japan (8.43%).

Among the best performing stock markets are Sweden (1.14%), Hong Kong (1.09%), Spain (0.78%), Switzerland (0.67%), and the U.S. (0.66%). The only negative mean monthly return is observed in Japan (-0.34%) and the most volatile stock markets are those of Hong Kong (8.03%), Sweden (6.80%), Italy (6.76%), Singapore (6.30%), and Japan (5.91%).

Table 2 contains the descriptive statistics of stocks, bonds, securitized and unsecuritized real estate annual total returns for each of the five countries studied for the 1987-2004 period. For Australia and the U.S., a non risk-adjusted ordering of the assets from highest to lowest mean returns is: real estate stocks, stocks, bonds and real estate. Canada and France have the same ordering except that stocks come before real estate stocks, and in the U.K., the order is stocks, real estate stocks, real estate and bonds. As in Chan, Hendershott, and Sanders (1990) and Glascock (1991), we do not find that securitized real estate displays higher risk-adjusted returns with respect to stocks in the U.S., but we do find that stocks outperform securitized real estate on a risk-adjusted basis for Canada and the U.K. Moreover, our results suggest that bonds offer a higher return than direct real estate and yet have a lower standard deviation in all of the countries except the U.K.

5. Empirical Results

5.1. Betas Behavior Results

Three major trends are identified and consequently three groupings of countries are made in order to better depict them. Nevertheless, a general tendency of decreasing betas is detected. If we submit our analysis just to comparing the first and last betas, we see that in 14 out of 16 countries, the beta decreased from 1990 to 2004. The only exceptions are New Zealand where the beta rose by 0.05 and Germany were the beta remained unchanged.

The summary statistics for the betas are reported in Table 3. Two countries present a mean beta over one; they are Singapore with 1.61 and Hong Kong with 1.28.[5] This means that when the stock market performs well, real estate stocks will perform even better but when the stock market performs poorly, real estate stocks will do even worse. Other countries with high mean betas are: Japan (0.90), Sweden (0.80), Spain (0.78), the U.S. (0.71), and Canada (0.66). The rest of the

[5] Ooi and Liow (2004) also reported high betas for Singapore (1.46) and Hong Kong (1.07) during the 1992-2002 period.

countries have a beta ranging from 0.20 to 0.45. By far the most volatile beta is that of Sweden with a standard deviation of 0.76 due to its steady decrease during the period. On the other hand, the most stable betas are seen in Hong Kong, Italy, and the Netherlands (standard deviations in the 0.10-0.12 range).

The first trend is illustrated in Figure 1 and comprises nine countries (Belgium, Canada, France, Japan, the Netherlands, Spain, Sweden, Switzerland, and the U.S.) whose betas appear to be decreasing during the whole period. The most significant reductions from the beginning to the end of the sample occur in Sweden, Canada, Belgium, Spain, and the U.S. All of these countries experience a reduction of at least 0.5 in their betas during this period. Sweden and Canada, for instance, experience 1.95 and 0.95 reductions, respectively. Japan, France, the Netherlands and Switzerland exhibit reductions ranging from 0.45 for Japan to 0.21 for Switzerland.

As can be seen in Figure 2, the second trend involves three countries (Germany, Italy and the U.K.) that experience their minimum betas around 2001. These countries' betas appear to start increasing after 2001. As the fall was larger than the subsequent rise for the U.K., the overall beta decreased by 0.36. In the case of Italy, the beta only decreased by 0.12 and, for Germany the beta practically ended up unchanged.

Finally, Figure 3 shows the last trend which involves four countries (Australia, Hong Kong, New Zealand, and Singapore). These countries experience relatively constant betas and reach their peak in 1999. Interestingly, these figures regroup all of the countries used in this research from the Asia-Pacific basin (except Japan). This similarity in the behavior of their betas could suggest that a continental factor affects publicly traded real estate returns.[6]

5.2. Betas Decomposition Results

Table 4 shows the betas for the two sub-periods (1990:01-1997:06 and 1997:07-2004:12). The arrows show if there is an increase or a decrease in the beta from sub-period 1 to sub-period 2. The null hypothesis of the *t*-statistic is that the beta from the first sub-period is equal to the beta of the second sub-period.

[6] Evidence on continental factors is contained in Eichholtz *et al*. (1998) and Hamelink and Hoesli (2004). Additionally, Ooi and Liow (2004) highlight the different continental environment when studying securitized real estate's performance in seven developing markets in East Asia.

The *t*-statistics show that of the 16 countries studied, 10 present a change in beta from the first sub-period to the second one. Australia, Germany, Hong Kong, Italy, New Zealand, and Switzerland are the six countries for which the betas are not significantly different between the two sub-periods. From the 10 countries whose betas differ from one sub-period to the other, nine of them experience a decrease in their betas. Thus, the decreasing beta evidenced by Khoo, Hartzell, and Hoesli (1993) for the U.S. appears to prevail for several countries. The only exception is Singapore whose beta has increased from sub-period 1 to sub-period 2. Once again a different behavior is noticed for the countries of the Asia-Pacific basin (excluding Japan) as an increase (albeit not significant) in their betas is obtained.

In search of an explanation of the variation of the betas, the first component analyzed is the standard deviation of securitized real estate. Table 5 shows that the standard deviation decreases in Belgium, Canada, the Netherlands, New Zealand, Sweden, and Switzerland at the 5% level or better, while the level of significance is 10% for Spain. The beta increases in Germany, Hong Kong, and Singapore at the 1% level whereas the significance level is 10% for Italy. There is thus a mild tendency to declining securitized real estate standard deviations over the period.

When the change in the standard deviation of the stock market is analyzed (Table 6), the results show an increase for Canada, France, Germany, Hong Kong, the Netherlands, Singapore, Sweden, and the U.S. at the 5% level or better, while the increase is significant only at the 10% level in Belgium, Spain, and Switzerland. The only three countries for which the common stock market's standard deviation has declined are Japan (1% level), New Zealand (5% level), and Australia (10% level). There is thus a clear tendency for increased stock market standard deviations.

Table 7 illustrates the third component of betas, i.e. the variation in the correlation between publicly traded real estate and common stocks. We can see at the 1% level that the correlation has decreased in France, Hong Kong, Japan, and the U.K. It has also decreased at the 5% level in Italy, Spain, and Sweden, and at the 10% level in Belgium and the U.S. These results pertaining to the decline in the correlation between securitized real estate and common stocks are consistent with the evidence by Ghosh, Miles, and Sirmans (1996) and Brounen and Eichholtz (2003).

The last three tables are summarized in Table 8 in order to better understand the variation in the betas in each country. It can be seen that only in Sweden the variation of the three components explain the decreasing beta at the 5% level or better, while this also holds for Belgium and Spain at

the 10% level. The standard deviations of securitized real estate and common stocks explain the beta decrease in Canada and the Netherlands. In France and the U.S., it is the stock market's standard deviation and the correlation that explain the decreasing beta (for the U.S. the significance level is only 10% for the correlation). The results for the U.S. are thus in contrast with those by Khoo, Hartzell, and Hoesli (1993) with respect to the causes of the decline in beta, as these authors report the decline in REITs' standard deviations as the dominant impact. Japan's beta also decreased due to a decline in the correlation between securitized real estate and stocks, but its variation was mitigated by the decrease in the stock market's standard deviation. Singapore exhibits an increasing beta with both standard deviations increasing and therefore having opposite effects. Finally, the decreasing beta in the U.K. was explained solely by the decrease in correlation.

5.3. Pure Factor Betas Results

The factor sensitivities (beta coefficients) of regressing publicly traded real estate returns on orthogonalized stock, bond and real estate returns, for the 1987-2004 period, are reported in Table 9. Three estimations are made, each using a different factor as numeraire. In Canada, the U.K., and the U.S. all of the beta coefficients are significant at the 5% level or better. For Australia, all factors are significant except the bond and real estate pure factors when the stock market is used as numeraire and the real estate pure factor when bonds are used as numeraire. Finally, in France, the bond factor is always significant, the stock factor never is, while the real estate factor is only significant at the 1% level when real estate is used as the numeraire.

The importance of these factors in driving real estate stock returns is as follows: Australia's stock market betas are close to one and the other two factor's betas when significant are small in magnitude. In Canada, securitized real estate presents a strong positive relationship with stocks and direct real estate and an even stronger but inverse relationship with bonds. Securitized real estate in the U.K. and the U.S. exhibits a negative relationship with the bond factor; this latter relationship is somewhat stronger for the U.K. than for the U.S. For the U.K., the real estate factor is more important than the stock market factor while the opposite holds for the U.S. This contrasts the tight relationship between securitized and direct real estate documented by Giliberto (1990), Gyourko and Keim (1992) and Mei and Lee (1994) for the U.S. Finally, in the French market the bond factor also appears inversely related to securitized real estate returns, whereas the evidence concerning the relationship between securitized and direct real estate remains small and inconclusive. In sum, securitized real estate returns appear to be positively related to stock and direct real estate returns, while the relationship with bonds is negative.

5.4. Variance Decomposition Results

Table 10 decomposes the variance of publicly traded real estate into the contributions of each of its orthogonalized factors. A somewhat surprising result from this table is that *a priori* we had thought that any given factor would in all cases account for a larger portion of the variation when taken as numeraire than when taken as an orthogonalized factor. The reason behind this is that as the numeraire a factor incorporates all of its driving factors and as an orthogonalized factor it includes only the driving factors not accounted for by the numeraire. As some drivers may affect the dependent variable with opposite effects, this assumption does not hold true for all countries. This is the likely explanation for the fact that stock and bond orthogonalized factors in the U.K. explain more of securitized real estate's variance than the same factors when taken as the numeraire. These results could provide some additional insight to Clayton and MacKinnon (2003) in their approach for creating a lower and upper bound on the proportion of REIT volatility attributable to each asset class when discussing the possibility of "overpurging" the numeraire (page 44).

The dominant factor in Canada, the U.K., and the U.S. appears to be the idiosyncratic risk's variance as the impact of that factor in the variation of securitized real estate returns ranges from 54.88% for Canada to 84.84% for the U.S.[7] This result supports the evidence by Clayton and MacKinnon (2003) that even if stock, bond and real estate related factors explain securitized real estate volatility in part, an important proportion of this volatility is still left unexplained (for the impact of the former two factors, see also Karolyi and Sanders, 1998). In France, the bond's variance accounts for around 65% of the variation of securitized real estate returns and the idiosyncratic risk's variance for nearly all of the remaining 35%. In Australia, the impact is evenly split between the stock and idiosyncratic factors.

Both the stock and bond factors appear important in Canada and the U.K., whereas the role of direct real estate is more limited. All three asset classes jointly explain around 45% of the variation of securitized real estate, but their specific explanatory proportion varies greatly across numeraires. In the U.S., stocks explain around 10% of the variation and bonds around 5%. Overall direct real estate returns have a quite a negligible impact on securitized real estate's variance (the

[7] Therefore, future research about securitized real estate's idiosyncratic risk is of outmost importance. For instance, Chaudhry, Maheshwari, and Webb (2004) analyze whether some of the characteristics of REITs are related to idiosyncratic risk measures (such as size, financial leverage, performance, liquidity, capital and earnings variability) and find that the different determinants impact idiosyncratic risk depending upon the time period examined.

maximum impact is 15.44% for Canada when real estate is used as the numeraire). Consistent with prior research, direct real estate returns thus appear to only marginally impact upon securitized real estate returns.

6. Concluding Remarks

This paper analyzes the behavior of securitized real estate betas since 1990 and finds that most of the countries of our sample have had a decrease in their beta over the last 15 years. A decomposition of each country's beta into securitized real estate's standard deviation, the stock market's standard deviation and the correlation between securitized real estate and common stocks indicates that the behavior of the beta can be explained differently in each country. In Sweden for instance, the three components contribute to the decrease in beta, while in the U.K. the decrease is explained solely by the decline in correlation between securitized real estate and common stocks.

The second part of this study has focused on how the factors driving stocks, bonds and direct real estate influence securitized real estate returns. The analysis uses "pure factors" uncorrelated with each other and a variance decomposition approach. Securitized real estate returns appear to be positively related to pure stock and real estate factors and negatively associated with the pure bond factor. A significant portion of the variance of securitized real estate returns is explained by the variance of stocks (Australia), by that of bonds (France) or by both (Canada and the U.K.), while the contribution of direct real estate is more limited. A large fraction of securitized real estate's variance is left unexplained, especially in the U.S. (85%). This means that the idiosyncratic factor (or factors yet to be defined) plays an important role in the determination of securitized real estate returns.

Further research should attempt to analyze the impact of the institutional setup (and of changes in the setup) of real estate securities across countries. For instance, one could hypothesize that leverage should render the security more prone to interest rate changes and thus lead to the assets behaving more like bonds. The tax status is also likely to impact, but such effect should be isolated from other influences. Indeed, tax transparent vehicles (such as U.S. REITs or Australian Property Unit Trusts) should behave more like the underlying real estate, as such investment types should spur institutional interest leading to growth and greater efficiency of the securitized real estate sector. Finally, and despite the complexity of the task, further research should attempt to identify what additional factors drive real estate security returns.

Table 1 - Summary statistics for securitized real estate returns and stock returns in 16 countries (monthly data for the period 1990-2004)

Country	Asset Class	Mean (%)	Std. Dev. (%)	Maximum (%)	Minimum (%)
Australia	Securitized	0.59	2.96	8.25	-6.69
	Stocks	0.47	3.70	7.71	-10.82
Belgium	Securitized	0.08	4.42	18.87	-17.31
	Stocks	0.40	4.59	13.30	-15.27
Canada	Securitized	-0.88	7.21	23.29	-29.08
	Stocks	0.52	4.14	11.08	-19.46
France	Securitized	0.40	3.69	11.35	-10.80
	Stocks	0.46	5.46	12.56	-16.59
Germany	Securitized	-0.70	4.71	16.99	-18.92
	Stocks	0.27	5.74	16.47	-21.53
Hong Kong	Securitized	1.19	11.44	62.18	-37.63
	Stocks	1.09	8.03	28.48	-30.22
Italy	Securitized	0.11	6.40	29.84	-18.79
	Stocks	0.26	6.76	23.19	-15.56
Japan	Securitized	-0.20	8.43	21.21	-25.62
	Stocks	-0.34	5.91	18.75	-21.00
Netherlands	Securitized	0.16	3.78	9.22	-18.18
	Stocks	0.53	4.88	12.47	-17.08
New Zealand	Securitized	-0.54	4.33	16.78	-22.59
	Stocks	0.22	4.84	13.30	-15.17
Singapore	Securitized	0.81	11.53	61.50	-34.87
	Stocks	0.30	6.30	23.69	-18.60
Spain	Securitized	0.77	7.29	26.66	-22.05
	Stocks	0.78	5.73	14.67	-19.59
Sweden	Securitized	1.18	9.34	57.93	-17.18
	Stocks	1.14	6.80	18.89	-16.42
Switzerland	Securitized	0.38	2.61	10.11	-9.09
	Stocks	0.67	4.85	12.93	-18.23
U.K.	Securitized	0.29	5.25	12.30	-13.62
	Stocks	0.29	4.23	10.41	-11.92
U.S.	Securitized	0.66	4.00	10.96	-14.11
	Stocks	0.66	4.32	11.40	-15.20

# of observations: 180 for every country except for Spain (157) and for Sweden (145).

Table 2 - Summary statistics for securitized real estate, stock, bond and direct real estate returns in 5 countries (annual data for the period 1987-2004)

Country	Asset Class	Mean (%)	Std. Dev. (%)	Maximum (%)	Minimum (%)
Australia	Securitized	15.76	19.43	73.18	-7.41
	Stocks	14.16	17.11	44.30	-12.30
	Bonds	11.03	8.21	26.31	-7.04
	Real Estate	9.92	9.54	32.47	-8.58
Canada	Securitized	11.26	31.26	86.15	-36.40
	Stocks	11.63	15.30	36.24	-11.61
	Bonds	9.09	6.24	21.03	-4.49
	Real Estate	8.02	7.44	18.50	-6.40
France	Securitized	9.76	17.29	53.07	-19.10
	Stocks	15.63	28.16	59.34	-28.81
	Bonds	8.63	6.75	21.10	-5.50
	Real Estate	7.81	9.74	23.80	-10.50
U.K.	Securitized	12.81	26.16	90.06	-18.56
	Stocks	12.90	17.03	38.46	-22.32
	Bonds	9.91	7.77	22.00	-7.03
	Real Estate	11.28	9.69	29.60	-8.50
U.S.	Securitized	14.56	23.61	49.26	-41.47
	Stocks	14.35	18.17	39.00	-21.57
	Bonds	7.63	5.86	17.34	-2.90
	Real Estate	6.69	5.88	16.24	-5.59

# of observations: 18 (17 for Canada).

Table 3 - Summary statistics of 5-year rolling betas, 1990-2004

Country	Mean	Std. Dev.	Maximum	Minimum
Australia	0.44	0.13	0.62	0.14
Belgium	0.32	0.18	0.90	0.12
Canada	0.66	0.31	1.24	0.13
France	0.34	0.15	0.59	0.16
Germany	0.22	0.13	0.39	-0.06
Hong Kong	1.28	0.10	1.43	1.03
Italy	0.37	0.12	0.54	0.11
Japan	0.90	0.28	1.30	0.48
Netherlands	0.44	0.12	0.66	0.28
New Zealand	0.39	0.17	0.67	0.11
Singapore	1.61	0.20	2.06	1.23
Spain	0.78	0.30	1.27	0.38
Sweden	0.80	0.76	2.23	0.05
Switzerland	0.23	0.13	0.45	0.06
U.K.	0.71	0.29	1.19	0.36
U.S.	0.31	0.19	0.81	0.08

Figure 1 -Five-year rolling betas for nine countries with decreasing betas over the period 1990-2004 (the time axis shows the point where the five-year sample ends)

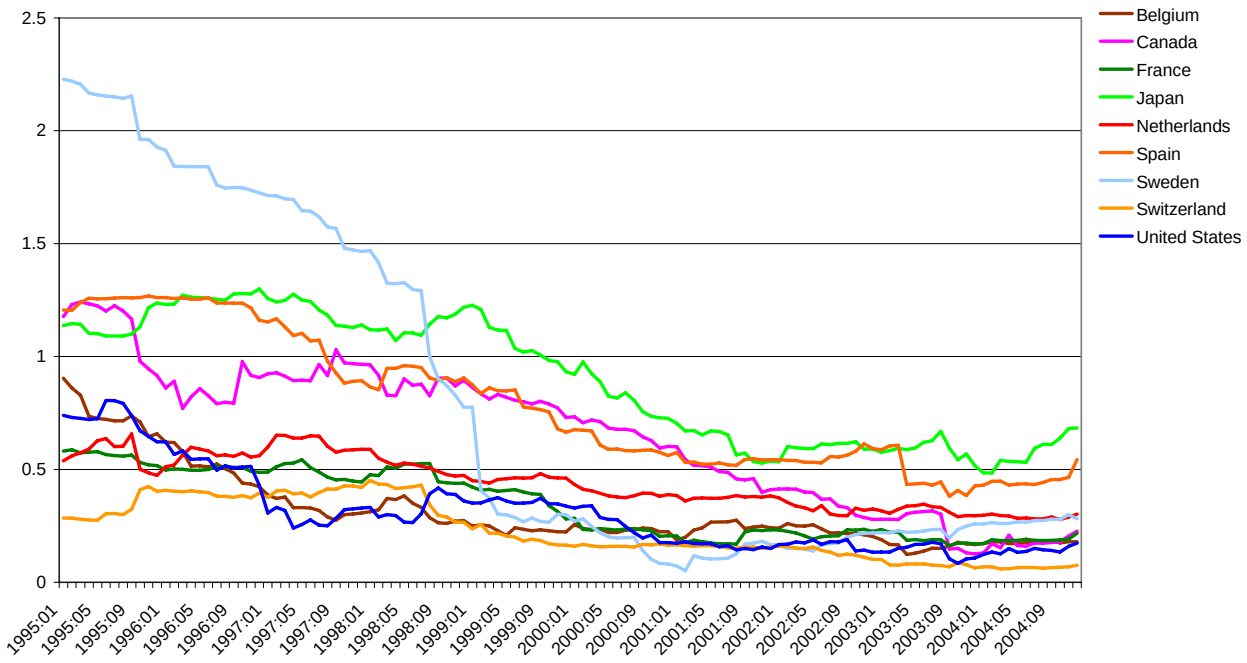

Figure 2 - Five-year rolling betas for three countries presenting minimum betas around 2001 over the period 1990-2004 (the time axis shows the point where the five-year sample ends)

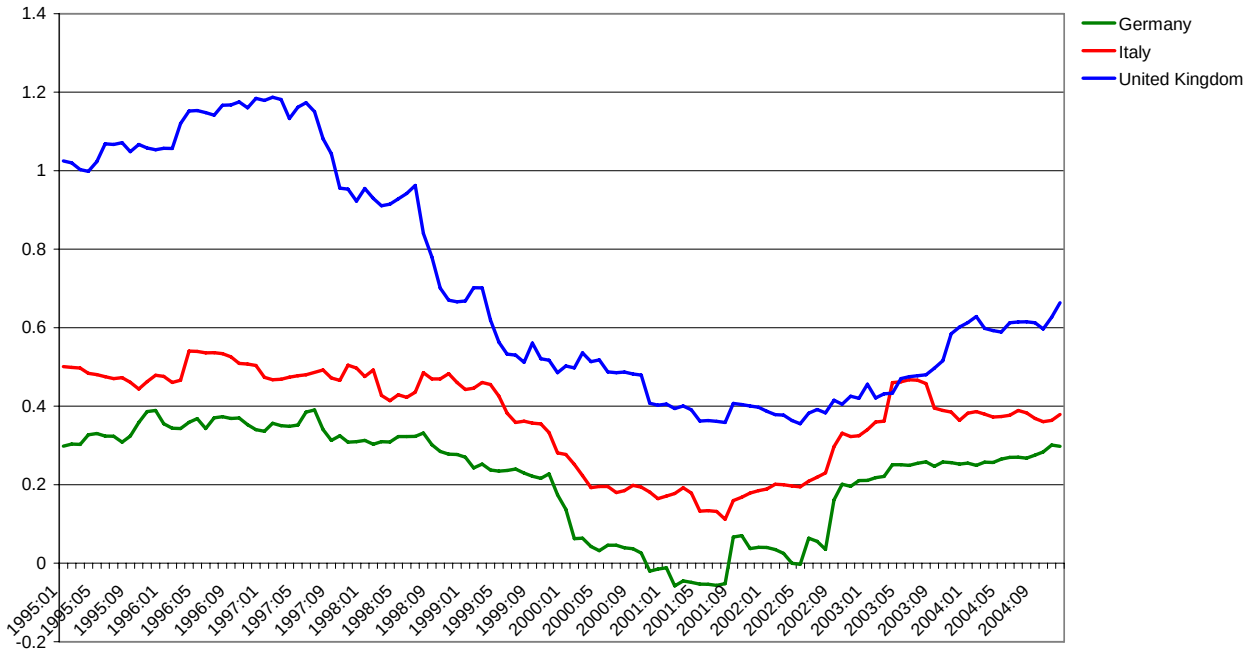

Figure 3 - Five-year rolling betas for four countries presenting relatively constant betas with maximums in 1999 over the period 1990-2004 (the time axis shows the point where the five-year sample ends)

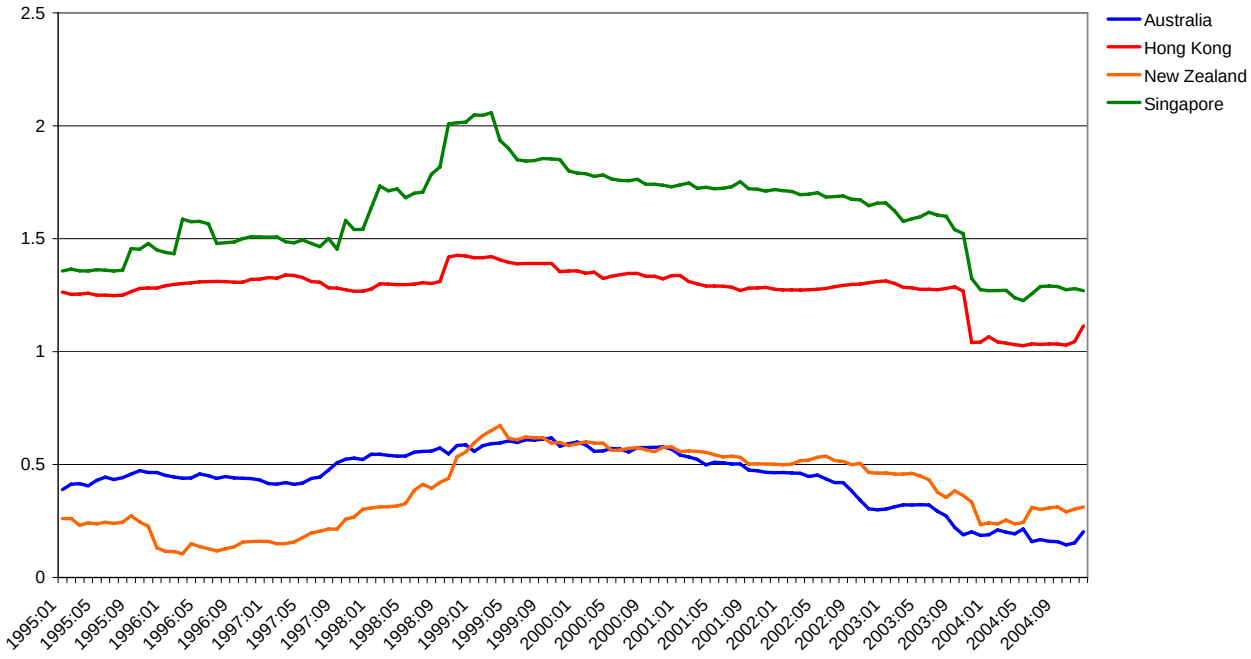

Table 4 – Betas for the sub-periods 1990:01-1997:06 and 1997:07-2004:12

Country	Sub-period 1 Beta	Sub-period 2 Beta	Change	t-statistic	
Australia	0.41	0.41	▲	-0.05	
Belgium	0.73	0.19	▼	4.19	***
Canada	1.27	0.39	▼	3.43	***
France	0.52	0.24	▼	3.43	***
Germany	0.31	0.26	▼	0.43	
Hong Kong	1.27	1.29	▲	-0.21	
Italy	0.49	0.30	▼	1.55	
Japan	1.16	0.75	▼	2.51	**
Netherlands	0.57	0.32	▼	2.20	**
New Zealand	0.30	0.48	▲	-1.46	
Singapore	1.34	1.65	▲	-2.14	**
Spain	1.10	0.55	▼	3.29	***
Sweden	1.64	0.25	▼	5.04	***
Switzerland	0.26	0.14	▼	1.46	
U.K.	1.06	0.52	▼	3.85	***
U.S.	0.59	0.22	▼	2.77	***

* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

Table 5 – Securitized real estate's standard deviations for the sub-periods 1990:01-1997:06 and 1997:07-2004:12

GPR 250	Sub-period 1 Std. Dev.	Sub-period 2 Std. Dev.	Change	F-stat	
Australia	0.03	0.03	▲	1.09	
Belgium	0.06	0.03	▼	4.27	***
Canada	0.09	0.04	▼	4.00	***
France	0.04	0.04	▲	1.05	
Germany	0.03	0.06	▲	2.67	***
Hong Kong	0.09	0.13	▲	1.98	***
Italy	0.06	0.07	▲	1.34	*
Japan	0.09	0.08	▼	1.23	
Netherlands	0.04	0.03	▼	1.49	**
New Zealand	0.05	0.04	▼	1.49	**
Singapore	0.08	0.14	▲	2.94	***
Spain	0.08	0.07	▼	1.39	*
Sweden	0.14	0.05	▼	7.67	***
Switzerland	0.03	0.02	▼	1.82	***
U.K.	0.06	0.05	▼	1.26	
U.S.	0.04	0.04	▲	1.02	

The null hypothesis tested is that securitized real estate's standard deviation in sub-period 1 is equal to that of sub-period 2.

* Statistical significance at the 10% level.

** Statistical significance at the 5% level.

*** Statistical significance at the 1% level.

Table 6 – Common stocks' standard deviations for the sub-periods 1990:01-1997:06 and 1997:07-2004:12

Stock Market	Sub-period 1 Std. Dev.	Sub-period 2 Std. Dev.	Change	F-stat	
Australia	0.04	0.03	▼	1.32	*
Belgium	0.04	0.05	▲	1.33	*
Canada	0.03	0.05	▲	1.89	***
France	0.05	0.06	▲	1.57	**
Germany	0.05	0.07	▲	2.19	***
Hong Kong	0.07	0.09	▲	1.61	**
Italy	0.07	0.07	▲	1.01	
Japan	0.07	0.05	▼	1.74	***
Netherlands	0.04	0.06	▲	2.63	***
New Zealand	0.05	0.04	▼	1.56	**
Singapore	0.05	0.07	▲	2.07	***
Spain	0.05	0.06	▲	1.44	*
Sweden	0.05	0.07	▲	1.89	***
Switzerland	0.04	0.05	▲	1.38	*
U.K.	0.04	0.04	▲	1.22	
U.S.	0.03	0.05	▲	2.15	***

The null hypothesis tested is that the stock market's standard deviation in sub-period 1 is equal to that of sub-period 2.

* Statistical significance at the 10% level.

** Statistical significance at the 5% level.

*** Statistical significance at the 1% level.

Table 7 – Correlation coefficients between securitized real estate and common stocks for the sub-periods 1990:01-1997:06 and 1997:07-2004:12

	Sub-period 1 Correlation	Sub-period 2 Correlation	Change	Fisher's z'-statistic	
Australia	0.56	0.47	▼	0.77	
Belgium	0.56	0.35	▼	1.74	*
Canada	0.49	0.42	▼	0.61	
France	0.70	0.40	▼	2.97	***
Germany	0.40	0.30	▼	0.73	
Hong Kong	0.95	0.87	▼	3.40	***
Italy	0.57	0.30	▼	2.23	**
Japan	0.87	0.47	▼	5.43	***
Netherlands	0.50	0.55	▲	-0.42	
New Zealand	0.34	0.53	▲	-1.54	
Singapore	0.83	0.86	▲	-0.53	
Spain	0.71	0.50	▼	2.09	**
Sweden	0.64	0.38	▼	2.09	**
Switzerland	0.38	0.34	▼	0.36	
United Kingdom	0.77	0.47	▼	3.36	***
United States	0.51	0.27	▼	1.85	*

The null hypothesis tested is that the correlation between securitized real estate and the stock market in sub-period 1 is equal to that of sub-period 2.

* Statistical significance at the 10% level.

** Statistical significance at the 5% level.

*** Statistical significance at the 1% level.

Table 8 - Summary results for the beta decomposition

	Std Dev EGPR		Std Dev TOTMK		Correlation (EGPR,TOTMK)		BETA	
Australia	▲		▼	*	▼		▲	
Belgium	▼	***	▲	*	▼	*	▼	***
Canada	▼	***	▲	***	▼		▼	***
France	▲		▲	**	▼	***	▼	***
Germany	▲	***	▲	***	▼		▼	
Hong Kong	▲	***	▲	**	▼	***	▲	
Italy	▲	*	▲		▼	**	▼	
Japan	▼		▼	***	▼	***	▼	**
Netherlands	▼	**	▲	***	▲		▼	**
New Zealand	▼	**	▼	**	▲		▲	
Singapore	▲	***	▲	***	▲		▲	**
Spain	▼	*	▲	*	▼	**	▼	***
Sweden	▼	***	▲	***	▼	**	▼	***
Switzerland	▼	***	▲	*	▼		▼	
U.K.	▼		▲		▼	***	▼	***
U.S.	▲		▲	***	▼	*	▼	***

* Statistical significance at the 10% level.

** Statistical significance at the 5% level.

*** Statistical significance at the 1% level.

Table 9 – Pure factor beta coefficients (three different numeraires), 1987-2004

NUMERAIRE TOTMK	**Australia**		**Canada**		**France**		**U.K.**		**U.S.**	
TOTMK	0.85	***	1.22	***	0.27		0.62	***	0.48	**
RESBOND	0.13		-1.76	***	-2.12	***	-1.65	***	-0.89	***
RESDIRECT	0.11		1.05	***	-0.16	*	0.81	***	0.17	***
NUMERAIRE BONDS	**Australia**		**Canada**		**France**		**U.K.**		**U.S.**	
RESTOTMK	0.87	***	0.97	***	0.03		0.70	***	0.43	**
BONDS	-0.34	***	-2.60	***	-2.18	***	-1.49	***	-1.13	***
RESDIRECT	0.11		1.05	***	-0.16	*	0.81	***	0.17	***
NUMERAIRE RE	**Australia**		**Canada**		**France**		**U.K.**		**U.S.**	
RESTOTMK	0.86	***	0.85	***	0.05		0.65	***	0.43	**
RESBONDS	-0.27	***	-2.29	***	-2.24	***	-1.38	***	-1.10	***
RE	0.30	***	1.81	***	0.34	***	1.03	***	0.37	***

The Beta coefficients are those derived from the second stage regressions.

* Statistical significance at the 10% level.

** Statistical significance at the 5% level.

*** Statistical significance at the 1% level.

Table 10 - Securitized real estate's variance decomposition (three different numeraires), 1987-2004

NUMERAIRE-Stocks	**Australia**	**%**	**Canada**	**%**	**France**	**%**	**U.K.**	**%**	**U.S.**	**%**
Stocks	0.02	49.85%	0.03	31.21%	0.01	18.38%	0.01	14.28%	0.01	11.18%
Bond Residual	0.00	0.26%	0.01	9.22%	0.01	49.03%	0.02	20.65%	0.00	3.85%
Real Estate Residual	0.00	0.23%	0.01	4.69%	0.00	0.68%	0.01	7.73%	0.00	0.14%
Idiosyncratic	0.02	49.66%	0.06	54.88%	0.01	31.90%	0.04	57.34%	0.06	84.84%
TOTAL VARIANCE	0.04	100.00%	0.11	100.00%	0.03	100.00%	0.07	100.00%	0.06	100.00%
NUMERAIRE-Bonds										
Stocks Residual	0.02	48.26%	0.02	17.57%	0.00	0.19%	0.01	17.79%	0.01	8.67%
Bonds	0.00	1.86%	0.03	22.86%	0.02	67.23%	0.01	17.15%	0.00	6.35%
Real Estate Residual	0.00	0.23%	0.01	4.69%	0.00	0.68%	0.01	7.73%	0.00	0.14%
Idiosyncratic	0.02	49.66%	0.06	54.88%	0.01	31.90%	0.04	57.34%	0.06	84.84%
TOTAL VARIANCE	0.04	100.00%	0.11	100.00%	0.03	100.00%	0.07	100.00%	0.06	100.00%
NUMERAIRE-RE										
Stocks Residual	0.02	47.41%	0.01	12.67%	0.00	0.38%	0.01	15.55%	0.01	8.51%
Bond Residual	0.00	1.04%	0.02	17.02%	0.02	64.26%	0.01	14.45%	0.00	5.95%
Real Estate	0.00	1.88%	0.02	15.44%	0.00	3.45%	0.01	12.66%	0.00	0.71%
Idiosyncratic	0.02	49.66%	0.06	54.88%	0.01	31.90%	0.04	57.34%	0.06	84.84%
TOTAL VARIANCE	0.04	100.00%	0.11	100.00%	0.03	100.00%	0.07	100.00%	0.06	100.00%

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