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Martin HOESLI
University of Geneva, Swiss Finance Institute, University of Aberdeen, and Bordeaux Ecole de Management

Elias OIKARINEN
Turku School of Economics

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Martin Hoesli* and Elias Oikarinen**

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* University of Geneva (HEC and SFI), 40 boulevard du Pont-d'Arve, CH-1211 Geneva 4, Switzerland, University of Aberdeen (Business School), Edward Wright Building, Aberdeen AB24 3QY, Scotland, U.K. and Bordeaux Ecole de Management, F-33405 Talence Cedex, France or martin.hoesli@unige.ch

** Turku School of Economics, Rehtorinpellonkatu 3, 20500 Turku, Finland or elias.oikarinen@utu.fi

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Are REITs Real Estate? Evidence from International Sector Level Data

Abstract

The aim of this study is to examine whether securitized real estate returns reflect direct real estate returns or general stock market returns using international data for the U.S., U.K., and Australia. In contrast to previous research, which has generally relied on overall real estate market indices and neglected the potential long-term dynamics, our econometric evaluation is based on sector level data and caters for both the short-term and long-term dynamics of the assets as well as for the lack of leverage in the direct real estate indices. In addition to the real estate and stock market indices, the analysis includes a number of fundamental variables that are expected to influence real estate and stock returns significantly. We estimate vector error-correction models and investigate the forecast error variance decompositions and impulse responses of the assets. Both the variance decompositions and impulse responses suggest that the long-run REIT market performance is much more closely related to the direct real estate market than to the general stock market. Consequently, REITs and direct real estate should be relatively good substitutes in a long-horizon investment portfolio. The results are of relevance regarding the relationship between public and private markets in general, as the 'duality' of the real estate markets offers an opportunity to test whether and how closely securitized asset returns reflect the performance of underlying private assets. The study also includes implications concerning the recent financial crisis.

Introduction

Direct real estate investments have been shown to provide significant diversification benefits in a portfolio containing stocks (Hoesli, Lekander and Witkiewicz, 2004; MacKinnon and Al Zaman, 2009; Brounen, Porras Prado and Verbeek, 2010). However, direct real estate assets have several disadvantages such as relatively low liquidity, high transaction costs, and lumpiness. The securitized real estate market has developed to circumvent these complications, so that many investors prefer to invest in real estate securities rather than in direct real estate.

If securitized and direct real estate returns are driven by a common 'real estate factor' over the long horizon, then real estate securities are expected to provide the same diversification benefits as direct commercial real estate in a mixed-asset portfolio of a long-horizon buy-and-hold investor, such as a pension fund. On the other hand, if securitized real estate behaves like the general stock market, real estate equities do not provide the diversification opportunities exhibited by the direct real estate market. Although the question of whether real estate securities behave as real estate or as equities is an old one and an important one for a large number of investors, the answer to the question is still not conclusive in the extant literature.

Securitized real estate prices may embed stock market noise that is not related to the fundamentals driving real estate returns. Therefore, the attractive diversification features of direct real estate may be lost by investing in REITs instead of in direct real estate assets. Indeed, it is well known that the contemporaneous correlation between securitized and direct real estate returns is relatively low (Mueller and Mueller, 2003; Brounen and Eichholtz, 2003). Instead of co-moving with direct real estate returns, early empirical evidence, mainly concerning the U.S. market, identified a similar return behavior between securitized real estate and the general stock market (Goetzmann and Ibbotson, 1990; Ross and Zisler, 1991; Myer and Webb, 1994). More recently, the results regarding the comovement between securitized real estate returns and general stock market returns have been mixed.

The short-run comovement between the securitized and direct real estate markets may also be significantly diminished by the typically sluggish adjustment of direct real estate market prices to changes in the fundamentals. However, as in the long run both markets should adjust to shocks in the fundamentals and the impact of noise in securitized real estate prices should vanish, securitized real estate should strongly co-vary with the returns on a portfolio composed of equivalent direct real estate investments, since the fundamental asset is essentially the same in both markets. In line with this assumption, it has been established that over long horizons the linkages between indirect and direct real estate are substantially stronger than suggested by the simple contemporaneous correlation figures (Giliberto, 1990; Geltner and Kluger, 1998; MacKinnon and Al Zaman, 2009; Oikarinen, Hoesli and Serrano, 2011).

Conventionally, the question has been studied by only including the three asset classes in the analysis while neglecting the role of economic fundamentals. Furthermore, the analyses have generally been based on aggregate real estate indices. The overall direct and securitized real estate indices typically differ notably with respect to the property-type mixes. Since the return dynamics between various real estate sectors may vary substantially (Wheaton, 1999; Oikarinen, Hoesli and Serrano, 2010), the use of overall indices may diminish the estimated comovement between securitized and direct real estate markets. That is, using sector level data should yield more accurate results regarding the linkages between direct and securitized real estate.

The aim of this study is to examine whether securitized real estate returns reflect direct real estate returns or general stock market returns. Similarly to a recent study by Sebastian and Schätz (2009), we include economic fundamentals in the econometric analysis. This allows us to cater for the effects that result from the interdependences between the fundamentals and the asset returns. However, while Sebastian and Schätz use the overall real estate market indices, we use sector level real estate data for the U.S and U.K.[1] This is important as portfolio composition effects may be masking the linkages between asset classes. To the best of our knowledge, only one study (Pavlov and Wachter, 2010) has examined the relationship between REIT returns and returns on similar direct real estate portfolios at the sector level while including fundamentals in the analysis. However, these authors do not consider the influence of lead-lag relations and potential long-run relationships in their investigation. We also propose that, in addition to the tests used in the previous literature, impulse response analysis can be utilized to investigate the substitutability between securitized and direct real estate. Given the complications and mixed results in the extant literature, more research on the linkages between securitized and direct real estate is warranted to assess whether REITs can be used as a surrogate for direct real estate to achieve greater inter-asset diversification in the long term.

We estimate vector error-correction models separately for four U.S. and two U.K. real estate sectors as well as for the Australian overall real estate market, and examine the variance decompositions of securitized and direct real estate returns and of general stock market returns. We also study the reaction patterns of the assets to shocks in the fundamentals and in the asset returns themselves. A particular emphasis is placed on analyzing whether securitized real estate returns are more tightly related to direct real estate returns or to overall stock market returns, especially in the long horizon. In this study, by ‘long horizon’ or ‘long term’ we refer to an investment horizon of three to four years, as this horizon is typically relevant for fund managers. This is also the horizon at which the variance decompositions and impulse responses converge at the latest to their eventual long-term values.

Our results suggest that the long-term REIT market performance is substantially more tightly related to direct real estate performance than to general stock market returns. Based on variance decompositions, neither direct real estate nor stock market shocks drive REIT market performance.

[1] No sector data were available for Australia and hence the analyses are performed for the REIT market as a whole for that country.

Nevertheless, the linkages between the direct and securitized markets appear to be tight, since a major part of the long-horizon forecast error variance of direct real estate indices can be explained by REIT return shocks. This implies that the direct and securitized markets are closely linked and the predictability goes from REITs to the direct market, i.e., ‘real estate shocks’ take place first in the REIT market after which the direct market adjusts to these shocks. Furthermore, our analysis indicates that, in general, the long-run accumulated responses of REIT and direct real estate returns to various shocks closely resemble each other. Importantly, the similitude between REITs and direct real estate is substantially greater than that between REITs and the general stock market. The Australian market appears to be a different case, though, as we cannot reliably identify tight links between the three assets (REITs, stocks and direct real estate) in that country. This may be partly due to some data complications.

Our findings have several practical implications. Since REITs behave much like direct real estate investments in the long horizon, the substitutability between REITs and direct real estate appears to be relatively good. That is, while the short-term comovement between REITs and stocks is stronger than that between REITs and direct real estate, REITs are likely to provide a similar exposure to various risk factors as direct real estate in a long-horizon investment portfolio. In other words, REITs are expected to generally offer similar diversification properties as direct real estate investments. The results also suggest that it is important to cater for the differences between real estate sectors when making portfolio decisions. Moreover, our analysis provides implications regarding the effects of the financial crisis on the asset markets. The notable deviations from the long-run relations between the securitized and direct real estate markets that emerged during the financial crisis suggest that an investor should not reallocate his portfolio from REITs to direct real estate after a drastic drop in REIT prices caused by a financial crisis, on the contrary rather. In accordance with Brunnermeir’s (2009) suggestion, the financial crisis hit much more adversely the real estate sector than the overall stock market. The data also indicate that the REIT market predicted the crisis and recovery.

Finally, the ‘duality’ of the real estate markets offers an opportunity to test whether and how closely securitized asset returns reflect the performance of underlying private assets. This is of relevance not only regarding real estate related assets but also concerning the stock market in general, as securities represent indirect claims on lumpy private assets such as factories and equipment or real estate. Empirical examination of the relationship between stock return dynamics and the performance of the underlying assets is usually not possible, since there are no reliable time series data on the typical underlying assets. Our findings suggest that in the long run securities reflect closely the underlying private market returns, while in the short-run comovement can be relatively weak.

The next section reviews previous literature on the interdependence between direct real estate, securitized real estate and overall stock markets. In the third section, we delineate the research methodology, after which the data used in the empirical analysis are described. The empirical findings are reported in section five, while we provide some concluding remarks in a final section.

Related Literature

It is well known that the contemporaneous correlation between securitized and direct real estate returns is relatively low (Mueller and Mueller, 2003; Brounen and Eichholtz, 2003). However, it has also been established that over long horizons, the linkages between indirect and direct real estate are substantially stronger than suggested by the simple contemporaneous correlation figures (Giliberto, 1990; Geltner and Kluger, 1998; Oikarinen, Hoesli and Serrano, 2011).

Instead of co-moving with direct real estate returns, early empirical evidence, mainly concerning the U.S. market, identified a similar return behavior between securitized real estate and the general stock market (Goetzmann and Ibbotson, 1990; Ross and Zisler, 1991). Giliberto (1990), on the other hand, finds that the residuals from regressions of direct and indirect real estate returns on financial asset returns are significantly correlated. This implies that there is a common factor (or factors) associated with real estate that influences both direct and indirect real estate returns. Also, Mei and Lee (1994) present some evidence of a common real estate factor driving both equity REITs and direct real estate.

Some recent results regarding the comovement between securitized real estate returns and general stock market returns are mixed. While Ling and Naranjo (1999) find that REITs are integrated with stocks, but segmented from direct real estate, the difference between indirect and direct real estate returns has diminished according to Clayton and MacKinnon (2001 and 2003), Pagliari, Scherer and Monopoli (2005), and Lee, Lee and Chiang (2008). Clayton and MacKinnon (2003) find that prior to the 1990s, REIT returns exhibit the greatest sensitivity to large cap stocks. The sensitivities appear to be time-varying, however, and they report increasing sensitivity of REITs w.r.t. direct real estate through time – greater than w.r.t. to the other asset returns during the later sample period (1992-1998). They further find small cap stocks to be a more significant contributor to REIT return volatility than large cap stocks during the later sample period. Hoesli and Serrano (2007), in turn, find evidence of a decreasing correlation between the securitized real estate and equity markets. Nevertheless, some studies show that the comovement between REIT returns and general stock market returns has increased recently (Ambrose, Lee and Peek, 2007; Simon and Ng, 2009).

The short-term comovement between securitized and direct real estate may be substantially diminished by direct market frictions. In the long run, as the direct market is able to adjust, the comovement between the markets is likely to be notably stronger. Indeed, Giliberto (1990) and Geltner and Kluger (1998) show that the relationship between REIT and direct real estate returns is considerably stronger when a lead in the REIT returns is considered. Other evidence supporting the leading role of securitized real estate with respect to direct real estate is presented, e.g., by Gyourko and Keim (1992), Myer and Webb (1993), Barkham and Geltner (1995), and more recently by Li, Mooradian and Yang (2009), Oikarinen, Hoesli and Serrano (2011), and Yunus, Hansz and Kennedy (forthcoming). The lead-lag relationships are likely to diminish the contemporaneous short-term correlation between the markets relative to the longer-horizon comovement.

An important issue regarding the substitutability between securitized and direct real estate in a long-horizon portfolio is the potential existence of long-term dynamics between the securitized and direct real estate returns. If there are tight long-run dynamics between the securitized and direct real estate markets, the comovement between the markets is considerably greater over the long run than the short-term correlations will indicate. Some authors have tested for the existence of long-run interdependence between the markets by conducting cointegration tests. In an early study, Ong (1995) does not find support for cointegration between indirect and direct real estate return indices in Singapore. However, Wang (2001) reports a cointegrating relation between direct and securitized real estate return indices in the U.K.; this result is confirmed by Oikarinen, Hoesli and Serrano (2011) and Boudry et al. (2012) using U.S. data. Furthermore, Yunus, Hansz and Kennedy (forthcoming) find cointegration between securitized and direct real estate indices in several countries. These analyses generally suggest that only direct real estate prices adjust towards the long-run relation. An exception is the study by Boudry et al. (2012) which reports significant adjustment of both securitized and direct markets.

With the exception of Pagliari, Scherer and Monopoli (2005), Li, Mooradian and Yang (2009), and Boudry et al. (2012), the above mentioned studies are based on the overall direct and securitized real estate indices that do not cater for the differing property-type mixes between the indices. The studies by Wheaton (1999), Yavas and Yildirim (2011), and Oikarinen, Hoesli and Serrano (2010) indicate that the price dynamics may notably differ between real estate sectors. Since the overall indices typically vary considerably with respect to the property-type mixes, the use of aggregate data may mask valuable sector specific information and diminish the observed interrelationships between securitized and direct markets.

Furthermore, the earlier mentioned papers generally do not cater for the influence of fundamentals on the comovement between the markets. That is, any observed comovement between the markets may be an indirect effect of economic factors, not due to a pure influence of the markets on each other. Recently, Sebastian and Schätz (2009) and Pavlov and Wachter (2010) include macroeconomic variables in their analyses to tackle this issue. Based on data for the 1992-2008 period, Sebastian and Schätz find that securitized real estate performance is significantly influenced by direct real estate market performance over the long term in the U.S. and U.K. While the stock market notably influences securitized real estate returns in the short run, the longer the investment horizon the stronger is the influence of the direct real estate market on REIT performance. Pavlov and Wachter also cater for the property-type mix. Their regression analysis shows significant dependence between REIT and direct real estate returns only in the office sector, when taking account of the influence of the fundamentals. However, the empirical analysis does not consider the potential lagging relationship of direct market returns with respect to REIT returns or the potential long-run relations between the markets. Given that price movements in the direct market appear to lag those in the securitized market and that there may be significant long-run dynamics between the markets, the estimated weak relationship between REITs and the underlying direct real estate may well be due to sluggish adjustment of the direct market rather than due to the lack of dependence between the two markets. Moreover, both these studies use appraisal-based direct real estate data, which may somewhat distort the results.

An early study that is closely related to our analysis is that by Myer and Webb (1994). They find evidence of a positive contemporaneous relationship between retail REITs and retail stocks, while a similar relationship could not be identified between direct retail real estate and retail REITs. However, Myer and Webb (1994) study only the short-term comovements and, as they mention themselves, some caution should be exercised in placing faith in the conclusions, since the sample period is short (1983-1991) and the number of retail REITs identified is small. The dynamics may also have changed after the 1980s and early 1990s. The recent studies by MacKinnon and Al Zaman (2009) and Boudry et al. (2012) are also highly relevant to our work. MacKinnon and Al Zaman examine how the predictability of real estate returns affects the risk of, and optimal allocations to, real estate for investors with differing investment horizons. They find that the correlation between direct real estate and REITs increases with horizon, but it never exceeds 0.54.

However, MacKinnon and Al Zaman use overall REIT and direct real estate indices and the results are based on a model that only caters for the short-run dynamics between the variables. Boudry et al. (2012), in turn, have sector level indices and examine the long-run dynamics, but their analysis includes only U.S. data and not the fundamentals or investigation of the variance decompositions. None of these studies cater either for the difference in leverage between the securitized and direct real estate indices. Therefore, further analysis on this issue that takes account of the potential consequences of long-term dynamics, property-type mixes, and leverage is desirable.

In summary, despite considerable research, there is still no conclusive evidence concerning the question of whether securitized real estate behaves like direct real estate investments in the long run or whether securitized real estate performance is more closely related to the general stock market. Previous studies reach inconsistent results which are largely dependent on the selected method, market or sample periods. We contribute to the literature by examining the interrelations between REIT, direct real estate and overall stock markets using sector level indices for the U.S. and U.K. (and an overall index for Australia), and by considering both short-term and long-term dynamics as well as the influence of economic fundamentals on those dynamics. We also include leverage to the direct market returns to have a 'fair' comparison between the security indices and the direct market performance and suggest that, in addition to variance decomposition, impulse response analysis based on a vector error-correction model can help identify the true nature of REITs.

Research Methodology

There are sound a priori theoretical reasons to expect that the securitized and direct real estate markets might be tightly related in the long horizon (see the discussion in Oikarinen, Hoesli and Serrano, 2011, for instance). There may also be cointegrating relationships between the real estate and stock market return indices. Since cointegration between the variables would have important implications regarding the asset return dynamics, we investigate the existence of such long-term relationships by employing the Johansen (1996) Trace test for cointegration. The Vector Error-Correction Model (VECM) used in the Trace test is the following:

$$\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \alpha\beta' X_{t-1} + \Omega D_t + \Psi S_t + \varepsilon_t \quad (1)$$

where ΔX_t is X_t - X_{t-1}, X_t is a three-dimensional vector of return index values in period t, μ is a three-dimensional vector of drift terms, Γ_i is a 3 x 3 matrix of coefficients for the lagged differences of the return indices at lag i, k is the maximum lag, i.e. the number of lags included in the corresponding vector autoregressive (VAR) model, α is a vector of the speed of adjustment parameters, β' forms the cointegrating vector, and ε is a vector of white noise error terms. β includes the three asset indices included in the test and no deterministic variables. All the tested models also include one or more point dummy variables (D) to cater for some outlier observations and thereby to fulfil the assumption of normally distributed residuals. Finally, a vector of three seasonal dummy variables (S) is included in the test if suggested by the Hannan-Quinn Information Criteria (HQ).

The lag length is selected based on HQ as suggested by Johansen, Mosconi and Nielsen (2000). However, more lags are included if needed based on the Lagrange Multiplier test at four lags, LM(4). The selection of the number of cointegrating vectors (r) is done by comparing the estimated Trace statistics with the quantiles approximated by the Γ-distribution (Doornik, 1998). Because asymptotic distributions can be rather bad approximations of the finite sample distributions, the Bartlett small sample corrected values suggested by Johansen (2002) are employed. The inclusion of dummy variable(s) that take the value of one only for one point in time and are zero otherwise is usually asymptotically negligible (Doornik, Hendry and Nielsen, 1998). However, as some of the tested models include several point dummies, we also report Trace test p-values based on the simulated statistics computed with the program CATS2 (see Dennis, 2006).

Weak exogeneity and exclusion of the variables are tested by the Bartlett small-sample corrected likelihood ratio (LR) test reported in Johansen (2000).[2] As a diagnostic check, we also examine the stability of the potential long-term relations by the recursive and backwards recursive Max Test statistics (in the R-form) of constancy of the estimated long-run relation (Juselius, 2006).

If we cannot detect a stable long-run relation between the assets (this is the case only in two out of seven tests), we include fundamentals in the cointegration analysis. This is because sometimes it is necessary to include fundamental variables in the Trace test to be able to detect a cointegrating relationship that includes two or more assets, i.e., to find long-run dynamics between the assets. In this case, the cointegration tests are based on the methodology proposed by Harbo et al. (1998), where the VECM used in the Trace test is the following:

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[2] Weak exogeneity of a variable indicates that the variable does not react to deviation from the long-run relation. In other words, the speed of adjustment parameter of a weakly exogenous variable is zero.

$$\Delta X_t = \alpha(\beta_X', \beta_1)(X'_{t-1}, t)' + \alpha\beta_Z{}' Z_{t-1} + \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1}\Delta X_{t-k+1} + \gamma_1 \Delta Z_{t-1} + \ldots + \gamma_{k-1}\Delta Z_{t-k+1} + \mu + \Omega D_t + \Psi S_t + \varepsilon_t$$

$$\Delta Z_t = \mu_z + \varepsilon_{zt}. \qquad (2)$$

In (2), γ_I is a 3 x 3 matrix of coefficients for the lagged differences of the economic fundamentals (Z) at lag *i*, ΔZ_t, is $Z_t - Z_{t-1}$, where Z_t is a vector of the fundamental variables, and $\alpha(\beta_X', \beta_1)(X'_{t-1}, t)' + \alpha\beta_Z{}' Z_{t-1}$ forms the long-run relationship(s). The tested model also includes a deterministic time trend (t) in the long-term relation. In the tested model, the fundamentals are assumed to be weakly exogenous variables. In other words, it is assumed that the fundamentals do not adjust towards the cointegrating relation(s). In the case of a large system and relatively small number of observations, the efficiency of the Trace test and the stability of the long-run parameters can be improved by modelling only the partial model, where partial model refers to the equations for the potentially non-weakly exogenous variables (X) (Harbo et al., 1998; Juselius, 2006).[3] Our analysis includes several fundamentals in addition to the three assets. Given the relatively small number of observations, it is reasonable to restrict the VECM so that the more efficient tests can be conducted. Moreover, testing several restrictions on the long-term relation and α at the same time would be highly problematic. In (2), the selection of the number of cointegrating vectors is done by comparing the estimated Trace statistics with the quantiles reported by Harbo et al. (1998).

Innovation Accounting

Based on the cointegrating long-run relations, we estimate VECMs to study the dynamics of the asset returns more carefully (if sensible long-run relations are not found, the innovation accounting is based on a conventional VAR model). In addition to the three assets and the fundamentals that belong to the respective cointegrating relationships, the short-run dynamics of the VECMs include additional fundamentals selected by the Sim's small-sample corrected LR test. The estimated models are used to conduct innovation accounting. The innovation accounting is based on the Choleski decomposition.

We derive the impulse responses of asset returns, i.e., we estimate the reaction patterns of the returns, to unanticipated changes in the fundamentals and in the asset returns themselves. If two

[3] To keep the model as simple and compact as possible, we are interested only in the cointegrating relations towards which at least one of the assets adjusts.

assets are good substitutes for each other in the long horizon, their long-term reactions to shocks in various factors should be similar or, less restrictively, the relative reaction magnitudes between the two assets should be similar regardless of the shock. If, for instance, the change in REIT prices was twice that in direct real estate prices after any shock in the fundamentals, 50% leveraged direct real estate investments would create similar reactions to those of REITs, and REITs and direct real estate would appear to be good substitutes for one another. In contrast, if the relative reaction magnitudes notably differed between different shocks, REITs would not appear to correspond that closely to direct real estate investments. As we restate the direct market indices to cater for the impact of leverage, we would not expect to have systematic differences in the response magnitudes between the REIT and direct markets, though. We investigate the long-run response magnitudes by the accumulated reactions of the asset returns. If the long-term accumulated responses of two markets are similar, then the markets are integrated in the sense that the risk premia for various factors are the same in both markets.

In this analysis also variance decomposition is of particular interest. If the forecast error variance decompositions show that a notable share of the long-term forecast error variance of securitized real estate returns is explained by innovations in the direct real estate market returns and that only a small share is explained by stock market innovations, the analysis indicates that the long-term influence of the direct real estate market on the securitized real estate market is greater than that of the general stock market. The greater the difference between the shares, the stronger this kind of result is. The causality can also run in the other direction, however. That is, if a substantial share of the long-run forecast error variance of direct real estate can be explained by shocks in REIT returns, then direct and securitized real estate would appear to be tightly linked. Instead, if we found that the impact of general stock market shocks on the securitized real estate market is greater than that of the direct real estate market even in the long run and that REIT market innovations do not explain direct market dynamics, the results would thus indicate that REITs behave more like stocks even in the long run.

The inclusion of market fundamentals in the models eliminates any indirect effects of these economic factors on the comovement between the REIT, direct real estate and stock markets. Stated differently, assuming that the models include the major economic fundamentals, the observed variance decomposition shares show the 'pure' effect of the asset markets on each other. Hence, the results are expected to be more reliable when the economic fundamentals are included in the analysis.

Data

For the U.S., we include four real estate sectors (apartments, offices, industrial, and retail) and for the U.K. two sectors (offices and retail) in the analysis. For the Australian market, we use the overall REIT and direct market indices given that no reliable sector data were available. For securitized real estate, the FTSE/NAREIT Equity REIT sector level indices are used for the U.S. and the S&P/ASX 200 A-REIT index for Australia. For the U.K., we have constructed the REIT indices from the company level price, dividend and market cap data provided by EPRA.[4] While the sector level direct real estate indices for the U.S. are transaction-based NCREIF (TBI) indices, the IPD appraisal-based indices are used for the U.K. and Australia. The overall stock market performance (s) is captured by the S&P 500 index in the U.S., by the FTSE All Share index in U.K., and by the S&P/ASX 200 index in Australia. Since the previous literature has shown that REIT performance may be more tightly linked to small cap stocks than the overall stock market (Clayton and MacKinnon, 2003), we also include small cap indices in the analysis to check whether the use of small cap stocks instead of the overall stock market performance notably influences the results. All asset indices employed in the analysis are total return indices.[5] The real estate data availability limits the sample periods. For the U.S. and Australia, we have data for 1994-2010, while the U.K. data cover 1991-2010. All data are at the quarterly frequency. Given the maturation of the REIT markets in the early 1990s (e.g. Clayton and MacKinnon, 2001), it would be sensible to use data from only the early 1990s onwards in any case.

While the REIT indices include the impact of leverage, the direct real estate indices consist of unleveraged properties.[6] The magnitude of leverage naturally affects the mean and volatility of securitized real estate returns. Moreover, time-variation in the leverage may hinder the cointegration tests and distort the estimated long-run parameters. Therefore, we add leverage to

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[4] The classification of companies by property type as of 2006 was used to construct the sector indices for the period from 1991 to 2005.

[5] The data used in this study were sourced from *Thomson Datastream* unless mentioned otherwise.

[6] Also the geographical composition between the constituents of REIT indices and direct real estate indices may somewhat differ. This may diminish the observed comovement between REIT and direct real estate markets to some extent. That is, the actual dependence between the markets may be even somewhat greater than indicated by the empirical analysis.

direct real estate returns to make the direct market data more comparable with the REIT data. In contrast with Pagliari, Scherer and Monopoli (2005), we add leverage to direct market data rather than compute unlevered REIT indices. This is expected to be closer to real life as investors typically lever they real estate investments. This also makes the real estate asset series more comparable with stocks. The levered direct real estate returns are computed using the formula that is based on the well-known proposition of Modigliani and Miller (1958):

$$r_{eit} = (r_{uit} - r_{dt}LTV_{it}) / (1-LTV_{it}), \quad (3)$$

where r_{eit} = the levered direct real estate return of sector i in period t, r_{uit} = the unlevered direct market return, r_{dt} = the cost of debt in period t, and LTV_{it} = the loan-to-value ratio of sector i REITs in period t. In the U.S., the average leverage of REITs during the sample period is 48% in the apartment and office sectors, 43% in the industrial property sector, and 51% in the retail property sector. The leverage is quite volatile, being at the lowest around 30% in the mid 1990s and at the highest some 70-75% in 2009. In U.K, the leverage is less volatile and 50% on average, while in Australia it varies between 9% and 50% being 30% on average. The cost of debt used in the computations is the corporate bond middle rate for the U.K. and Australia and the Moody's Baa rated corporate bond yield for the U.S. Figure 1 shows the levered direct real estate indices together with the indices for REITs and the overall stock markets.

[Figure 1 here]

In addition to the real estate and stock market indices, we incorporate in the analysis a number of fundamental variables that are expected to influence and have been found to affect real estate and stock returns significantly. These variables include economic growth (Ling and Naranjo, 1997; Payne, 2003; Ewing and Payne, 2005), economic sentiment (Berkovec and Goodman, 1996; Ling, Naranjo and Scheick, 2010; Oikarinen, Hoesli and Serrano, 2010), the short-term interest rates and the term structure of interest rates (Chan, Hendershott and Sanders, 1990; Ling and Naranjo, 1997), the default risk premium (Chan; Hendershott and Sanders, 1990; Karolyi and Sanders, 1998; Oikarinen, Hoesli and Serrano, 2010), and the inflation rate (Chan; Hendershott and Sanders, 1990; Ling and Naranjo, 1997; Payne, 2003; Ewing and Payne, 2005).

We measure economic growth with the change in GDP (*y*). The economic sentiment (*se*), that gives a more forward looking measure of growth in economic activity, is captured by various economic sentiments indices. Changes in the consumer price index (*i*) are used to track movements in the general price level. The measurement of these variables and of the short-term interest rates (*ir*), the term structure of interest rates (*ts*), and the default risk premium (*rp*) are summarized in Table 1.

In the econometric analysis, we use only real indices regarding asset returns and GDP. The nominal values are deflated using CPI to get the real indices. Furthermore, the real estate and GDP indices are used in the natural log form. Also the short-term interest rate is measured in real terms. Expectedly and in line with the previous literature, all the return indices appear to be non-stationary in levels and stationary in differences, and also the fundamental variables seem to be I(1) except for *ts* in the U.K. and Australia (see Table A1 in the Appendix). Therefore, with the exception of the stationary term spreads, only differenced variables are included in the analysis of short-run dynamics.

[Table 1 here]

Table 2 presents some descriptive statistics regarding the total returns. In the U.S. market, the volatilities of the REIT returns and the levered direct market returns do not notably differ from each other at the quarterly level. In the U.K. and Australia, the direct market volatility appears to be smaller, which is likely to be at least partly due to appraisal smoothing. Both REIT and direct real estate returns exhibit significant autocorrelation (with the exception of *ind_tbi*), whereas the stock market returns are not autocorrelated.

[Table 2 here]

Table 3 reports the contemporaneous quarterly correlations between the differences of the variables. In line with the contemporaneous correlations documented in the earlier literature, the quarterly comovement between REIT returns and general stock market returns is substantially stronger in the U.S. than that between REIT and direct real estate returns. Contrary to the claim that REITs are more closely related to small cap stocks than to the overall stock market, U.S. and Australian REIT returns correlate slightly less with small cap returns than those of the overall stock market. In the U.K., this is the other way round, however, and the REIT-direct real estate correlation is stronger than the REIT-stock correlation. Table 3 also reveals that while real estate returns and risk premium changes generally exhibit strong negative correlations in the U.K. and U.S., those are uncorrelated in Australia.

The long-run comovements may significantly differ from the contemporaneous quarterly correlations. For instance, lead-lag relationships may notably diminish the observed short-run correlations. Therefore, more rigorous analysis is needed to reach more definite conclusions regarding the long-term similarities of the assets.

[Table 3 here]

Empirical Findings

Long-Term Relations

Tables 4 and 5 report the cointegration test results. The Trace test statistics imply that long-term dynamics are present between the assets in all the markets except for the U.S. office sector and the Australian market. Conveniently, the statistics suggest that each model includes only one cointegrating relation. The stock market can be excluded from each of the long-run relations between the assets, i.e., REIT and direct market total return indices are pairwise cointegrated in five of the seven cases. This indicates tight long-run relationship between REIT and direct real estate performance in these five markets. In the U.S., only TBI returns appear to adjust towards the estimated relationships. Hence, the cointegrating vectors can be interpreted as long-term equilibrium relations for the TBI indices. Consequently, we normalize the vectors w.r.t. the TBI and place the TBI on the left hand side of the long-run equations presented in Table 4. In the U.K., REITs appear to adjust significantly towards the long-run relations as well. This may suggest that the REIT market is somewhat less efficient informationally in the U.K. than in the U.S., as adjustment towards a long-run relation implies predictability of the returns. For consistency, the vectors are normalized w.r.t. the direct market also when reporting the results outside the U.S. in Table 5.

[Tables 4-5 here]

The U.S. office sector and the Australian market are more complicated. There is some evidence of long-term dynamics between the assets even in these markets when fundamentals are included in the cointegration analysis. In the U.S. office sector, the inclusion of the risk premium in the model allows us to find cointegration between the variables. Stocks can be excluded from the relation. The negative sign of *rp* in the long-run model suggests that an increase in *rp* has a greater adverse impact on direct office prices than on office REIT prices; it appears that this is the reason why a pairwise cointegration between securitized and direct office markets cannot be detected. The estimated long-run relation has some complications, though. In particular, since the stock index is not present in the long-run equation, the stock market should not adjust towards the relation.

However, *s* cannot be restricted to be weakly exogenous according to the LR test. In any case, we restrict both REITs and stocks to be weakly exogenous in the estimated VECM. This restriction is not rejected at the 5% level of significance. The REIT adjustment parameter would have the wrong sign and can also be individually restricted to be zero at the 5% level. Because of the complications with the VECM, we also compare the implications of a second-order VAR model with those of the VECM.

In the Australian case, the inability to find pairwise cointegration may, at least partly, be due to the aggregated nature of the data, i.e., due to the lack of sector level indices. Since the detected cointegrating relation includes all three assets and three fundamentals, and even the deterministic time trend cannot be excluded from the relation, the interpretability of the long-run relation is complicated. Moreover, based on the recursive test, the stability of the estimated relationship is questionable. The result of the cointegration test is also crucially dependent on the selected lag length. Therefore, similar to the U.S. office case, we study both VECM and VAR models regarding the Australian market. In the VECM, only the direct real estate market adjusts towards the long-run relation.

In each of the estimated long-run relations all of the parameter estimates are highly statistically significant, and the estimated relations generally appear to be stable. In addition to Australia, an exception to the stability is the U.S. retail market, where the stability is violated at the 5% significance level for a period of a couple of quarters during the recent financial crisis. Even in this case the relation is stable in the other periods, and when fundamentals are added in the dynamics the relation is relatively stable throughout the sample period.

The estimated speeds of adjustment of the TBI indices vary between 39% per quarter in the industrial sector to 14% per quarter in the office and apartment sectors. While the corresponding figure is 13% in the Australian market, the estimated adjustment speed of the direct market is notably slower in the U.K., i.e., less than 5% per quarter. The use of appraisal-based return indices is a likely reason for the slower adjustment in the U.K. and Australian models than in the U.S. models. The REIT market adjustment speed in the U.K. is 12% in the office sector and 19% in the retail sector.

Figure 2 shows the direct market indices together with the estimated long-run relations. The indices generally track closely the equilibrium relations. However, the apparently slow reaction of direct real estate prices to shocks in the fundamentals induced notable deviations from the long-run relations after the outbreak of the financial crisis. This can be seen clearly even in the U.S. market for which transaction-based direct market data are used.

[Figure 2 here]

Variance Decompositions

We study the forecast error variance decompositions and impulse response functions based on separate VECMs for each of the markets and sectors. The fundamentals included in the dynamics vary somewhat across models. This is not unexpected given that the return dynamics between various real estate sectors may vary substantially (Wheaton, 1999; Oikarinen, Hoesli and Serrano, 2010) and that there may well be differences in the dynamics across countries as well. In addition to the three assets, all VECMs except those for the U.K. include both *y* and *ir* in the short-term dynamics. Only the U.K. office model notably differs from the other models w.r.t. the fundamentals included in the model, and all the VECMs include one lag in differences. The variance decompositions and impulse response function vary, to some extent, between the sectors and markets, which may be partly due to the inclusion of different fundamentals in different models.

We use the Choleski decomposition to conduct the innovation accounting. In our baseline models, the ordering is *i-y-ir-ts-se-rp-s-reit-tbi*. None of the models includes all the fundamentals, though. The inflation rate (present only in the U.K. office model) is placed first in the ordering, since shocks in the inflation rate are expected to affect all the variables that are measured in real terms. It is also assumed that GDP shocks influence all of the other variables simultaneously, and all fundamentals are allowed to affect the asset returns instantaneously. None of the other variables (except for inflation) are allowed to have an immediate impact on GDP. Given the sluggishness of the real economy, it seems reasonable to assume that GDP does not react to changes in the other variables immediately. *ir*, in turn, should be placed before *ts*, since *ir* affects directly one component in the term spread. Since the use of the small cap indices instead of overall stock market indices does not notably alter the main results, we concentrate on reporting the findings from the baseline models.[7]

[7] Generally, small cap stocks seem to be slightly more driven by REIT shocks and have somewhat smaller impacts on REITs than the overall stock market. More detailed results from the models including the small cap instead of overall stock indices are available from the authors upon request.

We are particularly interested in the relatively long-term interdependence between the variables. Due to direct real estate market frictions (and in the U.K. and Australia the use of appraisal-based indices) and to the short-run noise in REIT prices, it is expected that the links between REIT and direct real estate returns are substantially stronger than suggested by the quarterly correlations reported in Table 3. In line with this assumption, the long-horizon variance decompositions generally show a tight link between the direct and securitized real estate markets.

The variance decompositions converge close to the eventual long-horizon values in approximately three years. The convergence speeds vary only slightly across assets and markets. Since the three-year horizon is typically relevant for fund managers, the 12-quarter horizon variance decompositions of the asset return indices derived from the baseline models are summarized in Table 6. The reported values show the proportions of the forecast error variances of the total return indices that are due to shocks in the other assets and in the asset itself. For instance, 50.2 in the retail TBI-ΔREIT cell indicates that about 50% of the forecast error variance of the U.S. direct retail real estate index is due to shocks in retail REIT returns. Note that the remaining part of the forecast error variances is explained by the fundamentals. For example, the economic fundamentals explain 38% of the long-run forecast error variance of *re_tbi*.

[Table 6 here]

Based on the values in Table 6, it is clear that direct real estate market shocks do not drive REIT market performance. REITs appear to be (at least close to) exogenous w.r.t. both direct real estate and the overall stock market in the sense that shocks in those markets do not have notable effects on REIT returns. Nevertheless, the linkages between the direct and securitized markets appear to be tight, since a major part of the long-horizon forecast error variance of the direct real estate indices can be explained by REIT return shocks. In line with the recent findings by Yavas and Yildirim (2011), this implies that the direct and securitized markets are closely linked and that the predictability goes from REITs to the direct market, i.e., 'real estate shocks' take place first in the REIT market after which the direct market adjusts to these shocks. In the words of Clayton and MacKinnon (2003), 'if REITs work as better processors of information, then the REIT market may be reflecting changes in private real estate values far more quickly than a private real estate market index.'

There are no similar strong relations between the stock market and either of the real estate markets. Given that stock market shocks do not seem to influence greatly either REIT or direct real estate performance and that REITs do not appear to drive general stock market returns, the variance decomposition analysis suggests that REITs are much more closely related to direct real estate than to the stock market in the long run. This is in line with the pairwise cointegration between the REIT and direct real estate indices in many markets.

Since the ordering in the Choleski decomposition may notably affect the results, we check the robustness of the variance decompositions w.r.t. the imposed identifying restrictions, i.e., w.r.t. the ordering in the Choleski decomposition, by comparing the variance decompositions computed based on different asset orderings. The main results generally are robust regardless of the ordering. The ordering of the direct real estate market does not markedly matter, and the market does not appear to have a notable simultaneous impact on the other assets even if it is placed before stocks and REITs. Therefore, it is reasonable to place the TBI the last in the baseline model.

In the baseline model, the ordering between stocks and REITs is based on the assumption that the potential causality runs from the general stock market to the REIT market rather than the other way round. The ordering between REITs and the stock market seems to have some influence on the results. If *s* is placed after REITs, stock market shocks account for a negligible share of the REIT variance decomposition, whereas the share of REIT shocks in the stock market decomposition notably increases. This does not alter the main implication of the variance decomposition analysis, however. Even if we assume that stocks should be after REITs in the correct ordering, the results indicate that REITs are not driven by the general stock market. Instead, REIT market shocks would have some impact on the general stock market.

There are only a few exceptions to the general rules discussed above. In the U.S., the REIT-TBI linkage is weaker in the office sector, where *rp* is included in the long-term relation, than in the other sectors.[8] In the U.K., in turn, office REIT shocks appear to have a notable impact on stock market volatility. Furthermore, the Australian real estate indices are highly dependent on the stock market based on the baseline model. Some of those findings are highly dependent on the asset ordering in the Choleski decomposition, though. In the Australian case, the direct real estate market has a notable effect on the other assets if placed in front of them in the ordering. Moreover, the considerable stock market impact on the real estate assets completely vanishes and stocks are highly

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[8] The only notable change in the U.S. office sector findings, if a VAR model instead of a VECM is used, is that TBI shocks explain a substantially greater share of TBI's own variance.

dependent on both real estate markets if placed last in the ordering. Therefore, even though the notable impact of REITs on direct real estate remains regardless of the ordering and the VAR model yields similar findings to the VECM, the variance decomposition results are less reliable for Australia than for the other countries. In the U.K., in turn, the placement of the direct real estate market before the other assets yields a much greater impact of the direct real estate shocks on all three assets. The impacts of REIT shocks get smaller by a similar amount as the increases of the direct market variance decomposition shares. The finding that the REIT-direct real estate dependence is much tighter than that between the stock market and the real estate markets is robust to the ordering, however.

Impulse Response Analysis

We further investigate the relationships between the asset market dynamics based on impulse response analysis. If securitized real estate fully reflects the underlying private real estate performance in the long run and is thereby a close substitute for direct real estate in a long-horizon investment portfolio, the long-horizon accumulated reactions of REIT and TBI returns to various shocks should not notably deviate from one another. If the reaction magnitudes were to differ significantly, then securitized real estate would bring a different exposure to various risk factors than direct real estate into a portfolio, i.e., REITs and direct real estate generally could not be considered as good substitutes in a portfolio. Figures 3-9 show the accumulated reactions of asset returns to shocks in the fundamentals and in the assets themselves up to four years after the initial shocks based on the baseline models. Similar to the variance decompositions, the impulse responses converge within three to four years from the shocks. It should be kept in mind that all asset returns are leveraged, which amplifies the responses of the assets to shocks in the fundamentals compared with unlevered asset returns.

[Figures 3-9 here]

Expectedly, in the cases where pairwise cointegration is detected between REITs and direct real estate, the long-run accumulated responses of REITs and direct real estate closely resemble each other and the relative magnitudes of the responses are the same regardless of the origin of the shock, even though the short-run reactions typically differ substantially. The similarity between the real estate assets is substantially greater than that between REITs and the general stock market. In principle, the differences between REITs and the stock market might be due to different leverage levels. However, also the relative magnitudes of the reactions considerably vary between stocks and REITs. This is in line with the hypothesis that REITs reflect direct real estate performance more than it does overall stock market performance, and also with the variance decomposition results.

In the Australian market and in the U.S. office sector, where we could not find pairwise cointegration between the real estate markets, the picture is much less clear. In both cases, the relative reaction magnitudes of the assets substantially vary across different shocks. In the Australian market, it is hard to see whether REIT reactions resemble more stocks or direct real estate. However, in the U.S. office case, the REIT reactions generally appear to be closer to those in the stock market than in the direct real estate market (in terms of standard deviation of the relative reaction magnitudes). This is due to the large impact of a risk shock on direct real estate. The closer relationship between stock and REIT responses disappears if a VAR model is used instead of the VECM, since in the VAR model the influence of a risk shock on direct real estate is considerably smaller than in the VECM. Otherwise the impulses from the VAR models are similar to those graphed in Figures 6 and 9.

Some of the long-term responses to shocks in the fundamentals may seem surprisingly large. In addition to the use of leveraged returns, these large reactions can be explained, to some extent, by the endogeneity of the fundamentals in the models. For instance, in the U.S. retail sector model the responses to a GDP shock are large, because the eventual GDP change is five times greater than the initial shock and the shock lowers the risk premium as well as has a notable positive impact on sentiment. In any case, in this study the main focus is in the relative reaction magnitudes of the assets, not on the absolute reactions.

Note also that in many cases the stock and REIT markets exhibit similar initial reactions to shocks in the fundamentals. This is in line with the findings that the contemporaneous correlations between REIT and overall stock market returns are high. Moreover, in line with the hypothesis that direct real estate prices react more sluggishly than REIT and stock prices to various shocks, the impulse responses show a generally smaller short-term response of the U.S. transaction-based direct real estate returns to the shocks (relative to the eventual long-run response). This slow reaction of the direct market is most likely a major reason for the relatively small quarterly correlation between the direct real estate and REIT returns. As can be seen in the impulse response graphs, the similarity between stocks and REITs diminishes and that between REITs and direct real estate increases further away from the shocks. Note also that if publicly traded real estate investment funds choose their real estate investments in a manner consistent with value maximization, then direct real estate prices should be determined in equilibrium as if the markets were frictionless (Titman, 1985). The findings of the impulse response analysis are in line with the previous empirical evidence suggesting that the direct market adjustment seems sluggish and therefore does not seem to represent price determination in a frictionless market.

The impulse responses are quite robust with respect to the asset ordering. Furthermore, the conclusions are by and large robust when the small cap index is used in lieu of the stock index; despite the greater representation of REITs in the small cap indices than in the overall stock market indices, there is no evidence of small cap stocks driving REIT returns.

In sum, similar to the variance decomposition examination, the general conclusion of the impulse response analysis is that REITs exhibit much closer long-term resemblance with the underlying real estate assets than with the general stock market. This is clear in five out of seven markets in the study.

Implications Regarding the Financial Crisis

The outbreak of the financial crisis had a notable adverse influence on asset prices in each of the markets. This can be easily seen in Figure 1. In the U.S. and U.K., the REIT market was the first to react in the early months of 2007. It is not surprising that the U.K. appraisal-based direct market index reacted later than REITs, but the U.K. stock market drop started even later than that of the IPD indices. In the U.S., in contrast, the TBI drop started approximately at the same time as the stock market fall, i.e., one to two quarters later than the REIT market reaction. The decline in the TBI indices was not as steep and lasted longer than that of REITs.

The patterns suggest that especially in the U.K. market real estate indices could have been used to predict the forthcoming substantial drop in stock prices. In fact, if we measure the start of the financial crisis as the period when the risk premium started to trend upwards, the REIT market predicted the crisis. In the U.S., the notable REIT price decline started some two quarters prior to the risk premium rise, i.e., during 2007Q1 and 2007Q2. The same applies to the U.K. market with the difference that in the U.K. the REIT price decrease and the risk premium growth both started somewhat later than in the U.S. In Australia, where the influence of the crisis on the risk premium and output was much milder than in the U.S. and U.K., the lag between the REIT market and risk premium reactions was shorter than in the other two markets, and there was no notable lag between the REIT and overall stock market declines. In all of the markets, the output started to decline even later than the risk premium. In the U.S. and U.K., also the rebound after the price drops started notably earlier in the REIT market than in the stock and direct real estate markets and in the overall economy. That is, w.r.t. the output growth (and in the U.K. also w.r.t. the risk premium), the REIT market could predict the recovery as well.

Interestingly, the REIT and leveraged direct real estate index declines were of much greater magnitude than those of the stock market (except for the Australian direct market index, which is likely to be partly due to the appraisal-based nature of the IPD index). Furthermore, in the U.K. and Australia, the stock market rebound upwards until 2010Q4 was considerably larger than that in the real estate indices. Therefore, it appears that the financial crisis hit much more adversely the real estate sector than the overall stock market. The greater and more long-lasting drop in the direct real estate market than in the stock market is in accordance with the hypothesis set by Brunnermeir (2009) according to which the loss spiral is more pronounced for assets with low market liquidity, since selling them at a time of financial distress will bring about a greater price drop than would selling a more liquid asset. Also the liquidity of REITs is typically somewhat lower than that of the overall public stock market. In addition, the market liquidity may contribute to the faster drop in the securitized real estate market than in the direct market: investors prefer to sell more liquid assets, such as REITs, first during a crisis rather than sell less liquid assets, such as direct real estate (Brunnermeier, 2009).

Except for the U.K. retail sector, the financial crisis caused substantial deviations from the estimated long-run relations, as the REIT market fell and rebounded earlier than the direct real estate market (see Figure 2). At first, REITs were undervalued compared to direct real estate, but in the end of the sample period the direct market indices generally were substantially below their long-term relation with the REIT market. Graphical examination reveals that in the U.S. a notable increase in *ir* preceded, while an increase in risk premium coincided with, the emergence of the deviations from the long-run relations. As an example, Figure 10 graphs the deviation in the U.S. retail sector together with *ir* and *rp*. The deviation pattern is similar in the other U.S. sectors, but not as clear in the U.K. and Australian markets.

[Figure 10 here]

With respect to portfolio allocation implications, the lesson to be learned from the aftermaths of the crisis is that an investor should not reallocate his portfolio from REITs to direct real estate after a drastic drop in REIT prices: the direct market is likely to follow the REIT market fall, and the expected returns for REITs are therefore greater than those for direct real estate. Nevertheless, it appears that this was exactly what many investors did, at least in some markets (NRPN, 2011). As of 2010Q4, however, the expected return for leveraged direct real estate investments is greater than that of REITs at least in the five cases with pairwise cointegration between the REIT and direct markets, since the direct market valuation is below its long-term relation with REITs.

Concluding Remarks

Securities represent indirect claims on lumpy private assets such as factories and equipment or real estate. In addition to enabling portfolio diversification with smaller amounts of capital, securities are an attractive alternative to direct asset ownership because of their generally higher liquidity and lower transaction costs than those of the underlying private assets based on which the security cash flows are generated. An important question for an investor is how closely the securitized asset returns reflect the underlying private asset performance. Of particular interest often is whether the securities provide similar diversification benefits as the private market assets. Empirical examination of this question is usually not possible, since there are no reliable time series data on the typical underlying assets. However, the ‘duality’ of the real estate markets offers an opportunity to test whether and how closely securitized asset returns reflect the performance of underlying private assets: relatively reliable data are available both for securitized real estate (REIT) and direct real estate performance.

Although the issue of whether real estate securities behave as real estate or as stocks is of importance to a large number of investors, no clear-cut conclusion can be found in the extant literature. This study brings further empirical evidence on the issue. It appears that our analysis is the first one on the theme that incorporates economic fundamentals and sector level real estate data, and that caters for the short-run and long-run dynamics of the asset returns as well as for leverage.

We propose that the long-run nature of REIT returns can be studied rigorously by investigating the forecast error variance decompositions and impulse responses computed from vector error-correction models (VECM). Our findings, based on sector level REIT and direct real estate indices for the U.S. and U.K., suggest that securitized and direct real estate markets are tightly linked in the long run. It appears that REIT returns are largely independent with respect to shocks in the other assets – neither direct real estate nor stock market shocks appear to be driving REIT market performance. However, a major part of the long-horizon forecast error variance of the direct real estate indices can be explained by REIT return shocks. This implies that the direct and securitized markets are closely linked and the predictability goes from REITs to TBI, i.e., ‘real estate shocks’ take place first in the REIT market after which the direct market adjusts to these shocks. In addition, the long-run accumulated impulse responses of REIT and direct real estate returns to various shocks closely resemble each other. The resemblance between REITs and direct real estate is substantially greater than that between REITs and the general stock market.

Therefore, while the short-term comovement between REITs and stocks is typically stronger than that between REITs and direct real estate, REITs are likely to bring a similar exposure to various risk factors as direct real estate into a long-horizon investment portfolio. REITs are also expected to have similar attractive diversification properties as direct real estate investments in the long horizon, as least in the U.S. and U.K. Since the variance decompositions and impulse responses generally converge after three years, our findings indicate that three years can be regarded as a 'long horizon' for portfolio analysis purposes. These findings have important implications with respect to asset allocation in a long-horizon multi-asset portfolio, since they point to opportunities for investors to combine the advantages of listed real estate with the attractive diversification features of direct real estate investments.

Unlike for the U.S. and U.K. markets, we are not able to draw reliable conclusions for the asset interdependences in Australia. A potential explanation for this is the lack of sector level real estate data for the Australian market: our results show that it may be important to cater for the differences across real estate sectors when making portfolio decisions and analyzing real estate return dynamics. Naturally, there may also be some differences across countries.

Our analysis also indicates that an investor should not reallocate his portfolio from REITs to direct real estate after a drastic drop in REIT prices caused by a financial crisis, on the contrary rather. In accordance with Brunnermeir's (2009) suggestion, the subprime crisis hit much more adversely the real estate sector than it did the overall stock market. Our results also indicate that the REIT market predicted the crisis and recovery.

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Figure 1 REIT, Direct Real Estate and Stock Total Return Indices for the sample periods

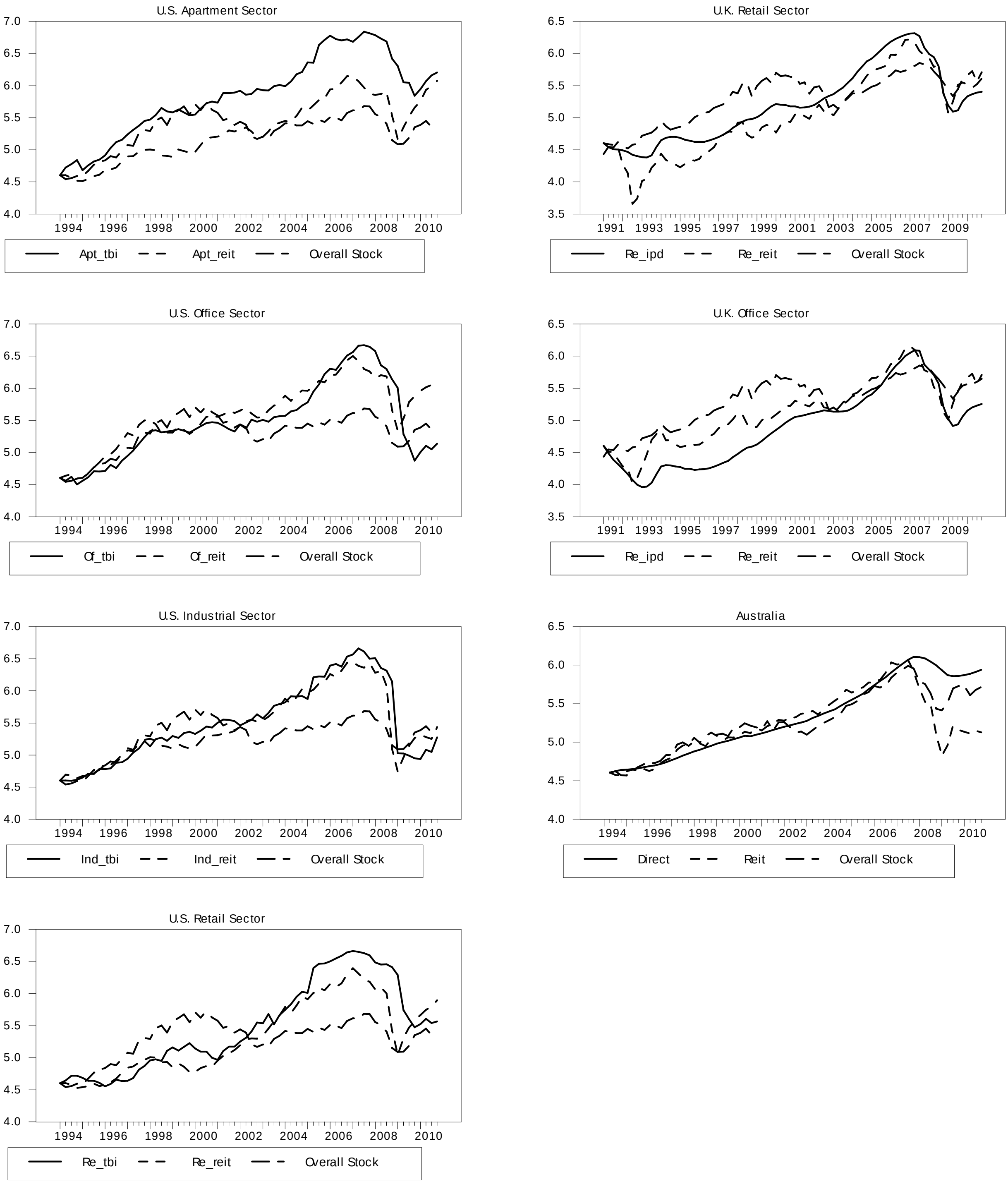

Figure 2 Direct Real Estate Indices and Estimated Long-Run Relations

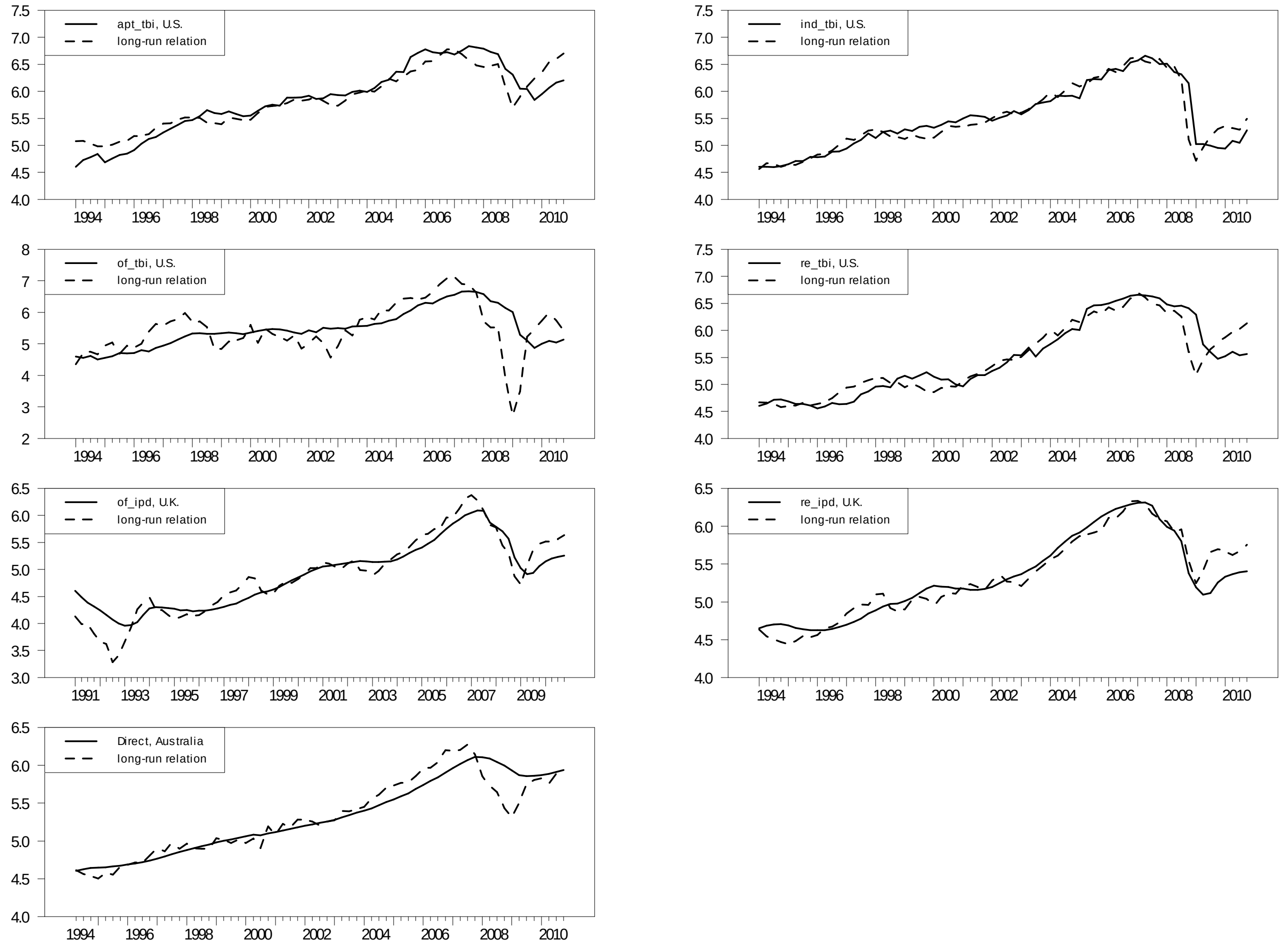

Figure 3 Accumulated Impulse Responses of Asset Returns to One Unit Shocks: U.S. Apartment Sector

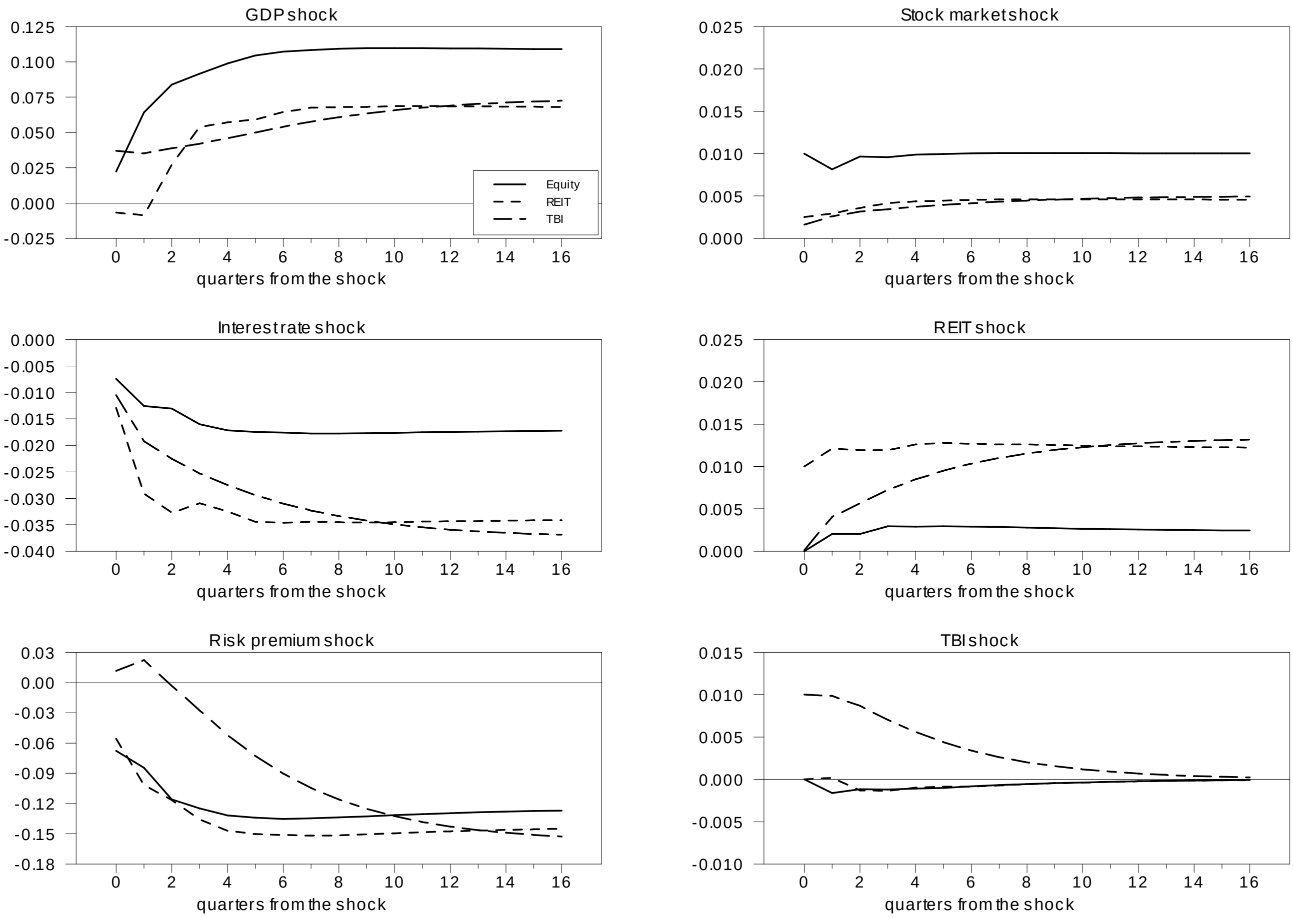

Figure 4 Accumulated Impulse Responses of Asset Returns to One Unit Shocks: U.S. Industrial Sector

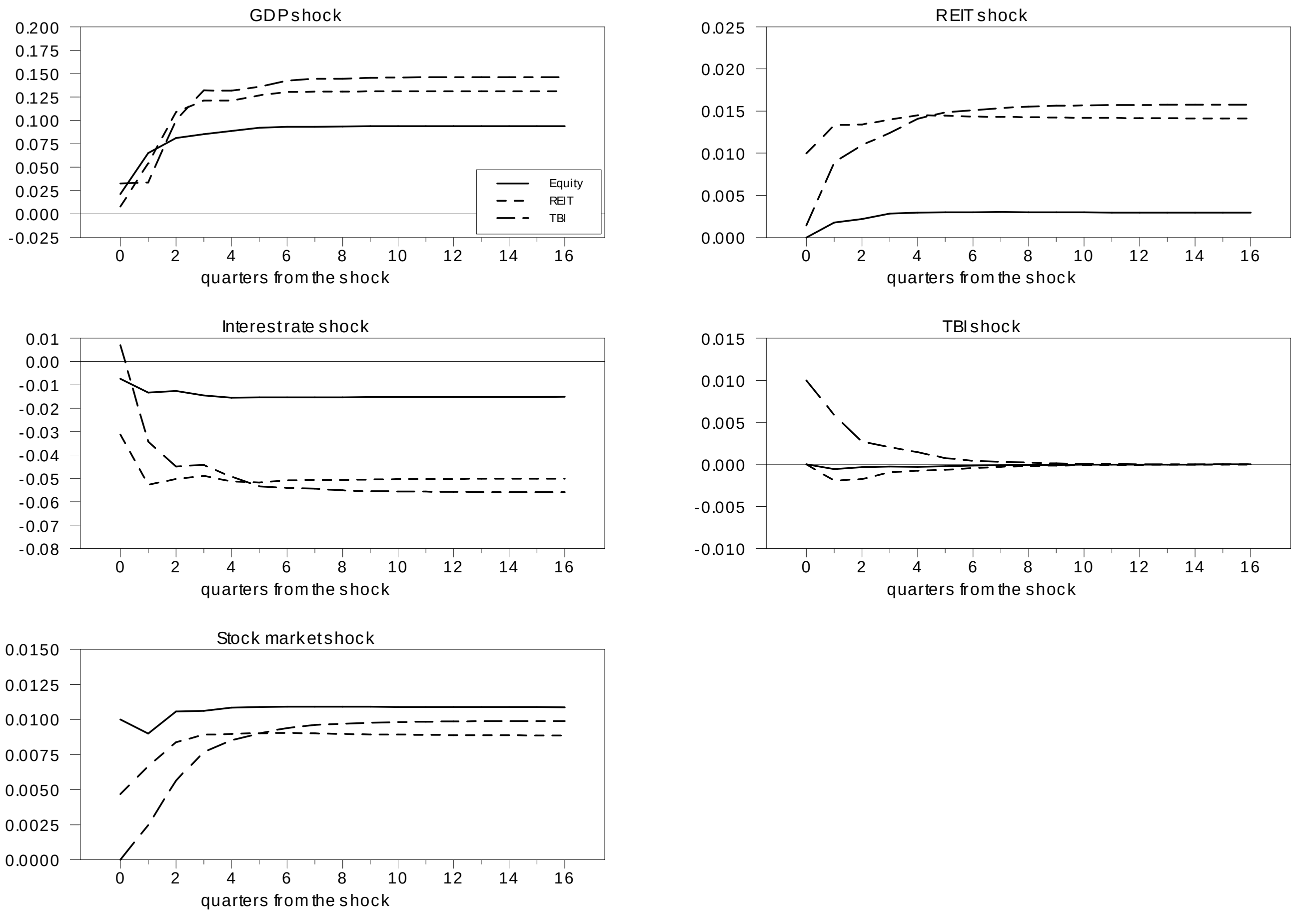

Figure 5 Accumulated Impulse Responses of Asset Returns to One Unit Shocks: U.S. Retail Sector

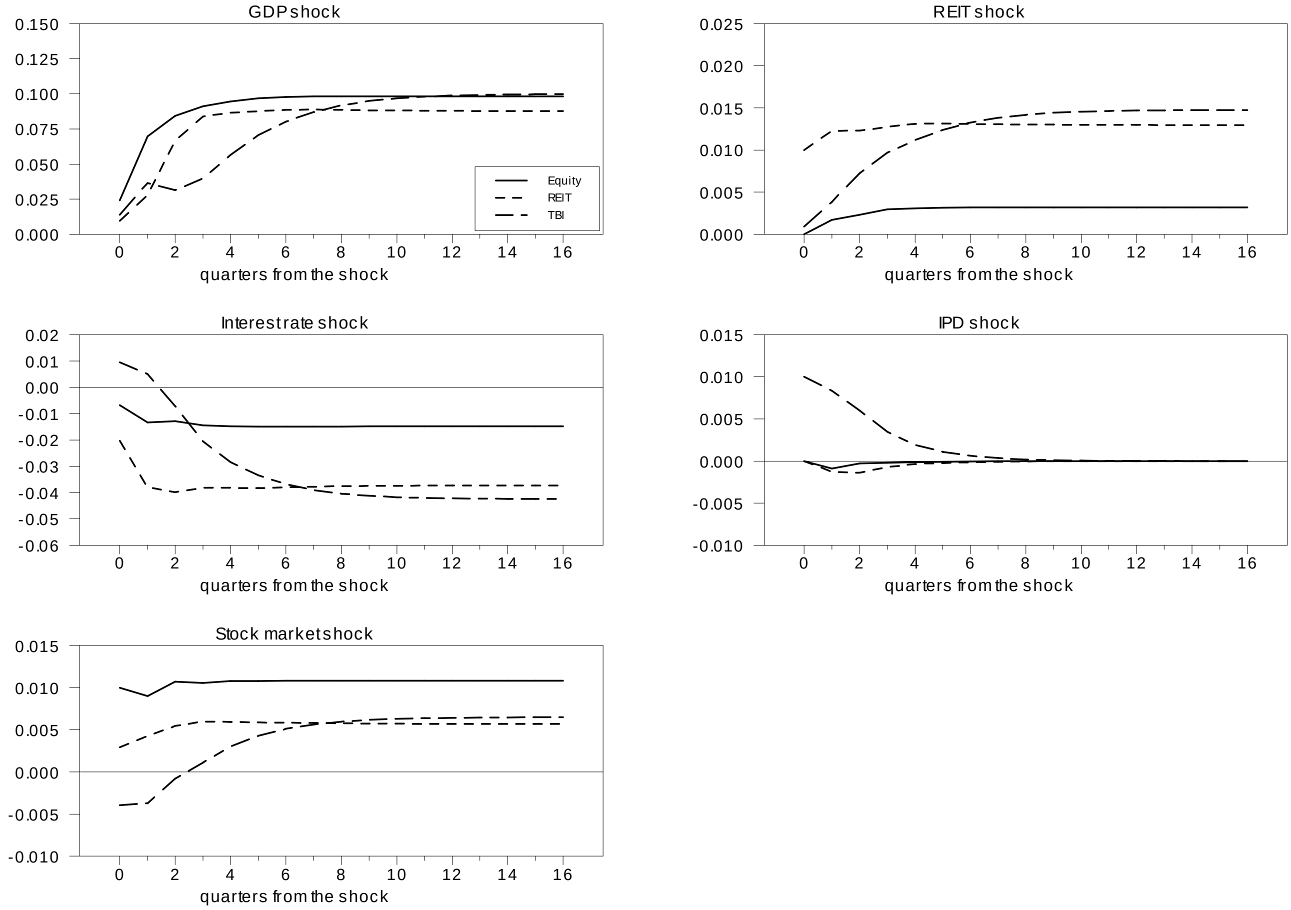

Figure 6 Accumulated Impulse Responses of Asset Returns to One Unit Shocks: U.S. Office Sector

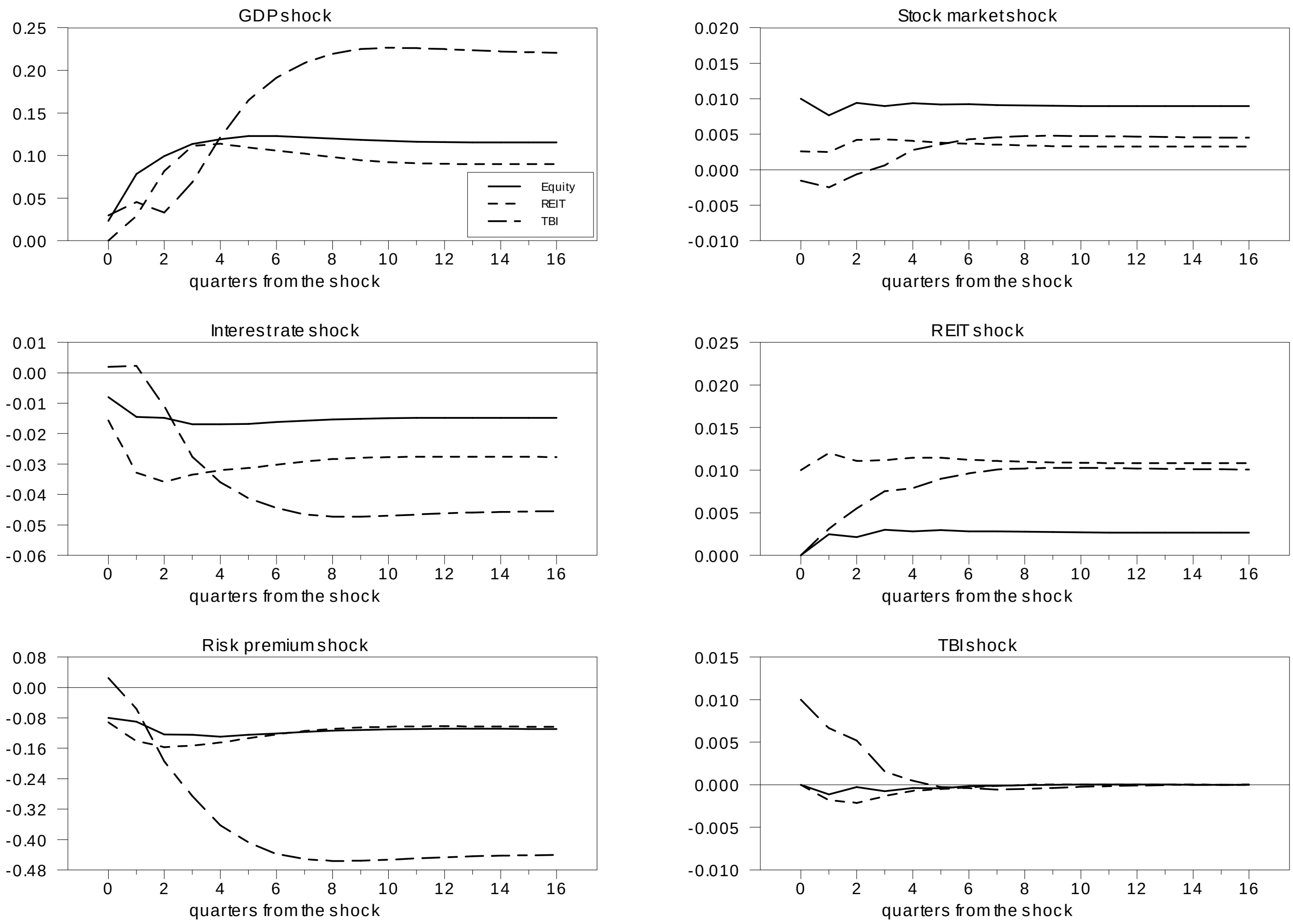

Figure 7 Accumulated Impulse Responses of Asset Returns to One Unit Shocks: U.K. Retail Sector

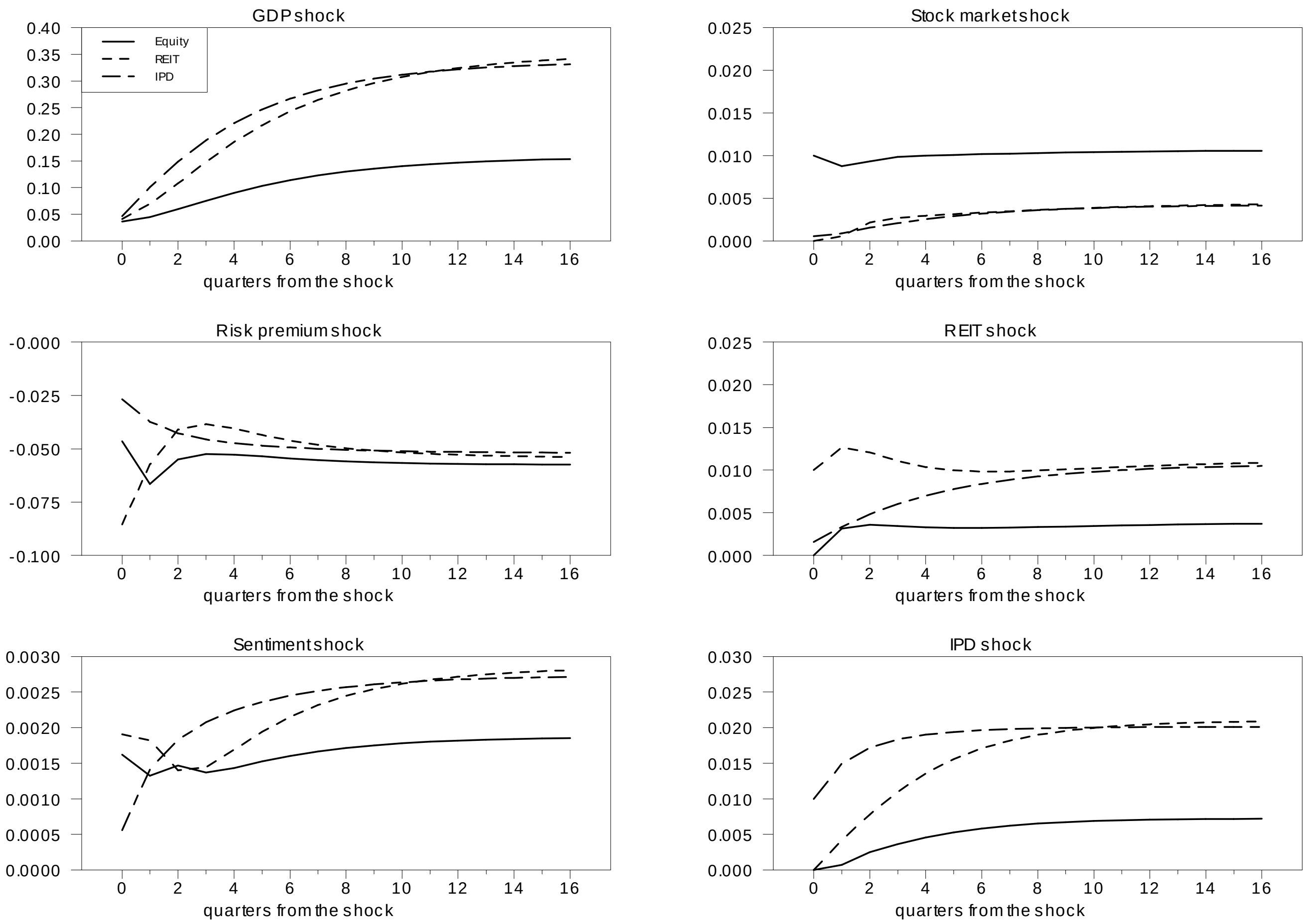

Figure 8 Accumulated Impulse Responses of Asset Returns to One Unit Shocks: U.K. Office Sector

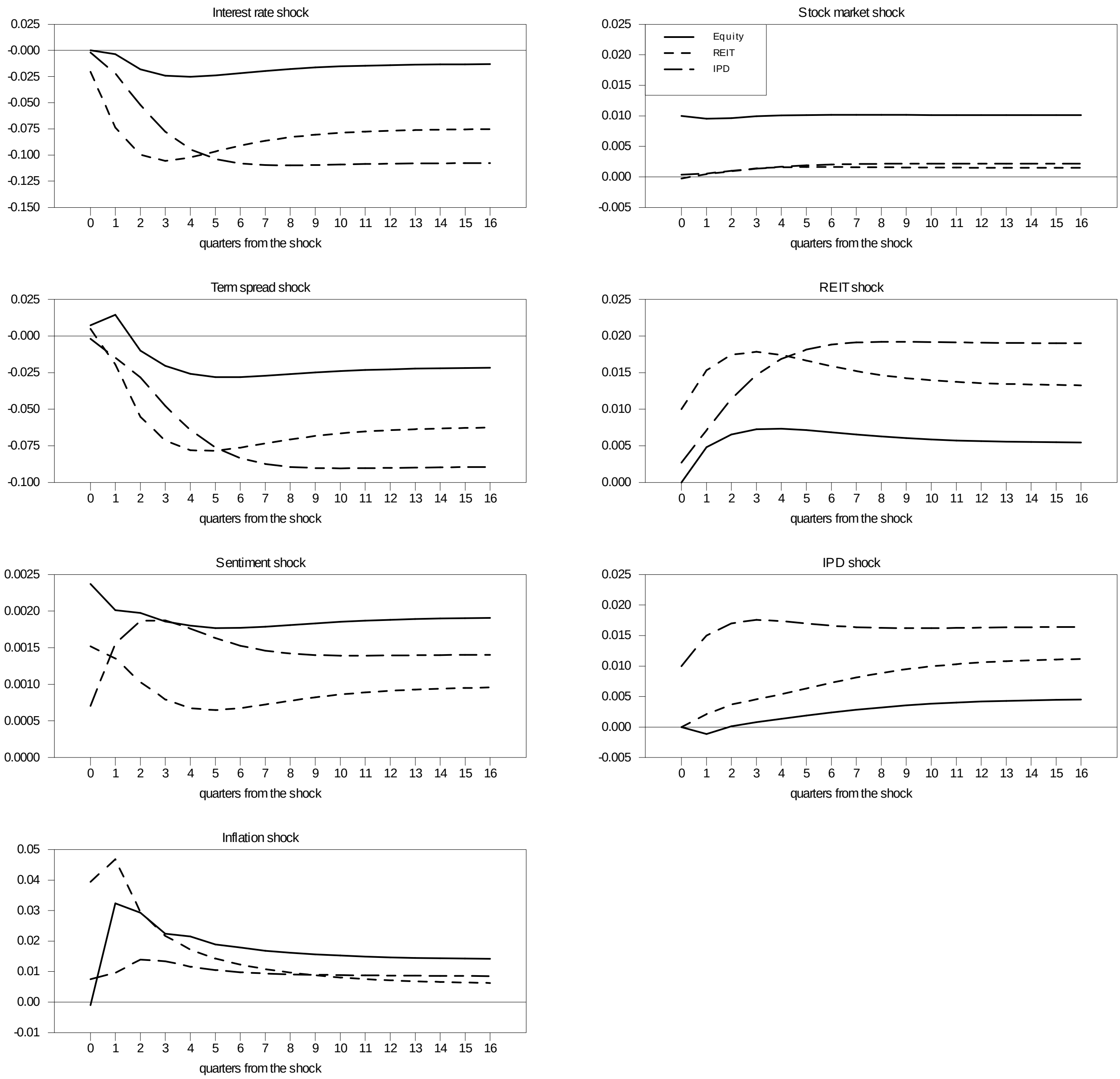

Figure 9 Accumulated Impulse Responses of Asset Returns to One Unit Shocks: Australia

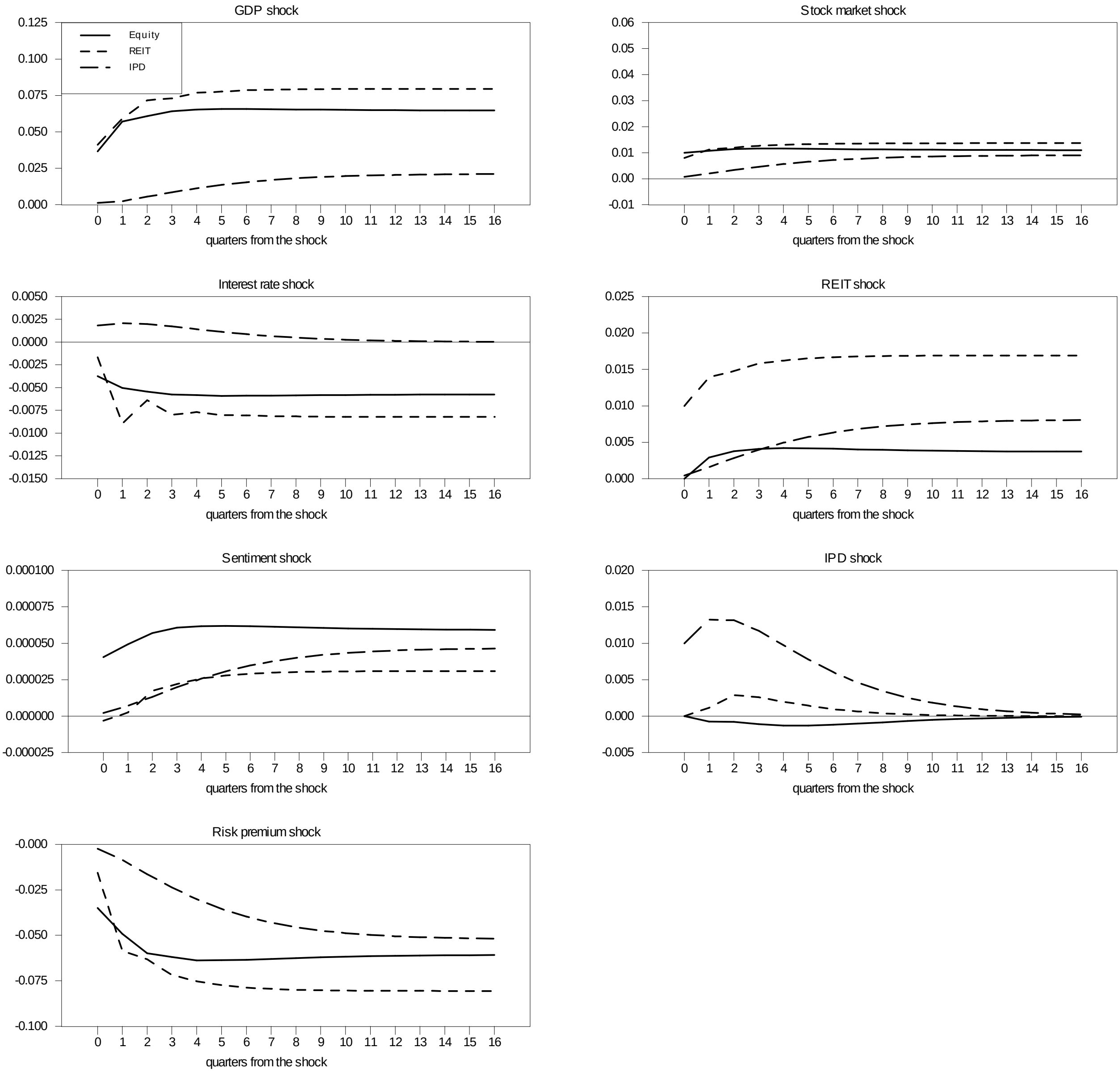

Figure 10 Deviation of TBI from the Long-Run Relation in the U.S. Retail Sector Together with Risk Premium and T-bill Rate

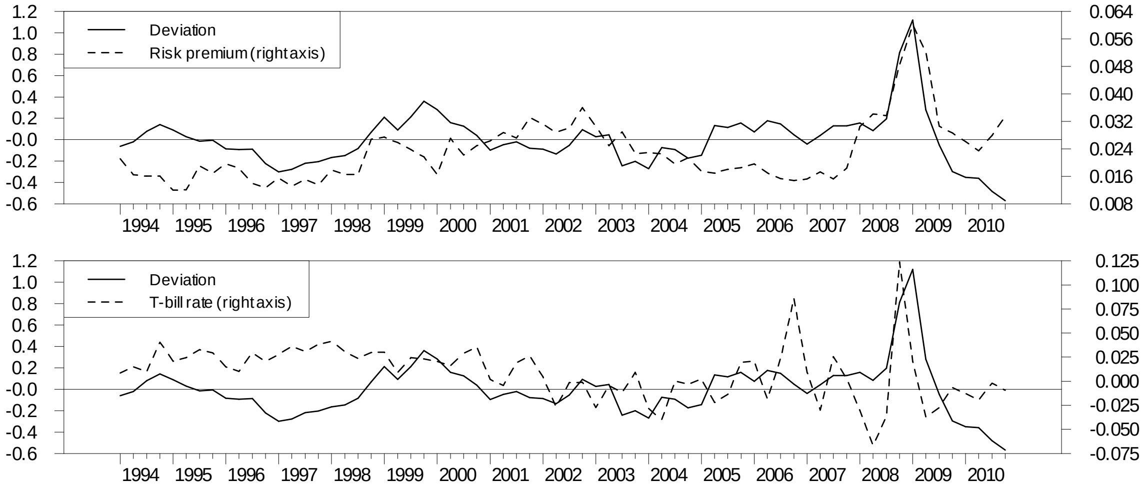

Table 1 Data Measurement

Variable	Market	Abbreviation	Measurement
Direct real estate	U.S.	Apartments:*apt_tbi* Offices: *of_tbi* Industrial: *ind_tbi* Retail: *re_tbi*	NCREIF transaction-based (TBI) sector level total return indices
	U.K.	Offices: *of_ipd* Retail: *re_ipd*	Investment Property Databank (IPD) sector level total return indices
	Australia	*direct*	Investment Property Databank (IPD) overall total return index
REITs	U.S.	Apartments (*apt_reit*)	NAREIT sector level total return indices
	U.K.	Offices (*of_tbi*) Industrial (*ind_tbi*) Retail (*re_tbi*)	Sector level value weighted total return indices constructed from firm level data provided by EPRA
	Australia	*reit*	S&P/ASX 200 A-REIT total return index
Overall stock market	U.S.	*s*	S&P 500 total return index
	U.K.		FTSE All Share total return index
	Australia		S&P/ASX 200 total return index
Small cap stock market	U.S.	*sc*	Russell 2000 total return index
	U.K.		FTSE Small Cap total return index
	Australia		ASX Small Ordinaries total return index
GDP		*y*	
Sentiment	U.S.	*se*	University of Michigan consumer sentiment index regarding the five year economic outlook
	U.K.		U.K. CBI Enquiry on business optimism
	Australia		Melbourne/Westpac Consumer Sentiment Index, seasonally adjusted
Inflation rate		*i*	Change in the consumer price index
Short-term Interest rate	U.S.	*ir*	Three month T-bill rate
	U.K.		U.K. three month interbank rate
	Australia		Australian three month interbank rate
Term spread		*ts*	Spread between the 10-year government bond yield and *ir*
Default risk premium	U.S.	*rp*	Spread between U.S. corporate bond (Baa, Moody's) and the 10-year government bond yield
	U.K.		Spread between U.K. corporate bond middle rate and the 10-year government bond yield
	Australia		Spread between Australian corporate bond middle rate and the 10-year government bond yield

Table 2 Descriptive Statistics of the Differenced Series

Variable	Mean (annualized %)	Standard Deviation (annualized %)	Jarque-Bera Test for Normality (p-value)	Ljung-box Test for Auto-Correlation (p-value, 4 lags)
U.S., 1994Q1-2010Q4				
apt_tbi	9.5	17.9	.02	.00
apt_reit	8.8	18.9	.00	.04
ind_tbi	4.0	32.2	.00	.31
ind_reit	5.0	30.4	.00	.02
of_tbi	3.2	28.9	.00	.00
of_reit	8.9	22.0	.00	.02
re_tbi	5.7	22.1	.00	.02
re_reit	7.7	23.1	.00	.05
S&P 500	4.9	17.6	.35	.37
Russell 2000	4.9	22.9	.42	.22
GDP	2.2	1.4	.20	.00
Sentiment (not in %)	-1.1	15.5	.73	.16
Interest Rate	-0.0	6.8	.00	.00
Term Spread	0.0	1.2	.37	.76
Risk Premium	0.0	1.1	.00	.57
Inflation Rate	-0.0	1.7	.00	.00
U.K., 1991Q1-2010Q4				
of_ipd	3.7	15.7	.00	.00
of_reit	5.3	20.0	.01	.00
re_ipd	4.0	15.1	.00	.00
re_reit	5.1	24.9	.00	.09
FTSE All Share	6.5	16.3	.04	.85
FTSE Small Cap	5.4	21.4	.00	.64
GDP	2.2	1.4	.00	.00
Sentiment (not in %)	2.5	33.5	.05	.54
Interest Rate	-0.0	9.3	.00	.00
Term Spread (level)	0.5	2.8	.16	.00
Risk Premium	0.0	1.1	.00	.11
Inflation Rate	-0.0	2.2	.00	.00
Australia, 1994Q2-2010Q4				
direct	8.1	5.0	.00	.00
reit	3.2	18.6	.00	.01
S&P/ASX 200	6.7	13.9	.01	.53
ASX Small Ordinaries	4.0	19.4	.00	.11
GDP	3.3	1.1	.04	.25
Sentiment (not in %)	-0.2	12.6	.09	.49
Interest Rate	-0.0	6.0	.00	.00
Term Spread (level)	0.7	2.2	.06	.00
Risk Premium	0.0	1.5	.06	.01
Inflation Rate	-0.0	1.4	.00	.00

The abbreviations are explained in Table 1.

Table 3 Contemporaneous Quarterly Correlations between the Differenced Variables

U.S., sample period 1994Q1-2010Q4										
	Δtbi	*Δreit*	*Δs*	*Δsc*	*Δy*	*Δse*	*Δir*	*Δts*	*Δrp*	*Δinf*
Δapt_tbi	1.00	.26**	.25**	.20*	.34***	-.00	.03	-.13	-.00	-.00
Δapt_reit	.26**	1.00	.41***	.39***	.06	.23*	-.00	.00	-.48***	.13
Δind_tbi	1.00	.40***	.22*	.21*	.22*	.08	.23**	.29**	-.27**	-.21*
Δind_reit	.40***	1.00	.48***	.39***	.10	.18	-.36***	-.17	-.49***	.40***
Δof_tbi	1.00	.06	.17	.13	.39***	-.14	.11	-.24**	.12	-.00
Δof_reit	.06	1.00	.51***	.45***	.04	.27**	-.23*	-.10	-.54***	.27**
Δre_tbi	1.00	.02	-.00	-.00	.29**	-.00	.17	-.11	.07	-.15
Δre_reit	.18	1.00	.40***	.35***	.08	.22*	-.28**	-.00	-.48***	.30**
Δs			1.00	.90***	.20*	.34***	-.17	-.09	-.41***	.21*
Δsc					.10	.30**	-.14	.02	-.45***	.18
U.K., sample period 1991Q1-2010Q4										
	Δipd	*Δreit*	*Δs*	*Δsc*	*Δy*	*Δse*	*Δir*	*ts*	*Δrp*	*Δinf*
Δof_ipd	1.00	.57***	.41***	.44***	.67***	.24**	.04	.02	-.47***	.02
Δof_reit	.57***	1.00	.37***	.45***	.35***	.44***	.03	.19	-.44***	.-00
Δre_ipd	1.00	.50***	.35***	.39***	.68***	.18*	.03	.15	-.48***	.03
Δre_reit	.50***	1.00	.29***	.39***	.34***	.34***	-.12	.24**	-.39***	.14
Δs			1.00	.84***	.23**	.48***	.02	.08	-.40***	-.00
Δsc					.30***	.51***	-.00	.13	-.50***	.05
Australia, sample period 1994Q2-2010Q4										
	Δdirect	*Δreit*	*Δs*	*Δsc*	*Δy*	*Δse*	*Δir*	*ts*	*Δrp*	*Δinf*
Δdirect	1.00	.41**	.32***	.49***	.28**	-.00	.14	-.14	.05	-.00
Δreit	.41***	1.00	.61***	.41***	.26**	.20*	.05	.25**	.15	.00
Δs			1.00	.30**	.29**	.35***	-.00	.25**	-.24**	.06
Δsc					.16	.23*	.13	.12	.12	-.00

*, ** and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. The abbreviations are explained in Table 1.

Table 4 Cointegration Test Statistics and the Estimated Long-Run Relations for the U.S.

INDUSTRIAL (k=2)			
Hypothesis	r=0	r≤1	r≤2
Trace test p-values	.11	.60	.96
Simulated Trace test p-values	.01	.15	
P-value in the LR test for exclusion of *s* and weak exogeneity of *s* and *re_reit*	.54		
Long-run relation (standard error)	Adjustment speed of *in_tbi* (standard error)		
ind_tbi = 1.12*ind_reit*	-.386		
(.053)	(.089)		
RETAIL (k=1)			
Hypothesis	r=0	r≤1	r≤2
Trace test p-values	.00	.76	.80
Simulated Trace test p-values	.00	.25	
P-value in the LR test for exclusion of *s* and weak exogeneity of *s* and *re_reit*	.64		
Long-run relation (standard error)	Adjustment speed of *re_tbi* (standard error)		
re_tbi = 1.14*re_reit*	-.294		
(.053)	(.036)		
APARTMENTS (k=2)			
Hypothesis	r=0	r≤1	r≤2
Trace test p-values	.12	.58	.60
Simulated Trace test p-values	.01	.14	
P-value in the LR test for exclusion of *s* and weak exogeneity of *s* and *apt_reit*	.49		
Long-run relation(standard error)	Adjustment speed of *ap_tbi* (standard error)		
apt_tbi = 1.10*apt_reit*	-.138		
(.086)	(.031)		
OFFICES			
Hypothesis	r=0	r≤1	r≤2
Baseline model (k=3):			
Trace test p-values	.96	.99	.80
Simulated Trace test p-values	.54	.67	
Harbo et al. (1998) model with *rp* as an exogenous variable (k=1):			
Trace test values (5% critical value)	78.9 (49.6)	13.3 (30.5)	3.2 (15.2)
P-value in the LR test for exclusion of *s*	.50		
for exclusion of *s* and *t*	.09		
for exclusion of *s* and *t* and weak exogeneity of *s* / *of_reit* / *s* and *of_reit*	.03 / .08 / .06		
Long-run relation (standard error)	Adjustment speed of *of_tbi* (standard error)		
of_tbi = 1.26*of_reit* – .652*rp*	-.139		
(.143) (.082)	(.015)		

The Trace test and LR test values are Bartlett small-sample corrected. The Trace test values simulated by CATS2 are not available for r≤2. k is the maximum lag in the tested VECM. The maximum lag (k) is selected by the Hannan-Quinn Information Criteria. Simulation is not available for the Harbo et al. (1998) model.

Table 5 Cointegration Test Statistics and the Estimated Long-Run Relations for the U.K. and Australia

U.K. OFFICES (k=2)			
Hypothesis	r=0	r≤1	r≤2
Trace test p-values	.00	.42	.48
Simulated Trace test p-values	.00	.10	
P-value in the LR test for exclusion and weak exogeneity of *s*			.98
Long-run relation	*of_ipd* = 1.44*of_reit*		
(standard error)	(.062)		
	of_ipd	*of_reit*	
Adjustment speeds of	-.048	.122	
(standard error)	(.014)	(.044)	
U.K. RETAIL (k=3)			
Hypothesis	r=0	r≤1	r≤2
Trace test p-values	.12	.84	.69
Simulated Trace test p-values	.01	.33	
P-value in the LR test for exclusion and weak exogeneity of *s*			.29
Long-run relation	*re_ipd* = .957*re_reit*		
(standard error)	(.057)		
	re_ipd	*re_reit*	
Adjustment speeds of	-.029	.188	
(standard error)	(.016)	(.058)	
Australia			
Hypothesis	r=0	r≤1	r≤2
Baseline model (k=2):			
Trace test p-values	.71	.89	.70
Simulated Trace test p-values	.17	.40	
Harbo et al. (1998) model with *y*, *se* and *ir* as exogenous variables (k=1):			
Trace test values (5% critical value)	184.6 (62.9)	22.2 (39.9)	7.1 (20.7)
P-value in the LR test for weak exogeneity of *s* and *reit*			.46
Long-run relation	*direct* = .597*reit* + .538*s* – 6.51*y* + .005*se* + 1.73*ir* + .061*t*		
(standard error)	(.041) (.064) (.713) (.001) (.385) (.006)		
Adjustment speed of *direct*	-.133		
(standard error)	(.009)		

The Trace test and LR test values are Bartlett small-sample corrected. The Trace test values simulated by CATS2 are not available for r≤2. k is the maximum lag in the tested VECM. The maximum lag (k) is selected by the Hannan-Quinn Information Criteria. Simulation is not available for the Harbo et al. (1998) model.

Table 6 Forecast Error Variance Decompositions (%) of the Assets at the 12-Quarter Horizon

Shock to	Variance Decomposition of		
U.S. market			
		Offices	
	REITs	*TBI*	*STOCKS*
ΔREITs	41.3	10.3	4.8
ΔTBI	0.2	1.7	0.0
ΔSTOCKS	5.1	2.1	36.3
		Industrial	
	REITs	*TBI*	*STOCKS*
ΔREITs	46.5	44.6	6.9
ΔTBI	0.1	1.8	0.0
ΔSTOCKS	9.5	8.9	58.4
		Retail	
	REITs	*TBI*	*STOCKS*
ΔREITs	50.3	50.2	5.5
ΔTBI	0.0	5.2	0.0
ΔSTOCKS	7.2	6.3	58.2
		Apartments	
	REITs	*TBI*	*STOCKS*
ΔREITs	37.9	30.6	2.5
ΔTBI	0.2	11.9	0.0
ΔSTOCKS	4.7	5.5	36.8
U.K. market			
		Offices	
	REITs	*IPD*	*STOCKS*
ΔREITs	83.8	73.1	34.1
ΔIPD	3.5	14.0	1.1
ΔSTOCKS	0.4	0.5	52.6
		Retail	
	REITs	*IPD*	*STOCKS*
ΔREITs	40.6	22.6	11.1
ΔIPD	15.1	23.5	5.2
ΔSTOCKS	1.5	1.7	45.9
Australian market			
		Overall	
	REITs	*IPD*	*STOCKS*
ΔREITs	50.3	36.3	6.5
ΔIPD	0.0	0.7	0.0
ΔSTOCKS	28.6	40.6	51.1

The table shows the magnitudes of the forecast error variances that are explained by shocks in the asset returns. The variance decompositions are those of the levels, i.e., of the total return indices. The reported values are based on VECMs in which the ordering in the Choleski decomposition is as follows: *i-y-ir-ts-se-rp-s-reit-direct*. The models do not include all the fundamentals.

APPENDIX

Table A1 DF-GLS Unit Root Test Results

Variable	Level (lags)	Difference (lags)
U.S.: 1994Q1-2010Q4		
apt_tbi	-0.36 (2)^{c}	-3.28** (1)
apt_reit	0.13 (2)^{c}	-5.44** (1)
ind_tbi	-0.91 (0)^{c}	-7.08* (0)
ind_reit	-1.07 (5)^{c}	-5.82** (1)
of_tbi	-1.47 (2)^{c}	-3.33** (2)
of_reit	-0.17 (2)^{c}	-6.03** (1)
re_tbi	-0.65 (1)^{c}	-6.00** (0)
re_reit	-0.62 (3)^{c}	-3.57** (2)
S&P 500	-0.58 (0)^{c}	-4.30** (1)
Russell 2000	-0.64 (1)^{c}	-10.0** (1)
Real interest rate	-1.56 (6)	-5.34** (6)
Term Spread	-1.12 (0)	-8.24** (0)
Inflation rate	-1.00 (7)	-5.53** (6)
GDP	0.19 (4)^{c}	-4.37** (1)^{s}
Sentiment	-1.73 (0)^{c}	-9.76** (0)
Risk premium	-0.54 (0)	-6.36** (1)
U.K.: 1991Q1-2010Q4		
of_ipd	-1.55 (1)^{c}	-3.32** (0)
of_reit	-1.01 (1)^{c}	-5.31** (0)
re_ipd	-1.23 (1)^{c}	-3.55** (0)
re_reit	-.84 (1)^{c}	-6.34** (0)
FTSE All Share	.14 (1)^{c}	-8.81** (0)
FTSE Small Cap	-1.08 (1)^{c}	-8.16** (0)
Real interest rate	.11 (5)^{s}	-2.63** (4)^{s}
Term Spread	-1.95* (1)	
Inflation rate	-.59 (5)^{s}	-2.75** (4)^{s}
GDP	-.02 (2)^{c}	-2.73** (1)
Sentiment	-.51 (7)^{s}	-2.04* (6)^{s}
Risk premium	-1.46 (1)	-7.62** (0)
Australia: 1994Q2-2010Q4		
re_ipd	-1.32 (8)^{c}	-2.02* (2)
re_reit	-.96 (5)^{c}	-3.25** (4)
S&P/ASX 200	-.02 (1)^{c}	-6.38** (0)
S&P/ASX Small Ordinaries	-1.18 (1)^{c}	-5.73** (0)
Real interest rate	-1.23 (3)	-6.49** (3)^{s}
Term Spread	-2.07* (5)	
Inflation rate	-1.71 (2)	-8.66** (1)
GDP	-.00 (5)^{c}	-2.71** (4)^{c}
Sentiment	-.20 (8)	-4.75** (7)
Risk premium	-1.14 (2)	-8.20** (1)

* and ** denote for statistical significance at the 5% and 1% level, respectively. Critical values at the 5% and 1% significance levels are -1.95 and -2.60. The number of lags included in the ADF tests is decided based on the Akaike Information Criteria (AIC). A constant term (^{c}) is included in the tested model if the series clearly seem to be trending or if the ADF test without the constant term suggests that the series are exploding. In addition, three seasonal dummies (^{s}) are added to the test if recommended by the AIC.

swiss:finance:institute

c/o University of Geneva
40 bd du Pont d'Arve
1211 Geneva 4
Switzerland

T +41 22 379 84 71
F +41 22 379 82 77
RPS@sfi.ch
www.SwissFinanceInstitute.ch