Real Estate Investment Indices in Japan and Their Role in Optimal International Portfolio Allocation

by

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Submitted to the Department of Urban Studies and Planning in Partial Fulfillment of the Requirements for the Degree of Master of Science in Real Estate Development

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ABSTRACT

It has been said that "home bias" exists among investors due to informational disadvantage involved in cross-border investment. But, real estate has become a major asset class and cross-border real estate investment has been surging. Behind this phenomenon is heightened awareness among investors of the modern portfolio theory and the benefits of diversification. Japan is not an exception. Since late 1990's, a large amount of capital has flowed into Japanese real estate markets. The markets have also experienced significant transformation. However, in the eyes of foreign investors they are far from transparent due to, among other things, lack of reliable investment indices of commercial real estate. Such indices cannot be generated overnight, and lack of such indices can be a critical issue for global real estate investors. This issue is contributing to under-investment in Japan's real estate from overseas. Facing this problem, researchers and industry practitioners launched a number of investment indices for private real estate in recent years, each of which has strong and weak points. Compared to other indices, the ARES J-REIT Property Index seems potentially the most reliable and promising index for Japanese commercial real estate.

The purposes of this paper is to analyze and compare various investment indices for Japanese private real estate; to understand distortions i.e. the "lagging" and "smoothing" effects involved in appraisal-based investment indices to see the "true" pictures of private real estate returns; and then to apply such indices to an international portfolio analysis to see the relative position of Japan's private real estate as a global asset class. Simulations are used to understand the mechanism of appraisal-based investment indices. Introductory sections provide some background on globalization of real estate and issues with Japanese real estate markets.

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Table of Contents

1. Introduction

1. 1. Globalization of Real Estate

Real estate investment is becoming global business as an increasing number of investors acquire assets in foreign countries. This trend has been accelerating in recent years. In the realm of public real estate, the number of countries that have publicly-traded real investment trusts (REITs) has increase from four as of the end of 1994 to sixteen in 2005. The estimated value of the total investable commercial real estate in North America, Europe, Asia and Australia/New Zealand has increased by 7% to USD 6.6 trillion during 2005.[1] Of the sixteen major cities of developed countries that the Japanese Association of Real Estate Appraisal surveyed, twelve cities experienced a decline in cap rates in at least either one of the commercial or multi-family residential real estate markets, while only three cities experienced increase in same from 2003 to 2005.[1] Clearly, the distribution is skewed toward cities experiencing declining cap rates. This phenomenon suggests the possibility that the same force is driving the real estate markets of developed nations. There is a mass of anecdotal evidence that an increasing number of investors in the world have begun allocating their real estate portfolios globally and thereby influencing the real estate markets. A study by Jones Lang LaSalle (JLL), a US-based commercial real estate service firm, reports that investors in 2004 allocated a total of US$99 billion to real estate in countries other than their own.[2]

1.2 Home Bias vs. Modern Portfolio Theory/CAPM

A question comes up: Why do investors invest overseas despite the informational disadvantage that they probably face in foreign markets? In order to earn at least zero net present value (NPV) in each opportunity, investors are better off if they are well-versed in the local markets. But, in reality, it would be almost impossible for all investors to know the localities of numerous markets in the world. In this case, the chances would be slim that foreign investors square off with local investors and earn the same level of NPVs. This mentality seems to have been common among investors up until just a decade ago. Cooper and Kaplanis (1993) demonstrates that "home bias"[3] existed then among institutional investors of nine developed countries including the US and Japan. Although, the study was on the stock markets of developed counties, it is reasonable to infer that the same or even stronger "home bias" existed for less informationally-efficient private real estate markets.

The situation apparently reversed in recent years. The globalization of real estate markets indicates that the awareness of the benefit of portfolio diversification has overcome the "home bias" caused by informational disadvantage. The beauty of diversification based on modern portfolio theory (MPT) is that it allows investors to identify, on an ex-ante basis, the asset allocation that minimizes risk per unit of return for any target return. The risk in this sense is the total covariance of the investor's portfolio. This theory can be extended such that it comprehends the "market portfolio" (MP), which would supposedly be the same for all investors across the board in a perfect world (the CAPM theory). The MP might ultimately contain all the investable assets in the universe. In this case, the beta (β, a measure of systematic risk) and the opportunity cost of capital (OCC) for an asset/project would be identical globally

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[1] Chen and Mills (2005, 2006)

[2] This information is cited by the Wall Street Journal of July 13, 2005. It also cites an expert of JLL as reporting that, in 2004, 50% of commercial real estate transactions in which JLL was involved in Europe was accounted for by "foreign buyers". The figures were 20% in the US and 12% in Asia according to the same source.

[3] Investors' inclination toward investing in their home countries rather in foreign countries.

for all investors.[4]

In reality, however, it is premature to use the "global MP" today since the world is still largely segmented, rather than integrated, in various ways. Despite the still-ongoing globalization, for example, Japanese stock markets are still dominated by Japanese investors.[5] Not to mention that this situation applies also to its private real estate markets, although statistical evidence is not available. The world is still in transition toward a true globalization and there is a long way to go. Given this situation, we should still assume that investors' MPs vary at least from country to country. When we use the CAPM theory to analyze the expected market return for an "average" investor investing in a foreign country, using her/his country's domestic MP is not ideal but can be justified unless her/his country's economy is relatively small and largely integrated into a much larger block of nations e.g. Luxemburg in the European Union. This justification is applicable to a country like Japan, which is the second largest economy in the world, shares no geographical boundaries on land with other countries, and has had relatively little investment activities into and from its neighbors such as South Korea and China. This means that foreign investors have betas different from those of local investors, since covariance in this case is the product of the correlation between the MP and an asset and their standard deviations.[6]

An asset in a country usually has a lower correlation with assets/MPs in foreign countries than with other domestic assets or MP within the same country.[7] The lower correlation of a foreign asset with the investor's domestic MP leads to a lower beta for the foreign asset from the investor's perspective, hence lower OCC for the foreign asset for the investor. This means the possibility that foreign investors might be able to earn an equal or higher NPV than local investors would on the same asset; depending on the cost associated with the informational disadvantage that the foreign investors would incur, the costs necessary for cross-border investment (e.g. cost of currency hedging) and other risks that the foreign investors might perceive. Eventually, the question comes down to which impact is larger: informational disadvantage (plus direct cross-border costs) or diversification. Although the answer to this question depends on each investor, one thing for sure is that an increasing number of institutional investors have begun to enjoy the positive side of cross-border investment, either consciously or unconsciously. In bygone days, investors used to require positive risk premium for investing in foreign countries. The risk premiums may be negative today.

1.3 Real Estate Investment into and out of Japan

As the second largest economy in the world, Japan plays an important role as a destination for cross-border investment. Its real estate markets are becoming major targets for global investors. In the late 1990's numerous opportunistic investors, mainly from the United States, flocked to Japan to acquire distressed properties and bad loans collateralizing real estate, while taking advantage of the unprecedentedly low local interest rates. In recent years, however, as Japanese real estate markets recover from a long slump, private equity and public funds from foreign institutional investors such as pension

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4 $\beta_A = Cov(M, A)/Var(M)$, $OCC = r_F + \beta a(r_M - r_F)$, where $Cov(M,A)$ is the covariance of Asset "a" with the MP, $Var(M)$ is the market variance, r_M is the market return, and r_F is the risk-free rate.

5 Foreign nationals owned only 23.7% of the total market value of Japanese stocks listed at the Tokyo Stock Exchange as of 2005 (Tokyo Stock Exchange 2005).

6 $Cov(M,A) = p_{MA} \sigma_M \sigma_A$, p is the correlation of MP and Asset "A", σ_M is the MP's standard deviation, and σ_A is the asset's standard deviation.

7 See Chen and Mills (2005, 2006) and Cooper and Kaplanis (1993).

funds and REITs are flowing into the markets. Unlike the US investors in the late 1990's, these foreign institutional investors are not driven by short-term capital gain, but attracted to the long-term outlook of the Japanese markets and the benefit of diversifying their portfolios. On the other hand, Japanese investors are opening their eyes to real estate markets overseas, coming back to the international real estate community over the aftereffect of their blunders in the US real estate markets in the late 1980's and early 1990's.[8]

In 2005, foreign nationals owned 23.7% of the total market value of all of Japan's listed stocks, which is a significant figure.[9] The ratio of real estate owned by non-Japanese citizens is considered much lower, although statistical evidence is not available. Then, how much (as flow) is invested in Japan's real estate markets from countries overseas, and how much out of Japan into real estate markets overseas every year? The amount (flow) of outward direct investment in real estate from Japan has far outweighed that of inward investment to Japan in each of the 20 years from 1985 through 2004.[10] Although direct investment does not represent the entire investment, it is reasonable to infer that the total (including direct) outward real estate investment from Japan has outweighed its inward counterpart, too. The reason is that, unlike its stock markets, Japan's private real estate markets are far from transparent. As far as Japan's private real estate markets are concerned, the "home bias" still prevails over the awareness of the benefit of cross-border investment.

[8] For example, Japan's Ministry of Land, Infrastructure and Transport recently announced that it would allow J-REITs to own real estate overseas.

[9] Tokyo Stock Exchange reported on June 16, 2005.

[10] Japan External Trade Organization, http://www.jetro.go.jp/jpn/stats/fdi/, as of July 21, 2006. It should be noted that the data, which are primarily based on data from Japan's Ministry of Finance, do not take into consideration reinvestment or withdrawal of investment. The data series was discontinued after 2004.

2. Transparency of Japanese Real Estate Markets

2.1 International Ranking

Relatively low transparency of the Japanese real estate markets for their size is contributing to this "trade imbalance". According to Global Real Estate Transparency Index 2006 by Jones Lang LaSalle (JLL), Japan is ranked twenty-third from the top among fifty-six nations, barely in the second of the five tiers, in terms of market transparency (refer to Table 2.1)[11]. This is the lowest among the G7 Economic Summit member nations.[12] It should also be noted that Japan's transparency is relatively low for its high GDP per capita, a measure of the economic well-being of a nation.

Table 2.1
Partial List of Ranking, from JLL's Global Real Estate Transparency Index 2006
Top 10 and G7 Nations

1.	Australia
2.	United States
3.	New Zealand
4.	Canada
5.	United Kingdom
6.	Hong Kong
7.	Netherlands
8.	Sweden
9.	France
10.	Singapore
…	
12.	Germany
…	
…	
21.	Italy
…	
23.	Japan

2.2 Japan's Weakness

A weighty reason is, among other things, that Japan lacks reliable investment indices to measure commercial real estate performance. A real estate investment index usually is a time series of periodic income and capital returns tracking a group of properties with certain common attributes. Although Japan has a number of fledgling real estate investment indices for (private) commercial real estate, most of them are either based on the controversial the Published Land Prices, have a very short track record, or both.

[11] JLL defines a transparent real estate market as "any open and clearly organized real estate market operating in a legal and regulatory framework that is characterized by a consistent approach to the enforcement of rules and regulations"; "that respects private property right"; and "that has the ethical and professional standards of private sector advisors, agents and brokers who are licensed to conduct business in each country." JLL has five explicit sub-indices to calculate the score for each country: the Investment Performances; Market Data, Disclosure and Governance; Regulatory and Legal; and Professional Standards and Transaction Process sub-indices.

[12] G7 consists of US, Canada, UK, France, Germany, Italy and Japan.

Due to the nature of real estate investment indices, it takes a long time to create one with a long history like the NCREIF Property Index (NPI) of the US. For this reason, of the JLL's five criteria for judging a market's transparency, the availability of investment performance indices is the only criterion upon which the fifty-six nations are distributed in a bipolar manner: with the majority being toward the highest rank "Highly Transparent" and the lowest tier "Opaque".[13] Needless to say, Japan is near the lower pole. Japanese real estate market participants did become aware of the importance of real estate investment indices in recent years, but the situation can't be changed overnight.[14]

There may be other problems with Japanese real estate markets that are tarnishing their transparency but are not covered by JLL's transparency index. Having once practiced in Japanese commercial real estate markets, the author is aware of numerous other issues that foreign investors (especially from the West) must find perplexing, To raise just a few of them, the coexistence of old and new Land and Building Leasing Laws, one of which is excessively favorable to tenants; purchase and leasing contracts that are usually not detailed and use vague language, leaving the parties open to future ad-hoc negotiations in case extraordinary events occur; and reluctance on the part of sellers to disclose financial information or lack of same on the very income-producing properties that they are trying to sell. However, these problems can largely be overcome to some extent, depending on the learning curve of foreign investors.

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[13] This observation is based on JLL's Global Transparency Index 2004.

[14] Japan is ranked low also due to paucity of market data indicating the current real estate market fundamentals. However, this kind of data can be compiled in a relatively short time frame, and is not considered as serious as lack of time-series investment indices.

3. Importance of Real Estate Investment Indices

The reason why the availability of reliable investment indices is granted such great importance by foreign investors is closely tied to the MPT/CAPM theory summarized above. For commercial real estate investors who employ the MPT/CAPM theory for diversification, transaction price-based investment indices would be ideal, but are usually not available. Therefore, they often have no choice but to resort to appraisal-based investment indices. Appraisal values of properties often deviate from their market values in both idiosyncratic and systematic ways. This systematic component does not diversify away when assembled into an index, providing distorted information on market values.[15] Therefore, if investors use appraisal-based indices without necessary adjustments, they would end up allocating their assets based on wrong information. This means what they believe to be the optimal portfolio is actually not.

[15] Geltner and Miller (2000).

4. Real Estate Appraisal and Published Land Prices in Japan

Before various investment indices are compared, the uniqueness of the Japanese appraisal practice and the Published Land Prices need to be noted, as it is relevant to appraisal-based indices.

4.1 Japan's Real Estate Appraisal Standards

As Japanese real estate markets emerged in the international investment community, efforts were made to bring the local appraisal practice to the "global" (or American) standard. This move was mostly driven by pressures, directly or indirectly, from foreign investors and local industry professionals competing with them. This lead to the revision of Japanese Real Estate Appraisal Standards of July 3, 2002. The media and industry professionals emphasized that the discounted cash-flow method (DCF) was officially recognized as a proper method (in addition to the traditional direct capitalization method) by the Ministry of Land, Infrastructure and Transport (MLIT). However, this was an ex-post facto approval of the method already in use among appraisers. Rather, the most significant change is seen in how the revised standards define the value appraisers should opine.

In the former standards,

1. The value appraisers should normally opine is a "fair"[16] value, which in essence is a market value that would be formed in a "rational market" (Chapter 5.3.1).
2. Due to "abnormal" circumstances that "often" surround each transaction, real estate is usually not traded in markets where "fair" values are formed (Chapter 1.2).[17]
3. Therefore, real estate appraisals by appraisers as experts are necessary to "form" "fair" values. (Chapter 1.2).

Thus, appraisal values are regarded as values that properties "should" have ("sollen" values).[18] This is because the former Japanese Real Estate Appraisal Standards were drafted in an era when real estate prices were steeply climbing, and their most important mission was to contribute to stabilizing real estate values

In the revised standards,

4. The value appraisers should normally opine is a "fair" value, which in essence is a market value that would be formed in a "rational" market that is "under real socio-economic circumstances". (Chapter 5.3.1.1)
5. Due to "abnormal" circumstances that "often" surround each transaction, it is very difficult for "nonprofessionals" to find "fair" values. (Chapter 1.2).
6. Therefore, real estate appraisals appraisers as experts are necessary to "form opinions of" "fair" values. (Chapter 1.2).

Thus, appraisal values are regarded as market values that properties actually have in markets ("sein" values).

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[16] Both the old and new standards are written in Japanese and there is no official English version. The author made best efforts to summarize the essence of the standards relevant to the definition of values that appraisers are supposed to seek. In this section, the author quotes words that are very subtle in the original text or do not exist but are needed in the English translation by reading between the lines.

[17] This implies that "rational" real estate markets do not exist.

[18] See Nishimura and Shimizu (2002) about the controversy over "sollen" and "sein" values.

Now, some of the unique (meaning not American) philosophies introduced above (1~3) are gone. But, what is really unique about Japanese Real Estate Standards is the very fact that they try to define the values that appraisers should seek. The US counterpart, Uniform Standard of Professional Appraisal Practice known as USPAP, rather focuses on setting forth the procedures that appraisers should follow in appraisals. As for values, the following excerpts eloquently summarize a totally different philosophy of USPAP:

> "Value expresses an economic concept. As such, it is never a fact but always an opinion of the worth of a property at a given time in accordance with a specific definition of value. In appraisal practice, value must always be qualified – for example, market value, liquidation value, or investment value."[19]

In short, what kind value an appraiser should opine depends on her/his client's intended use of the appraisal.

The former Japanese Real Estate Appraisal Standards aroused confusion and mistrust among market participants. They are now revised and provide clarification, but still have a lingering effect. Meanwhile, their link to the Published Land Prices still remains, a grave issue upon which public trust in the appraisal industry depends.

4.2. Government-Sponsored Published Land Prices

Every year, MLIT (formerly the Ministry of Construction) has numerous parcels of land throughout Japan appraised by real estate appraisers, and publishes market values of the parcels as if vacant (the Published Land Prices). For the 2005 Published Land Prices, a total of 31,230 parcels were appraised.[20] Since the law requires each parcel to be appraised by two appraisers, a total of 62,460 appraisals were ordered. Based on the number of officially-registered appraisers or 6,696 (as of 2004), on average 9.3 appraisals were assigned to each registered appraiser.[21] In addition to this, each prefecture has different parcels appraised every year. The number of parcels for this prefecture-level appraisal was 26,521 in 2004. Thus, the total number of parcels appraised under the two surveys is approximately 57,000 a year today. MLIT announces year-over-year changes of the simple (equally-weighted) averages of the Published Land Prices for each prefecture. No other countries on the planet conduct this thorough a survey for real estate.

The Land Price Publication Law stipulates that, whenever real estate appraisers appraise properties, whether for public or private purposes, they must "base" their opinions of values upon the Published Land Prices available in the areas of the subject properties. The Published Land Prices, therefore, must be the yardsticks of all appraised values by real estate appraisers. Thus, the Published Land Prices are extremely important for appraisers, and supposedly for market participants too.

However, most market participants as well as nonprofessionals give little thought to the Published Land Prices in determining prices to trade their properties. This is because they believe MLIT manipulates the

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[19] Appraisal Standard Board and the Appraisal Foundation (2004).
[20] All numerical data in this paragraph are from MLIT.
[21] A total of 2,711 appraisers were hired, or on average approximately 23 appraisals were assigned to each appraiser who was actually hired for this survey.

Published Land Prices to influence the real estate markets. As previously noted, the Japanese Real Estate Appraisal Standards had for a long time taken the position that appraisal values are what properties "should" be worth ("sollen" values) rather than what they actually are worth ("sein" values). Under this philosophy, until the burst of the so-called "bubble" economy in the early 1990's, MLIT is said to have kept the Published Land Prices at about 80% of the market values of the parcels. Conversely, after the burst of the "bubble" economy and during the prolonged recession until the early 2000's, the Published Land Prices were said to be somewhat higher than the actual market values (either for tax purposes or for price stability). Besides, the parcels that had been appraised in the past were often replaced by other parcels, diminishing the credibility of the Published Land Prices as time-series data. For these reasons, people do not have much trust in the Published Land Prices, despite the huge amount of taxpayers' money and time and efforts spent by appraisers. Private (as opposed to government-sponsored) real estate appraisals are also fettered by the Published Land Prices for the aforementioned reasons.

5. Real Estate Investment Indices in Japan

5.1 Periodic Return for Real Estate Investment Index

A real estate investment index is a time series of periodic total returns on a certain group of properties. A periodic total return in Period t can be expressed as follows:

$$
\begin{aligned}
r_t &= r_{i,t} + r_{g,t} \\
&= (CF_t/V_{t-1} + V_t/V_{t-1})-1 \\
&= (CF_t + V_t)/V_{t-1} - 1
\end{aligned}
$$

Where $r_{i,t}$ is an income return, $r_{g,t}$ is a capital return, CF_t is a cash flow, and V_t is the value. Subscript t in CF_t and V_t means the cash flow/value is as of the end of Time t. Subscript t for r means returns are for the period of t.

5.2 Types of Real Estate Investment Indices

There are various types of real estate investment indices.[22] The three major types are:

1. REIT indices,
2. Transaction price-based indices, and
3. Appraisal-based indices.

1. REIT indices are stock-price indices tracking only REIT-stock returns. Since stock markets are informationally more efficient than private (direct) real estate markets, REIT indices exhibit more volatile returns than the underlying private real estate does.
2. Transaction price-based indices keep track of actual transactions prices. One way to create transaction price-based indices is the Repeated Measures Regression[23] and another common way is the hedonic regression, which controls the quality of heterogeneous properties with an equation that tries to accounts for how properties are priced. Since a large transaction database is necessary, indices of this type are common for residential properties, but usually not for commercial properties, which change hands less frequently.
3. Appraisal-based indices are the most common for commercial real estate. Regardless of the availability of actual transaction data, indices of this type can be created by periodic appraisals in lieu of actual sales, and are very common for commercial real estate. However, indices of this type suffer what is called “smoothing” and “lags” by individual appraisals[24] and also in the process of aggregating data[25], and are said to not show the reality of private real estate markets, especially when the markets are moving. A brief introduction of currently available indices and the author’s comments will follow.

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[22] For more detailed categorization, see Geltner and Miller (2000).
[23] See Geltner and Goezmann (2000)
[24] See Quan and Quigley (1989).
[25] See Geltner (1993).

5.3 Comparison of Private Real Estate Investment Indices in Japan

The following chart is a snapshot of the investment indices for which the data compiling methods are available to the public.

Chart 5.3 (1/2)

	(1)	(2)	(3)	(4)
Index Name	Urban Land Price Index	STIX	MTB-Ikoma	RENEX
Index Provider	Japan Real Estate Institute	Sumitomo Trust Bank, STB Research Institute	Mitsubishi-UFJ Trust Bank, Ikoma Data Service System	Mizuho Trust Bank, Urban Research Institute
Index Type	Appraisal	Appraisal	Appraisal	Appraisal
Property Type	Commercial/ Residential Land	Office	Office	Office
Data Source				
Land Value	Provider's Own Database	Published Land Price	Published Land Price	Published Land Price
Bldg Value	N/Ap.	Monthly of Construction Statistics	Cost Manual	Monthly of Construction Statistics
Income	N/Ap.	BOMA*[4] Data	Provider's Own Database	Client (Existing Properties)
Valuation/Adjustment Method				
Land Value	Appraisal	Estimated from Published Land Price	Published Land Price	Estimated from Published Land Price
Building Value	N/Ap.	Estimated Replacement Cost	Estimated Construction Cost of Hypothetical New Bldg	Actual Original Cost/Estimated Replacement Cost
Income	N/Ap.	Area Average of Actual Rents	Estimated Income with Hedonic Regression	Reported Actual Income
# of Properties Comprising Index	2,000 (as of 2005)	8 (model properties)	600 (as of 2006)	80 (as of 2004)
# of Transactions in Price Database	N/Ap.	N/Ap.	N/Ap.	N/Ap.
# of Properties in Income Database	N/Ap.	Total 188	Total 12,000 (leases)	N/Ap.
Covered Area	223 Cities throughout Japan	Tokyo 8 CBDs, Osaka	13 Major Cities throughout Japan	Tokyo 5 CBDs + 6 Wards
Time-series Data Since	1936	1976	1970	1994
Return Period	Semiannual	Annual	Quarterly	Annual

(Chart continues on the following page.)

Chart 5.3 (2/2)

	(5)	(6)	(7)	(8)
Index Name	Japanese Consultative Property Index	ARES J-REIT Property Index	Residential Market Index	Recruit Residential Price Index
Index Provider	IPD	Association for Real Estate Securitization	KEN Corporation, JREI*[1], At Home, REEI*[2]	Recruit
Index Type	Appraisal	Appraisal	Transaction Price	Transaction Price
Property Type	Office/Retail/Multi-family Residential	Office/Retail/Multi-family Residential	Residential Condo	Residential Condo
Data Source				
Land Value	N/Ap.*[3]	N/Ap.*[3]	N/Ap.*[3]	N/Ap.*[3]
Bldg Value	J-REIT/Client Appraisal	J-REIT Appraisal	Provider's Own Database (Sold Price)	Provider's Own Database (Sold/Asking Price)
Income	J-REIT/Client (Existing Properties)	J-REIT (Existing Properties)	Provider's Own Database	Provider's Own Database
Valuation/Adjustment Method				
Land Value	N/Ap.*[3]	N/Ap.*[3]	N/Ap.*[3]	N/Ap.*[3]
Building Value	Reported Appraisal Value (Income Approach)	Reported Appraisal Value (Income Approach)	Adjusted Actual Transaction Price with Hedonic Regression	Adjusted Actual Transaction Price with Hedonic Regression
Income	Reported Actual Income	Reported Actual Income	Estimated Income with Hedonic Regression	Estimated Income with Hedonic Regression
# of Properties Comprising Index	503 (Dec 2004)	149 (Sep 2005)	N/Ap.	N/Ap.
# of Transactions in Price Database	N/Ap.	N/Ap.	21,000+ (5 years)	Total 456,730 in Initial Database (1989~2001)
# of Properties in Income Database	N/Ap.	N/Ap.	240,000+ (5 years)	
Covered Area	Properties Owned by J- REITs (nationwide)	Properties Owned by J- REITs (nationwide)	Tokyo 23 Wards	Tokyo & Surrounding Prefectures
Time-series Data Since	2003	2002	1998 (Recent 5 years)	1989
Return Period	Monthly	Monthly	Semiannual	Monthly

Notes to Chart 5. 3:

*1 Japan Real Estate Institute.

*2 Real Estate Economic Institute

*3 Land values are integrated into building values as improved properties. No separate valuation for land is available.

*4 Building Owners and Managers Associations, Tokyo and Osaka.

5.4 Grouping of the Indices and Comments

Four categories can be established using the eight indices above. It should be noted that "In-house" and "Outside" as used below refer to whether the index providers appraise/evaluate properties by themselves or use appraisals reported by third parties/clients/members.

Group 1 – In-house Appraisal-based Index for Land

(1) Urban Land Price Index (ULPI)

ULPI is for land values only. Constituent properties are appraisals by in-house appraisers. Significant smoothing and lag was observed compared to a research-purpose transaction-based index (Nishimura and Shimizu 2003). The relatively small number of subject properties per city (ten) and the "thinness" of land sales are the weaknesses. ULPI has the longest time series of all the indices in Japan.

Group 2 –In-house Appraisal-based Index for Commercial Real Estate

(2) STIX
(3) MTB-Ikoma (MTBI)
(4) RENEX

The most notable characteristic of these appraisal-based indices is that these providers appraise properties by themselves using the cost approach. While STIX and RENEX use the Published Land Prices as comps for the properties they appraise, MTBI directly take the Published Land Prices.

STIX has one model building in each of the eight areas that is representative of the average location and quality of the area. Its valuation method is the so-called cost approach, where land values are estimated from comps and improvements values are based on estimated replacement costs.

MTBI assumes there exists an optimal office building on a parcel of land that is a subject of the Published Land Prices, regards the published price as the land value, estimates the construction cost of this hypothetical building, and figures out its market rent. MTBI has an extensive database of rents for running a hedonic regression. Its hedonic model is a linear regression and relatively simple:

$$Y = aX_1 + bX_2 + cX_3 + dX_4$$

Where Y: actual rent, a~d: coefficients, X_1: average asking rent of the area to which a sample belongs, X_2: building area, X_3: minutes on foot to the nearest train station, X_4: building's chronological age. It seems dummy variables can be used in place of X_1.

Anyway, the weaknesses of this group are the use of the Published Land Prices and the fact that the cost approach these providers use is not the mainstream valuation method among investors today. MTBI has the most extensive database of actual lease transactions for commercial properties, and in this category the largest pool of properties comprising the index, reducing the sampling error (standard error) of individual appraisal.[26]

[26] See Geltner (1998).

Group 3 – Outside Appraisal-based Index for Commercial Real Estate
(5) Japanese Consultative Property Index (JCPI)
(6) ARES J-REIT Property Index (ARES)

This group is very similar to the NCREIF Property Index (NPI) of the US in its data collection method. These index providers do not evaluate the constituent properties by themselves, but collect and aggregate values of the properties. These indices are newcomers and have data with relatively short time series. The appraisals underlying the indices are mostly based on the income approach, i.e. direct capitalization and/or DCF, the valuation methods that are most widely used by investors today. For this reason and due to lack of influence from the Published Land Prices, these indices are potentially the most reliable indices for (private) commercial real estate in Japan.

ARES will more deeply be analyzed later in this paper.

Group 4 – Transaction Price-based Index for Residential Real Estate
(7) Residential Market Index (RMI)
(8) Recruit Residential Price Index (RRPI)

These indices are hedonic-regressed transaction-price-based indices. Both have large databases of sales and rentals. RRPI uses the following elaborate hedonic equation for prices and rents:[27]

$$\begin{aligned} logRP_{gt} &= a_0 + a_{1,t}\, logWK_t + a_{2,t}\, logACC_t + a_{3,t}\, logFS_t \\ &+ a_{4,t}\, logBY_t + a_{5,t}\, logBS_t + a_{6,t}\, logNU_t + a_{7,t}\, logNRt + a_{8,t}\, RTt \\ &+ \sum_h a_{9,h,t}\, BC_{h,t} + \sum_i a_{10,i,t}\, RD_{i,t} + \sum_j a_{11,j,t}\, LD_{j,t} + \sum_k a_{12,k}\, TD_k + \varepsilon \end{aligned}$$

Where RP_g : g =1 is price, g=2 is rent; FS: floor space (m^2); WK: minutes (on foot + by bus) to the nearest station; ACC: accessibility measured by minutes by train to the nearest train terminal; BY: building's chronological age; BS: balcony space (m^2); NU: # of units in building, BC_h: other building characteristic; RD_i: train dummy; LD_j: city/ward dummy; TD_k: time dummy (monthly)

[27] For details, see Ono, Takatsuji and Shimizu 2002.

6. The ARES J-REIT Property Index

As noted above, the ARES J-REIT Property Index is currently one of the most potentially reliable and promising indices for commercial real estate in Japan. The general information of the ARES index is as follows.

6.1 General Information about ARES J-REIT Property Index

Property Categories:	Office, retail and industrial owned by J-REITs
Data Source:	Publicly available disclosure and financial data by J-REITs
# of properties:	Increased from initial 24 properties to 447 in September 2005
# of portfolios	22 J-REITs
Return Time Series:	From January 2001 to September 2005
Method:	Semiannual Appraisals (income approach) by outside appraisers hired by J-REITs
Valuation Date:	Every six months. Each J-REIT selects the two valuation dates, which are six-months apart and can be at the end of any month of a calendar year.
Periodic Returns:	Monthly (The return for each month is expressed on an annualized basis.)

Formulas:

Semiannual Income Return ***= NOI / (BMV + 0.5 C I- 0.5 PS - 0.417 NOI)***

Semiannual Capital Return ***= (EMV – BMV – CI + PS) / (BMV + 0.5 C I – 0.5 PS – 0.417 NOI).***

Total Return ***= Income Return + Capital Return***

The denominator assumes: one-sixth of a semiannual NOI comes in at the end of each month during a six-month period, and CI and PS occur at the middle of a six-month period. NOI: semiannual net operating income, EMV: ending market value, BMV: beginning market value, CI: semiannual capital improvements/expenses, PS: partial sale

6.2 Issues in the ARES J-REIT Property Index

6.2.1 Three Types of Smoothing/Lag in the ARES Index

This section analyzes the following three types of smoothing/lag involved in the ARES index. (For the sake of simplicity, the adjustment to the denominator of the capital return by CI, PS and 0.417 NOI is intentionally omitted in this section.)

i. **Mismatch of the appraisal interval and the return period;**
ii. **Backward-looking behavior in individual appraisals; and**
iii. **Temporal aggregation of staggered appraisals**

The ARES index is akin to NPI in many aspects. The most notable differences are frequency of appraisals, staggered timing of the appraisals by cohort, and the return period. ARES obtains income and appraisal data from securities reports of J-REITs, which have their individual properties appraised every six months, or biannually. ARES publishes monthly capital and income returns based on these biannual appraisals. To understand the mechanism of these smoothing/lag types, simulations of compiling the ARES index will follow. In these simulations, a return series that follows a random walk is used. This is based on the assumption that (private) commercial real estate markets are efficient in the weak sense (the weak-form market efficiency hypothesis). The validity of this assumption will be reflected later in analyzing how to "unsmooth" and "de-lag" the simulated return series.

6.2.2 Rules about Abbreviation, Symbol and Calculation

These issues pertain mainly to capital returns and hardly affect income returns, since income returns are not estimated by appraisers but reported by J-REITs and income returns are usually stable across periods. Therefore, in this paper, income returns are abstracted from discussions and the word "return" (which will be frequently expressed by the letter "r") refers to capital returns, unless otherwise noted.

There are also three types of "r" in terms of return periods;
"r" (plain): true return (unobservable);
"r^*": appraisal return; and
"r^{**}": reported (or published) return. This (r^{**}) is the return used for compiling the index.

Returns are for a specific length of time. In terms of time, unless it is not necessary to specify such length of time,
"r_a": annual return (unobservable);
"r_s": semiannual (six-month) return; and
"r_m": monthly return.

As for values "V",
"V" (plain): true market value (unobservable); and
"V^*": appraisal value.

"t" refers to a month. Subscript "t" if attached to "r" refers to "during Month t", and if attached to "V" refers to "at the end of Month t".

“j” specifies the cohort to which “V” or “r” refers. There are six (6) cohorts of J-REITs in total, and “j” is one of the six integers ranging from 0 through 5.[28] “Cohort j” is the cohort one part of which ends “Month t+j”. For example, Cohort 2 is so called because one of its semiannual returns ends Month t+1.

The above symbols can be combined.

Example 1

“$r_m{}^{**}{}_{t+1,\,3}$”, which means the “published (index-level) monthly return of Cohort 3” during Month t+1.

Example 2

“V^*_{t-2}”, which means “appraisal value at the end of Month t-2.

For ease of expression and calculation, from this point forward in this paper, returns are continually-compounded returns unless otherwise noted. Continually-compounded returns can be calculated by taking the logarithm of numbers.

[28] As previously noted, a J-REIT is appraised every six months, or twice a year. The dates of the appraisals are the ends of its fiscal terms. One of the dates can be at the end of any months, and the other is exactly six month later. For example, if J-REIT “A” has its properties appraised at the ends of June and December every year. Therefore, all J-REITs can be classified into six groups by their fiscal terms. These groups are called cohorts in this paper.

6.2.3 Smoothing by Mismatch of Appraisal Interval and Return Period

The fact that the six-month appraisal interval is longer than the return period of one month that is calculated by ARES causes smoothing of return series. This is because the reported monthly return of a cohort is simply one-sixth (1/6) of its semiannual return. This smoothing has nothing to do with appraisal. Let's for the moment make an unrealistic assumption that the appraisal equal the market value (V*=V). The unobservable "true" monthly return for Month t, $r_{m,t}$, is calculated as follows:

$$r_{m,t} = \ln(V_t) - \ln(V_{t-1}) \qquad (1)$$

On the other hand, ARES calculate monthly returns using two appraisal values as follows (V*=V for now):

$$r_m{}^{**}{}_t = [\ln(V^*{}_t) - \ln(V^*{}_{t-6})]/6 = [\ln(V_t) - \ln(V_{t-6})]/6 = r_{s,t}/6 \qquad (2)$$

where $r_m{}^{**}{}_t$ is the published monthly return for Month t.

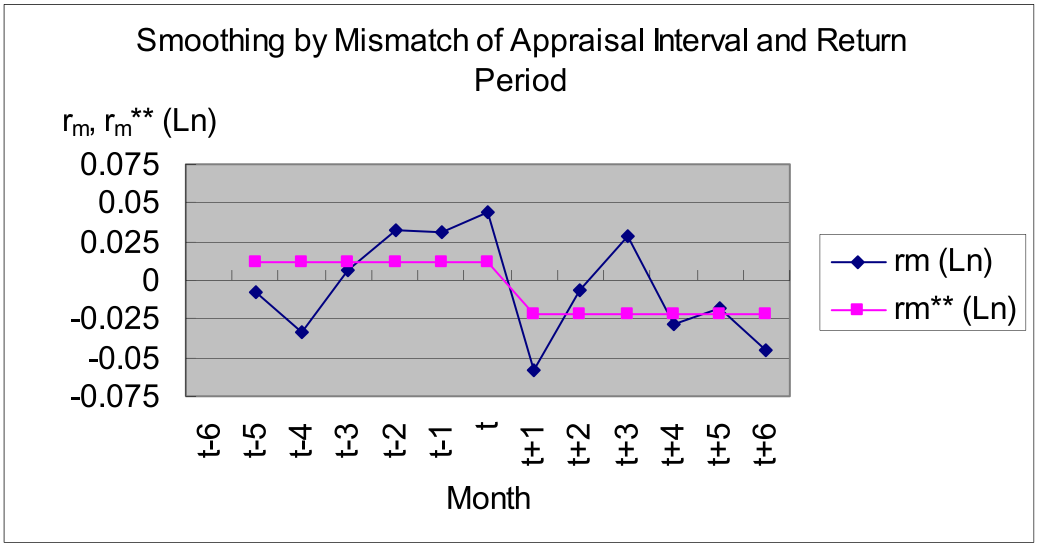
Thus, $r_m{}^{**}$ for a cohort remains constant for the six months from Month t-5 through Month t, while r_m may not. $r_m{}^{**}$ is calculated without regard to V_t, whereas r_m depends on V_t. If V fluctuates during this period, $r_m{}^{**}{}_t$ is distorted.

The following example illustrates this smoothing. Table 6.2.3 below shows randomly-generated returns (r_m) at σ_a (annual standard deviation) of 9% for the period of Month t-5 to Month t+6 and the price indices (V) based on the returns starting at 1.00. It also shows $r_m{}^{**}$, which is calculated with Equation 2 from V_{t-6}, V_t and V_{t+6}. Notice that the values in Column $r_m{}^{**}$ remains the same for six months despite the constantly-changing values in Column r_m. Graphs 6.2.3-1 and 6.2.3-2 visualize Table 6.2.3.

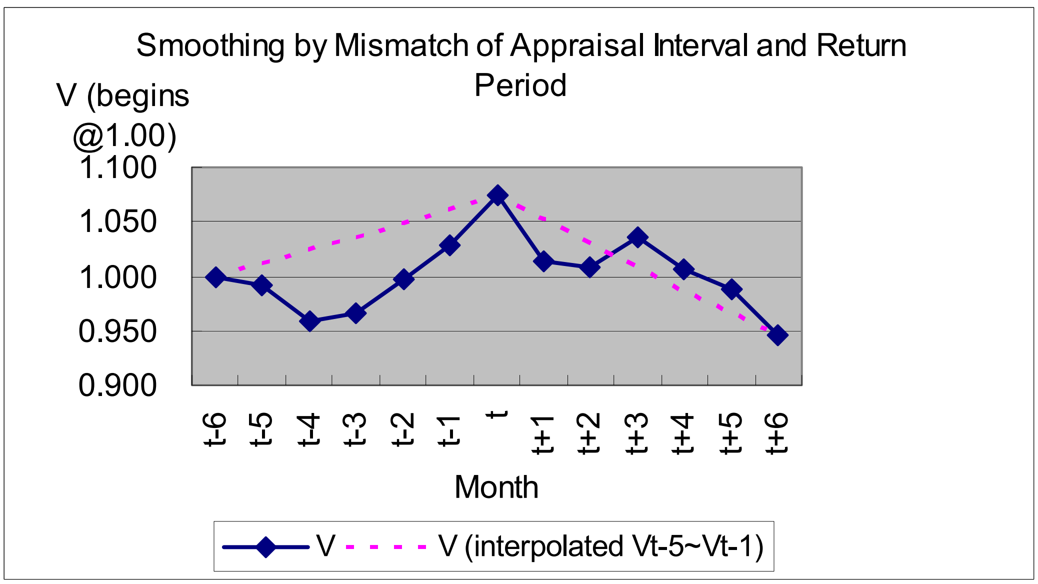
Table 6.2.3

Month	r_m (Ln)	$r_m{}^{**}$ (Ln)	V	V* (interpolated V^*_{t-5}~V^*_{t-1})
t-6			1.000	1.000
t-5	-0.0087	0.0133	0.991	1.013
t-4	-0.0376	0.0133	0.955	1.027
t-3	0.0070	0.0133	0.962	1.041
t-2	0.0362	0.0133	0.997	1.055
t-1	0.0340	0.0133	1.031	1.069
t	0.0488	0.0133	1.083	1.083
t+1	-0.0651	-0.0238	1.015	1.058
t+2	-0.0068	-0.0238	1.008	1.033
t+3	0.0311	-0.0238	1.040	1.008
t+4	-0.0319	-0.0238	1.007	0.985
t+5	-0.0201	-0.0238	0.987	0.962
t+6	-0.0500	-0.0238	0.939	0.939

Graph 6.2.3-1



Graph 6.2.3-2



6.2.4 Smoothing and Lag by Individual Appraisals

6.2.4.1 Dispersions of Transaction Price and Appraisal Value

In stock markets, prices[29] indicated by numerous transactions converge to market values[30] (MVs). Literally up-to-the-minute information on MVs is available by observing the prices of other shares traded. However, private real estate markets are "thin" and not as informationally efficient [31] as stock markets. This is because a piece of real estate is unique in terms of location and physical characteristics and does not change hands as frequently as a share of a stock. It is also possible, and often likely, that circumstances surrounding actual real estate transactions differ from the conditions under which MVs are achieved. In other words, actual transaction prices are "noisy"[32] indications of MVs.

For this reason, appraisers try to estimate subjects' MVs by analyzing multiple comps, or the actual transaction prices for properties that are physically and geographically similar to the subject properties. Finding comps is not an easy task, especially in commercial real estate markets, where properties are not as homogeneous as in residential real estate markets. Even if appraisers are able to find comps, the number of comps used per appraisal is fairly small.

Let's assume for a moment that there are numerous "ideal" comps, or comps which are current and almost identical to the subject property and that the prices of the comps are normally distributed around their average MV, which are equal to the subject's MV in this case. If the dispersion of the prices around the MV is expressed as ε_p, and if an appraiser can find a certain number of such "ideal" comps or "n" [33], the dispersion of the appraisal value around the MV or ε_a is smaller than ε_p, because ε_a can be expressed as follows:

$$\varepsilon_a = \varepsilon_p / n^{1/2} \qquad (3)$$

In other words, ε_a is the standard deviation of the sample mean (standard error) with a sample size of

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[29] A price can be defined as: "The amount a particular purchaser agrees to pay and a particular seller agrees to accept **under the circumstances surrounding the transaction.**" (Appraisal Institute, 2002)

[30] Market value can be defined as: "The most probable price, as of a specific date, in cash, or in terms equivalent to cash, or in the precisely revealed terms, for which the specified property right should sell after a reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and the seller each acting prudently, knowledgeably, and for self interest, and assuming that neither is under duress." (Appraisal Institute, 2002)

[31] Informational Efficiency: A market is said to be informationally efficient when market prices reflect "all available information". Generally, the definition of "all available information" can be: all information including inside information (strong form); all public information (semi-strong form); or all information on past prices (weak form). Arguably, listed stock markets can be generalized as usually having semi-strong form or at least weak form market efficiency.

[32] This expression is used in Geltner and Miller (2002).

[33] Hamilton and Clayton (1999) obtained data on appraisals from two Canadian commercial real estate managers who managed properties worth a total of over $750 million. They found that, during the period of 1986 to 1996, the appraisers hired by the two managers used on average 6.86 comps to estimate the cap rate for a subject property. The situation does not seem much different in Japan.

n.[34] This assumes that all the appraiser has to do is to simply take the average of the comps she/he finds.

6.2.4.2 Appraiser Behavior

However, in the real world, appraisal values disperse more than Equation (3) indicates. The reason is that the above assumption is unrealistic in that there are no such "ideal" comps in the real markets, due to "thinness" and heterogeneity of commercial real estate. Nevertheless, this individual appraisal dispersion from the MV is not serious because such dispersion diversifies away in the index level during the process of aggregating numerous appraisals, as long as such appraisal dispersion is random (idiosyncratic).

Given the lack of current "ideal" comps, appraisers have no choice but to refer to comps that were traded in the past, even if the market condition has since somewhat changed. Temporal adjustments to update such comps are hardly perfect, often ending in under-adjustment, because appraisers tend to avoid making major adjustments to comps due to lack of firm and current evidence to do so. Uncertainty about current market condition also makes appraisers refer to previous appraisals of the same property such that the current appraised value becomes "consistent" with previous appraisal values.[35]

This behavioral tendency of appraisers to systematically rely on past information does not cancel out during the aggregation of individual appraisals for constructing an index, unlike the idiosyncratic dispersion of an appraisal value from the MV.[36]

For this systematic backward-looking behavior of appraisers, a typical appraisal-based investment index may not converge to the MVs regardless of the number of samples or properties comprising an index.

6.2.4.3 Partial Updating Factor of Appraisal (Quan-Quigley Model)

Quan and Quigley (1991) assume that private real estate capital returns follow a random walk (or have little autocorrelation) and quantifies the appraisers' backward-looking behavior as follows:

$$r^*_k = \alpha_k r_k + (1-\alpha_k) r^*_{k-1} \qquad (4)$$

$$\alpha_k = \sigma_k^2 / (\sigma_k^2 + \varepsilon_p^2), \quad 0 \leqq \alpha \leqq 1 \qquad (5)$$

where, r^*_k is the appraisal-based return for Period k, r_k is the "true" return for the same period. σ_k is the temporal (market-wide) volatility of r_k during Period k, and ε_p is the cross-sectional dispersion of prices around the MV.

α_k is an adjustment factor that appraisers use in updating their previous appraisals in Period k-1. The intuition behind these equations is that appraisers place greater weight on current market information and

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34 Geltner (1998).

35 Diaz and Wolverton (1996) proves there exists appraisers' "anchoring" on their own past appraisals., as supports the Quan-Quigley model.

36 In addition, some maintain that appraisers in Japan are relatively conservative due to the influence by the old appraisal standards, as discussed in Section 4.1. In the case of the US, it is often reported that there are (usually upward) pressures from clients about appraisal values, e.g. for loan underwriting purposes, in bullish markets. Either way, for simplicity this paper assumes there are no biases other than the backward-looking behavior.

less on past market information when the market-wide volatility is relatively high and ε_p is relatively small. In other words, if appraisers observe current transaction prices that somewhat deviate from the level seen in the past, the appraisers tend to interpret that such deviation is relatively more accounted for by changes in the market condition than by market participants' pricing errors.

Since properties for the ARES index are appraised semiannually, these formulas can be written as follows:

$$r_{s\,t}^{*} = \alpha_s r_{s,t} + (1-\alpha_s)\, r_{s\,t-6}^{*} \qquad (6)$$

$$\alpha_s = (\sigma_a^2/2)/(\sigma_a^2/2 + \varepsilon_p^2), \quad 0 \leqq \alpha \leqq 1 \qquad (7)$$

where

$r_{s\,t}^{*}$ is the appraisal-based semiannual return for the six-month period ending at the end of Month t, $r_{s,t}$ is the true semiannual return for the same period. $r_{s\,t} = \ln(V_t) - \ln(V_{t-6})$. $r_{s\,t}^{*} = \ln(V_t^{*}) - \ln(V_{t-6}^{*})$. α_s is a partial updating factor for a six-month period. σ_a is the **annual** temporal volatility of returns. Note, in Equation (7), the **semiannual** temporal volatility $\sigma_s = \sigma_a/2^{1/2}$.[37]

$r_{s\,t}^{*}$ in Equation (6) can be written as what is very similar to a first-order autoregressive function as follows:[38]

$$\begin{aligned} r_{s\,t}^{*} &= \alpha_s r_{s,t} + (1-\alpha s) r_{s\,t-6}^{*} \\ &= \alpha_s r_{s,t} + \alpha_s(1-\alpha_s) r_{s,t-6} + \alpha_s(1-\alpha_s)^2 r_{s,t-12} + \alpha_s(1-\alpha_s)^3 r_{s,t-18} \quad + \alpha_s(1-\alpha_s)^{\infty} r_{st-6\infty} \\ &= \sum_{k=1} \alpha_s(1-\alpha_s)^k\, r_{s,t-6k} \qquad (8) \end{aligned}$$

6.2.4.4 Estimating Price Dispersion from Partial Updating Factor in Canada

Hamilton and Clayton (1997) estimate that α_a (annual) was 20% for commercial real estate appraisers in Canada for the period of 1986 to 1996. The data published from Canadian Real Estate Association (CREA) for the period of 1995 through 2004 indicate σ_a= 4.5% for residential real estate. With Equation (5), these figures correspond to ε_p = 9% in Canada.

Of course, this figure cannot be accepted blindly due to the fact that the CREA data do not control for quality and also are smoothed.[39] Needless to say, it is not advisable to use the σ_a for residential real estate with the α_a for commercial real estate. The periods of the data are also different. Nevertheless, with appropriate adjustments, these figures can indicates ε_p for Canada's commercial real estate.

Empirically, commercial real estate is more volatile than residential real estate. Therefore, a figure that is somewhat higher than the residential σ_a should be used for Canada's commercial real estate. As for α_a, Hamilton and Clayton (1997) report a standard error (SE) of 6.5% for the figure of α_a =20%.

The following table shows sensitivity of ε_p using a matrix of different levels of α_a and σ_a. Residential

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[37] The "Square root of N" rule applies for σ, while ε_p remains constant regardless of time.

[38] Geltner (1993).

[39] This figure is not from a point-to-point measurement of prices. In CREA's data, each annual average contains sales that occur throughout the year.

σ_a is escalated at an increment of 25% to extrapolate the higher volatility of commercial real estate. α_a has a range of $\pm$ two SEs (6.5% x 2) in the matrix.

Table 6.2.4.4

ε_p for Canada's Commercial Real Estate

Sensitivity of ε_p with varying α_a and σ_a					α_a				
					-2 SE	-1 SE	Mean	1 SE	2 SE
					7.0%	13.5%	20.0%	26.5%	33.0%
Adjustment to σ_a		0%	σ_a	4.5%	16.4%	11.4%	9.0%	7.5%	6.4%
	+	25%		5.6%	20.5%	14.2%	**11.3%**	9.4%	8.0%
	+	50%		6.8%	30.8%	21.4%	16.9%	14.1%	12.0%
	+	75%		7.9%	53.8%	37.4%	29.5%	24.6%	21.0%
	+	100%		9.0%	107.6%	74.8%	59.1%	49.2%	42.1%

It is hard to pinpoint a figure from this matrix. σ_a that is 25% higher than the residential σ_a is arbitrarily selected for Canada's commercial real estate. With the α_a of 20%, this indicates an ε_p of 11.3% for Canada's commercial real estate.

6.2.4.5 Estimating the Partial Updating Factor for Japanese Commercial Real Estate

With Equation (7), α_s for Japanese commercial real estate can be estimated. This can be done by adjusting the above and using information on the σ_s of Japanese commercial real estate.

In Japan, there are no reliable data about ε_p. There is however a court decision about an appraisal error (ε_a), which ruled that a six-percent valuation error in appraisal is "within a normal range".[40] [41] And Equation (3) at least suggests appraisal errors (ε_a) are smaller than ε_p. Therefore, 6% can be regarded as the lower bound of ε_p.[42]

There is a reason to believe that ε_p should be lower in Japan than in Canada. This is because Japanese commercial real estate is considered "thicker" than Canada's due to the sheer size of Japan's economy. The "thickness" of a market is considered to be negatively correlated with ε_p.[43] Therefore, ε_p = 11.3% of Canada's commercial real estate becomes the higher bound for Japan's.

Now, the figure of 9.4% is selected from the column of 1 SE of the above matrix as the ε_p of Japanese commercial real estate. This figure is also within the range of 6% to 11.3% as discussed above.

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[40] It is unknown what "normal" means. Here, it is assumed to be one standard error from the market value.

[41] In a court decision concerning the appraisals for a property assessment, it was ruled that a six-percent difference in the valuations of two appraisals is permissible as being within a normal range of variation (Supreme Court of Japan, Tokyo, January 22, 2002).

[42] If the number of comps n=6.86 is applicable in Japan as Hamilton and Clayton (1997) find in Canada, from Equation (3), $\varepsilon_p = \varepsilon_a n^{1/2} = 6\% \times 6.86^{1/2} = 6\% \times 2.62 = 15.7\%$. Again, this equation does not work perfectly in the real world.

[43] Hamilton and Clayton (1997) also suggest that αk of the Quan-Quigley model has positive correlation with the quantity of recent information, meaning a lower εp, holding σk constant in Equation (5).

As for σ_a, there are two sets of data we can rely on, although they are both residential. The Government Housing Loan Corporation of Japan (GHLC) publishes data that have a long time series but lack control for quality and also are smoothed.[44] The data on the residential properties that GHLC collateralizes indicates an σ_a of approximately 7%.[45] It should also be noted that this is a smoothed figure on residential real estate, suggesting a higher figure for commercial real estate. The other is Recruit Residential Property Index (RRPI), which has a short history but is a transaction price-based investment index using a hedonic regression. RRPI indicates a σ_a of approximately 5% for the Tokyo Metropolitan Area for the period of July 1997 to June 2006. This does not include the "bubble" economy in the 1980's but covers only a relatively stable period, necessitating an upward adjustment. Based on the above reasoning, the higher figure of 7% is selected as representing σ_a of Japanese residential real estate. For the same arbitrary reason, the figure of 8.8% (which is 25% higher than the residential figure of 7%) is selected for the σ_a of Japanese commercial real estate.

Given ε_p=9.4 % and σ_a = 8.8%, Equation (7) provides α_s = 30.4%.[46] The following table shows sensitivity of this α_s to various combinations of ε_p and σ_a.

Table 6.2.4.5
α_s for Japan's Commercial Real Estate

Sensitivity of α_s with varying σ_a and ε_p				ε_p (from Canada's Data)				
				-2 SE	-1 SE	Mean	1 SE	2 SE
				20.5%	14.2%	11.3%	9.4%	8.0%
Adjustment to σ_a	0%	σ_a	7.0%	5.5%	10.8%	16.2%	21.8%	27.6%
	+ 25%		8.8%	8.3%	15.9%	23.2%	**30.4%**	37.3%
	+ 50%		10.5%	17.0%	29.8%	40.5%	49.5%	57.3%
	+ 75%		12.3%	38.6%	56.5%	67.6%	75.0%	80.4%
	+ 100%		14.0%	71.5%	83.9%	89.3%	92.3%	94.3%

44 The GHLC data tracks annual average prices of residential properties by prefecture.

45 This is simply an equal weighted average of the volatilities of condominiums (9%) and detached houses (5%) capital returns for the last 25 years in ten major prefectures (Tokyo, Kanagawa, Chiba, Saitama, Aichi, Kyoto, Osaka, Hyogo, Hiroshima, and Fukuoka.

46 Can α be higher than this? The answer may be affirmative. There is empirical reason which supports a relatively high α for commercial real estate markets of recent years. As commercial real estate has become a major asset class for institutional investors, its markets have been becoming more efficient in a relative sense and more linked to the financial markets. This phenomenon allows real estate to be priced based on ex-ante returns, which can be inferred from indices available in the other markets. For example, surveys such as Korpacz Real Estate Investor Survey by PriceWaterhouseCoopers are available and more widely used than before to indicate the current expectations of the market participants. This kind of investor surveys is also becoming popular in Japan. Using this type of information, appraisers today can base their opinions of values on current market information as well as on comps, the traditional past information. The fact that appraisers mainly use the so-called income approach instead of the sales comparison approach for income-producing properties supports this hypothesis for a higher α than in the past. Unfortunately, the author finds no research in this regard and α_a=20% by Hamilton and Clayton (1997) is currently the only data available with a solid figure.

6.2.4.6 Simulation of Appraisal Lag and Smoothing

The ARES index has a relatively short history, and the number of properties contained in the index has been also relatively small. For this reason, in order to extract and observe the pure effect of smoothing caused by individual appraisals, randomly-generated[47] "true" semiannual capital returns, r_s, and their appraised values, r_s*, over a period of one thousand (1,000) months are compared.

The following is a summary of the assumptions for this simulation:

Initial "true" value (MV of time 0):

V_0=1

"True" monthly volatility of capital return:

σ_m =**(annual)** σ_a **/$12^{1/2}$=9%/$12^{1/2}$,** symmetric random walk

Mean of "true" monthly capital return:

r_m=0%[48]

"True" semiannual capital return for the six-month period ending at the end of Month t:

$$r_{s,t} = ln(V_t) - ln(V_{t-6}) \qquad (9)$$

where V_t is the "true" value (MV) as of the end of Month t

Appraisal semiannual capital return for the six-month period ending at the end of Month t:

$$r_{s\ t}^{*} = \alpha_s\, r_{s,t} + (1-\alpha_s)\, r_{s\ t-6}^{*}$$
$$= \sum_{k=0} \alpha_s (1-\alpha_s)^k\, r_{s,t-6k} \qquad (10)$$

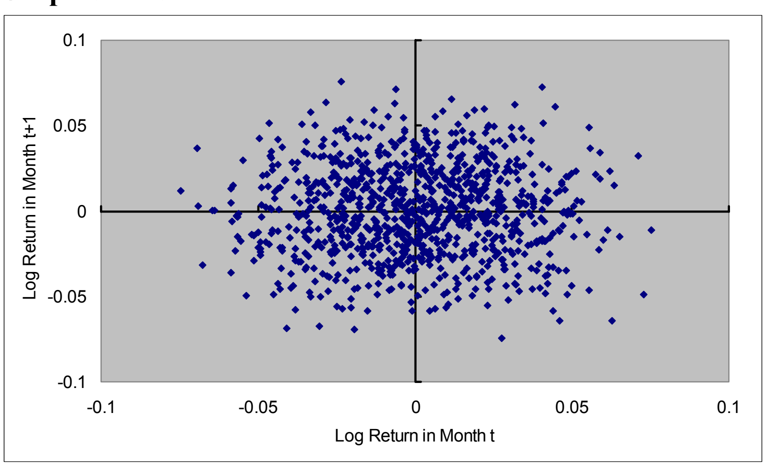
where α_s is appraisers' semiannual updating factor by the Quan-Quigley model (Equation 7)

Appraisers' semiannual updating factor:

α_s= 30% (rounded from 30.4%)

Graph 6.2.4.6-1 shows how the randomly generated "true" returns are distributed in terms of the relationship between $r_{m,t}$ and $r_{m,t+1}$. It is visually confirmed that the returns follow a random walk.

Graph 6.2.4.6-1



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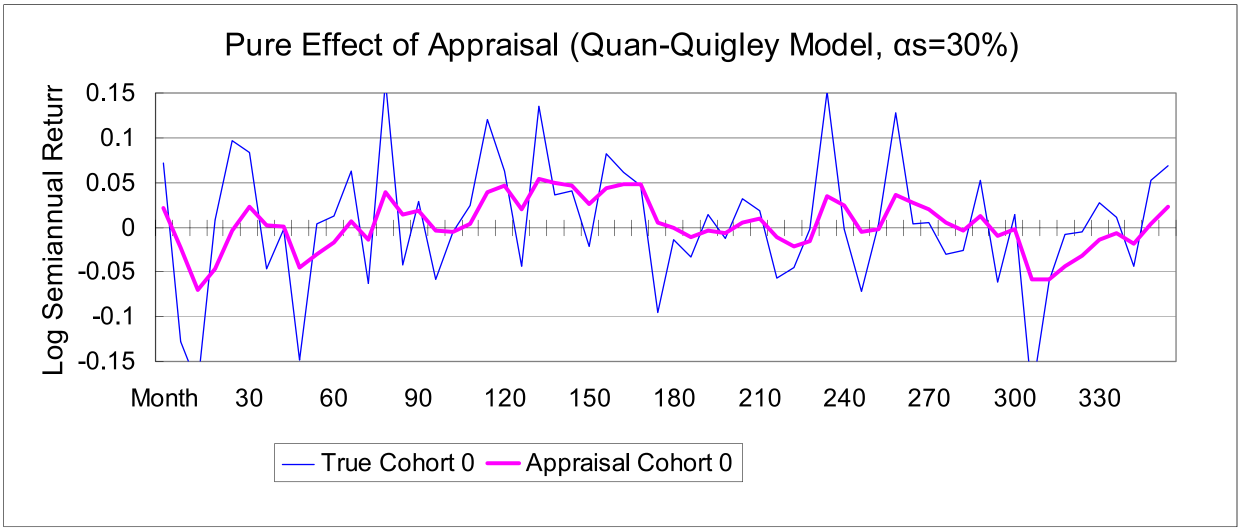
[47] r_s was generated using Excel's Random Number Generation tool.

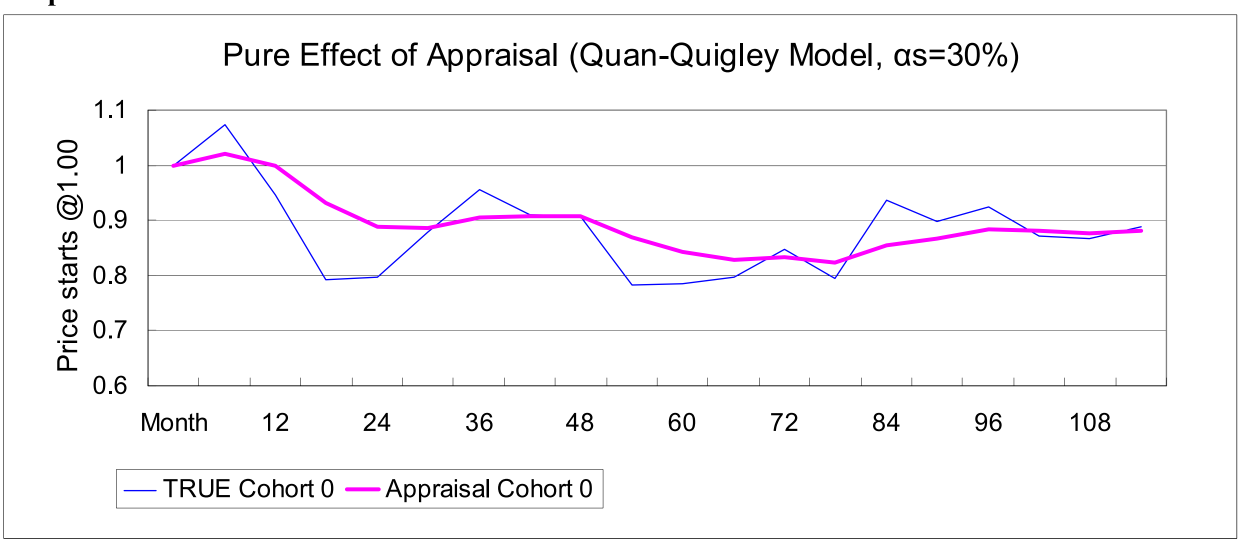
[48] This is because the actual average of the monthly capital returns of the ARES office returns during 2002 to 2005 is minuscule.

Graph 6.2.4.6-2 below is shows the relationship between the r_s and the r_s^* of a cohort. As seen, r_s^* is smoothed and lags behind r_s. Graph 6.2.4.6-3 converts these returns into price indices. The lag and smoothing are more clearly seen in Graph 6.2.4.6-4. This chart indicates autocorrelation for r_s and r_s^*, and the correlation between $r_{s,t}$ and $r_{s\ t+6k}^*$ and the correlation between rst+6k and $r_{s\ t}^*$ (k is a non-negative whole number). While r_s has little autocorrelation (since it was generated such that it follows a random walk), r_s^* has high autocorrelation, as is evidence of smoothing. While r_s^* also has high cross-correlation with past r_s but little correlation with future r_s, evidencing the lag effect of appraisal. These results are consistent with the Quan-Quigley model of Equation (4).

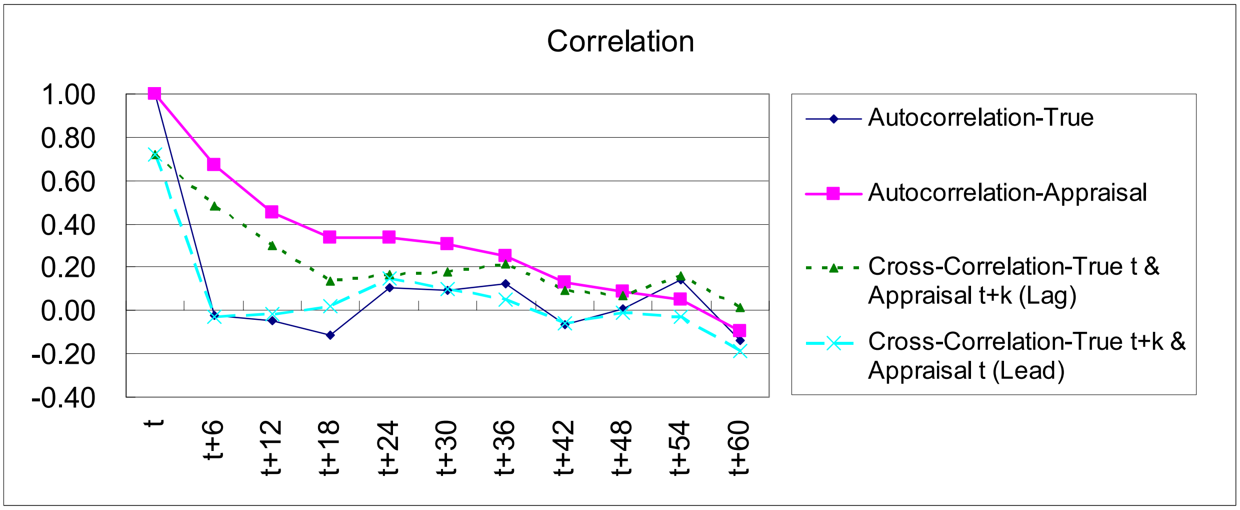
Graph 6.2.4.6-2



Graph 6.2.4.6-3



Graph 6.2.4.6-4



Correlation
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
t
t+6
t+12
t+18
t+24
t+30
t+36
t+42
t+48
t+54
t+60
Autocorrelation-True
Autocorrelation-Appraisal
Cross-Correlation-True t & Appraisal t+k (Lag)
Cross-Correlation-True t+k & Appraisal t (Lead)

6.2.5. Smoothing by Temporal Aggregation of Staggered Appraisals

Most real estate investment indices involve the process of assembling multiple transaction prices or appraisal values. In the case of the ARES index, the way in which the appraisals of each cohort are combined into an index per se poses a very unique issue: smoothing without lags. In this regard, the ARES index can be called a series of moving averages of returns. This section sheds light on this unique mechanism.

6.2.5.1 Staggered Appraisals among J-REITs and Six Cohorts

J-REITs usually have their properties appraised at the ends of semi-yearly fiscal terms, which vary from J-REIT to J-REIT. For this reason, the biannual appraisals are staggered among J-REITs. For example, REIT A appraises its properties at the ends of June and December, REIT B March and September, REIT C April and September, and so on. In short, the properties comprising the ARES index can be classified into six groups based on the dates upon which the appraisals are regularly conducted. Furthermore, in terms of values, properties are not evenly distributed among these six cohorts.

To the extent seen from the number of J-REITs for each six-month intervals, the ends of June/December and March/September combinations seem most common, but not dominant. The reason the end of June/December is popular seems to be that this cycle matches the calendar year. The end of March/September is also common because this cycle coincides with the most common fiscal year for Japanese corporations, beginning April 1st and ending March 31st.

For example, there were fifteen (15) J-REITs that owned office properties and were incorporated into the office index as of September 2005, the month for which the latest index is issued as of the writing of this paper. For these J-REITs, the closing date of books or the dates of the appraisals are distributed as follows:

Table 6.2.5.1
How staggered are the appraisals of the ARES office index?

Jun	– Dec	4
Jan	– Jul	1
Feb	– Aug	1
Mar	– Sep	4
Apr	– Oct	2
May	– Nov	3
Total		15

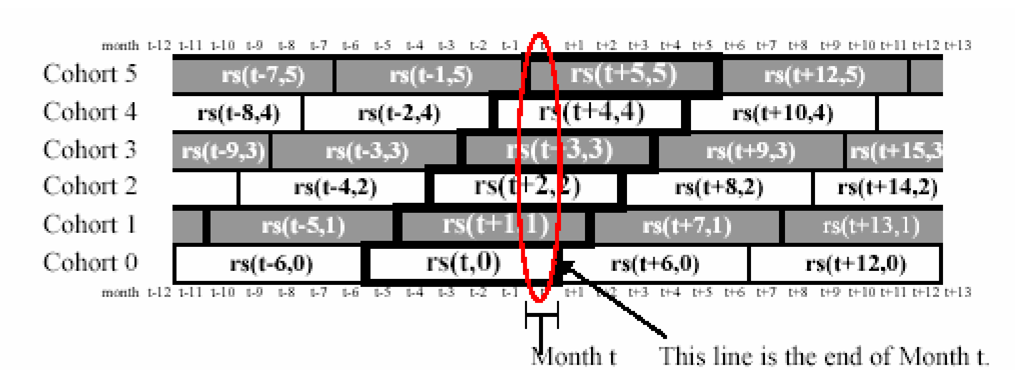
Dates are the ends of the indicated months.

6.2.5.2 Simplified Model of Temporal Aggregation of the ARES J-REIT Property Index

For simplicity, from this point forward, each of the six cohorts is assumed to always have the same total value equal. Therefore, the value weight of each cohort is one-sixth (1/6). Also, in order to extract only the effect of temporal aggregation (or "pure" effect of temporal aggregation not mixed with the previous appraisal smoothing/lags), it is assumed for a moment that α_s is unity (α_s=1). Therefore, for now, $r_s^*=r_s$. In addition, each cohort is assumed to have a large number of properties such that idiosyncratic individual appraisal valuation errors (ε_a, deviation of the appraisal value of a property from its MV) are diversified away on the cohort level. Therefore, $V^*=V$.

The following Chart 6.2.5.2 illustrates how the six staggered cohorts are related.

Chart 6.2.5.2



$r_{s,t-k,j}$ is a semiannual return ending Month t-k of Cohort j. Cohort j is the cohort whose properties are appraised at the end of Month t+j. For example, Cohort 2 (j=2) is so called because one of its appraisal dates is the end of Month t+2.

As seen, the index-level monthly return in Month t, $r_m{}^{**}{}_t$ (= $r_{m,t}$), "true" return in Month t now, in the oval on Chart 6.2.5.2) is equally affected by each cohort. However, which part of the semiannual return of a cohort is affecting differs from cohort to cohort. For example, r_m is affected by the last part of $r_{s,t,0}$, but by the very first part of $r_{s,t+5,5}$. Thus, the ARES index can be regarded as taking central moving averages of returns. From a different angle, it is noted that an index-level return in Month t is affected not only by stale (past) appraisals but also by future appraisals, or the appraisals for a period that contains time after Month t. In this sense, the lag and the "lead" cancel each other out, and there is no overall lag effect due to this temporal aggregation per se. This is the most notable uniqueness of the ARES index.[49]

[49] Most appraisal-based indices that report monthly or quarterly returns suffer from lags as well as smoothing by temporal aggregation because their properties are usually appraised less frequently. For instance, the NCREIF Property Index (NPI) reports returns quarterly, but each of the underlying properties is formally appraised only once a year. Therefore, there are four cohorts in total based on the quarter in which the properties are appraised. In three of the four quarters of a year, a property is usually deemed to be appraised, but at the appraisal value of the last appraisal. The majority of the properties belong to the cohort appraised at the end of the fourth quarter. Therefore, when the four cohorts are aggregated to form the index, the first three quarters of a year tend to be smoothed and the fourth quarter tends to see a spike (when the MVs are surging). In this case, NPI has both smoothing and lag effects due to temporal aggregation of appraisals. See Geltner (1993) for details.

As previously shown as Equation (9), the "true" semiannual return for Cohort 0 for the six-month period ending Month t can be expressed as follows:

$$r_{s,t,0} = ln(V_t) - ln(V_{t-6}) \qquad (9)$$

As seen in Equation (2), ARES calculates the monthly return for Month t for Cohort 0 as follows:

$$r_m{}^{**}{}_{t,0} = r_{s,t,0}/6 = [ln(V_t) - ln(V_{t-6})]/6 \qquad (11)$$

While there is no appraisal in the intervening period between the ends of Months t-6 and t for Cohort 0, ARES assumes that all the monthly returns for this six-month period for Cohort 0 are identical:

$$r_{s,t,0}/6 = r_m{}^{**}{}_{t,0} = r_m{}^{**}{}_{t-1,0} = r_m{}^{**}{}_{t-2,0} = r_m{}^{**}{}_{t-3,0} = r_m{}^{**}{}_{t-4,0} = r_m{}^{**}{}_{t-5,0} \qquad (12)$$

This smoothing was explained in **Section 6.2.3.** In other words, smoothing later shown in this part comprehends the smoothing caused by the mismatch of appraisal interval (semiannual) and reported return period (monthly).

The above three equations can be generalized for any cohort as follows:

$$r_m{}^{**}{}_{t+j-k,j} = r_{s,t+j,j}/6 = [ln\ (V_{t+j}) - ln(V_{t+j-6})]/6 \qquad (13)$$

where k is an integer and k=0~6.

Therefore, the index-level monthly return for Month t can be expressed as follows:

$$r_m{}^{**}{}_t = 1/6\ \{\sum_{h=0}^{5}[ln\ (V_{t+5-h}) - ln(V_{t-1-h})]/6\} \qquad (14)$$

Again, it should be noted Equation (14) assumes each cohort has an equal weight and $V^*=V$. It is important to note from Equation (14) that the monthly ARES return in a given month is affected by the future market condition that exists during the following five months (counted from the end of the month) as well as the previous five months (counted from the beginning of the month). This means the ARES monthly return in a given month has autocorrelation of up to an eleven-month lag, as the pure effect of temporal aggregation. This is consistent with the intuition from Chart 6.2.5.2 above. Thus, the nature of the ARES index can be regarded as value-weighted central moving averages of the returns of the six cohorts. Therefore, smoothing exists, but no lag does, in the pure effect of temporal aggregation of staggered appraisals per se. It should also be noted that ARES needs to wait for at least five months until it collects all the appraisal data necessary to compute the index-level monthly return of a month.

6.2.5.3. Caveat about Temporal Aggregation of Staggered Appraisals

In reality, each cohort has a different value, and a lag or the opposite effect (lead) does exist at any given month at the index level. For example, in the above model, if Cohort 5 captures a dominant value and property values surge toward the end of Month t+5, $r_{m,t}$ is affected positively by this future value appreciation. Conversely, if Cohort 0 is heavy and property values have appreciated since the end of Month t-6, $r_{m,t}$ is dragged down by this past information.

In short, analyzing the value share of each cohort is necessary to figure out the effect of this temporal aggregation with precision. However, the difficulty is that the composition of the cohorts has been changing constantly since the inception of the first J-REIT in 2001, and will continue to change until the ever-growing J-REIT market stabilizes.

6.2.5.4 Simulation of Smoothing by Temporal Aggregation

In order to extract and observe the pure effect of temporal aggregation of staggered appraisals, the same randomly-generated "true" semiannual capital returns, r_s, that we used in the simulation of Section 6.2.4.6 and their temporally-aggregated counterparts, r_s^*, are compared over a period of one thousand (1,000) months.

The following is the summary of the assumptions for this simulation:

$\mathbf{V^*=V}$

Initial "true" value (MV of time 0):

$\mathbf{V_0=1}$

"True" monthly volatility of capital return:

σ_m **=(annual)** σ_a $\mathbf{/12^{1/2}=9\%/12^{1/2}}$, symmetric random walk

As seen, the true monthly capital return $r_{m,t}$ for Month t (t=0~1,000) is calculated as follows:

$$r_{m,t} = ln(V_t) - ln(V_{t-1}) \qquad (1)$$

where V_t is the "true" market value (MV) as of the end of Month t

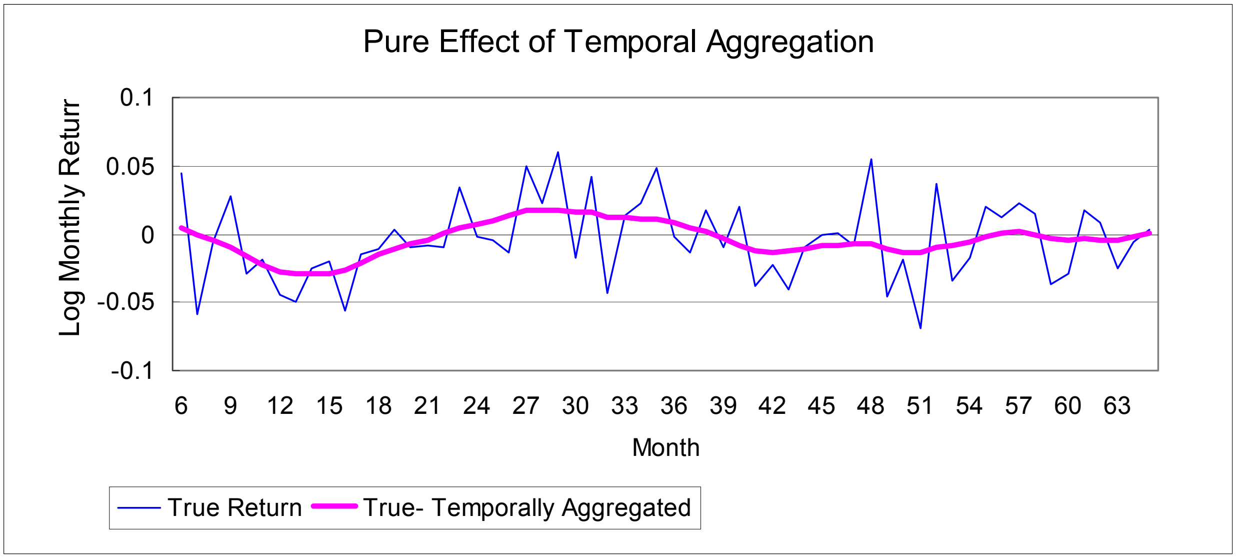
Again, the temporally-aggregated monthly capital return $r_m^{**}{}_t$ for Month t (t=0~1,000) is calculated as follows:

$$r_m^{**}{}_t = 1/6\ \{\sum_{h=0}^{5}[ln\ (V_{t+5-h}) - ln(V_{t-1-h})]/6\} \qquad (14)$$

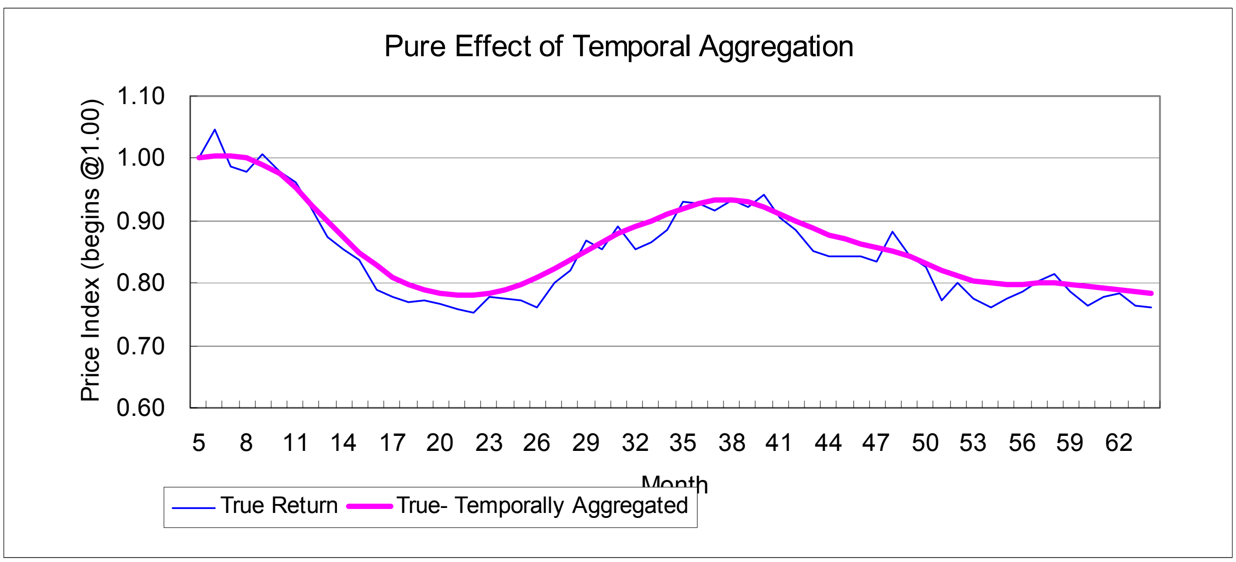
Graph 6.2.5.4-1 below shows the relationship between the r_m and the r_m^{**}. As seen, r_m^{**} is significantly smoothed, but lags, if any, are not visible. Graph 6.2.5.4-2 converts these returns into price indices. This smoothing effect can more clearly be seen in Graph 6.2.5.4-3. This graph indicates autocorrelation for r_m and r_m^{**}, and the cross-correlation between $r_{m,t}$ and $r_m^{**}{}_{t+k}$ and the cross-correlation between $r_{m,t+k}$ and $r_m^{**}{}_t$ (k is a non-negative whole number).

While r_m has little autocorrelation (since it was generated such that it follows a random walk), r_m^{**} has significant autocorrelation, as is evidence of smoothing. The two cross-correlations have exactly the same pattern, attesting that the lag and lead effects offset each other. These results are consistent with the intuition suggested by Chart 6.2.5.2.

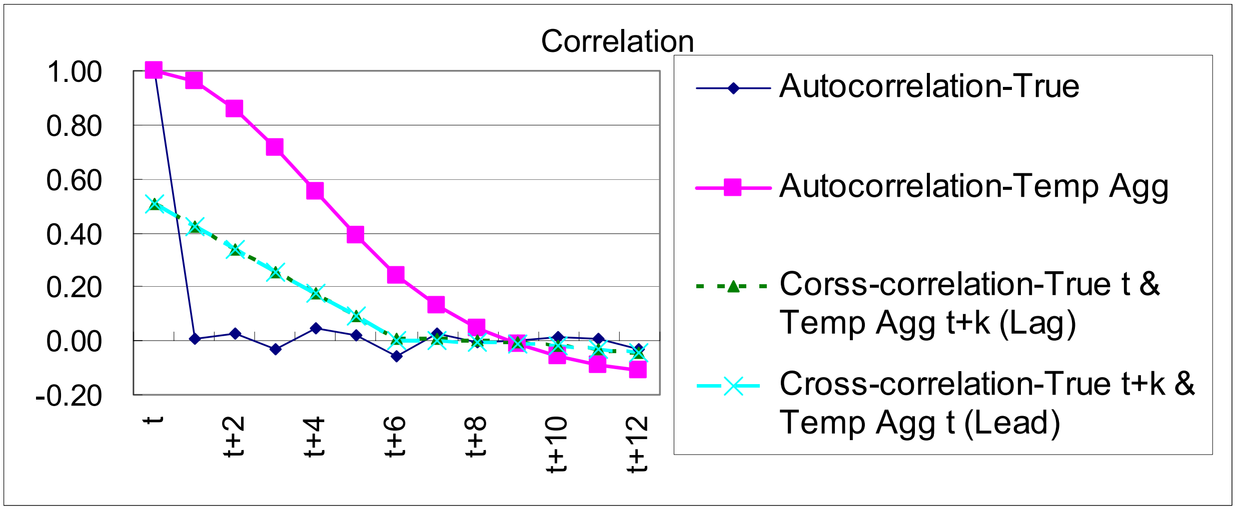
Graph 6.2.5.4-1



Graph 6.2.4.4-2



Graph 6.2.5.4-3



Correlation
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
t
t+2
t+4
t+6
t+8
t+10
t+12
Autocorrelation-True
Autocorrelation-Temp Agg
Corss-correlation-True t & Temp Agg t+k (Lag)
Cross-correlation-True t+k & Temp Agg t (Lead)

6.2.5.5 All Effects Combined

So far, the effect of each step has been analyzed separately. In this section, all the effects are synthesized as follows:

$$r_m{}^{**}{}_t = 1/6 \{ \sum_{h=0}^{5} [\ln (V^*_{t+5-h}) - \ln(V^*_{t-1-h})]/6 \} \qquad (15)$$

This formula is very similar to Equation (14), but the values are with asterisks, meaning they are appraisal values. Again, $r_m{}^{**}{}_t$ is the published (index-level) monthly return for Month t, and V^*_t is the appraisal value as of the end of Month t.

Table 6.2.5.5 below shows the numerical result of this simulation.

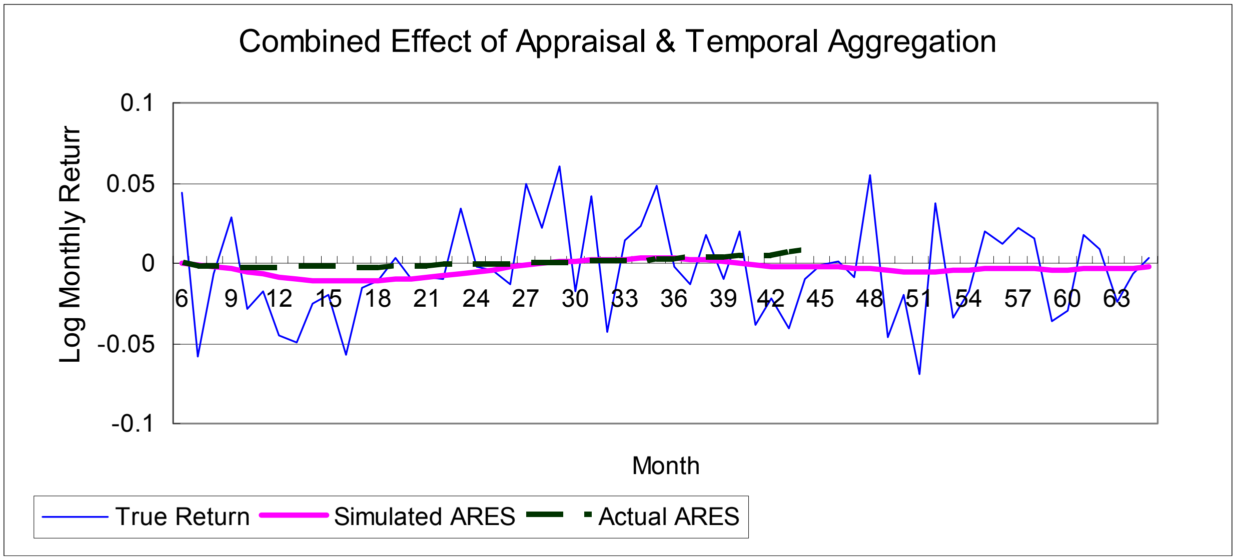
Table 6.2.5.5

	"True" Index (random)	Simulated ARES Index
Mean r_m (monthly)	0.03%	0.03%
Mean r_a (annual)	0.33%	0.41%
σ_m (monthly)	2.65%	0.43%
σ_a (annual)	9.19%	1.50%

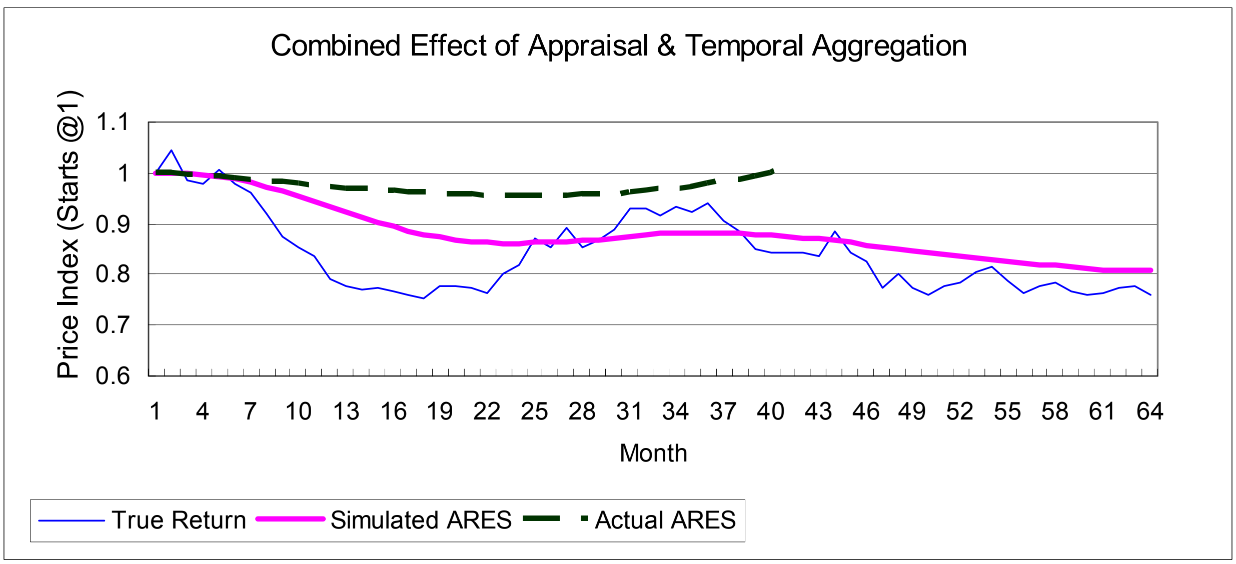
The following graphs visualize the synthesized effect. Compared to the previous graphs, smoothing has apparently intensified. The smoothing effect is so intense that the lag effect by appraisal is dwarfed and unperceivable in Graphs 6.2.5.5-1 and 6.2.5.5-2. Graphs 6.2.5.5-3 however indicates an overall lag effect does exist. It also indicates that it takes nearly sixty months for the effect of $r_m{}^{**}{}_t$ to disappear.

The conclusion is that, under this simulation, the combined smoothing effect of the ARES index is very powerful.

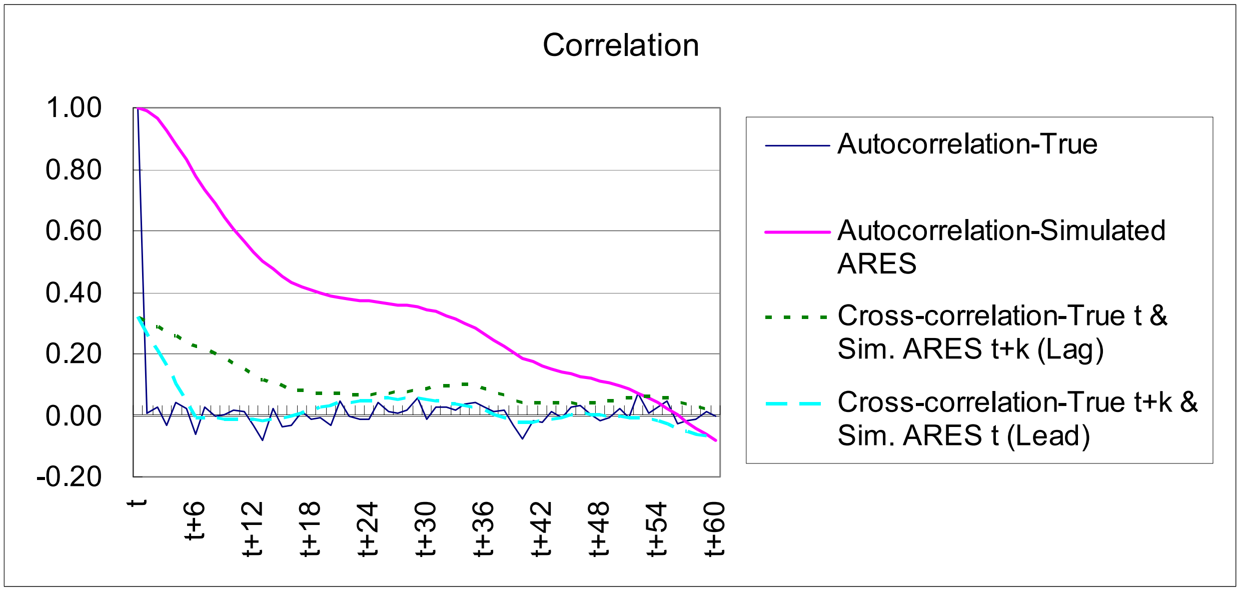
Graph 6.2.5.5-1



Graph 6.2.5.5-2



Graph 6.2.5.5-3


Correlation
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
t
t+6
t+12
t+18
t+24
t+30
t+36
t+42
t+48
t+54
t+60
Autocorrelation-True
Autocorrelation-Simulated ARES
Cross-correlation-True t & Sim. ARES t+k (Lag)
Cross-correlation-True t+k & Sim. ARES t (Lead)

6.3. How Can the Simulated ARES Index be Corrected?

It is now clear that the ARES index is subject to rather intense smoothing and lag effects. In this section, the feasibility of three methods of "unsmoothing" and "de-lagging" appraisal-based indices are analyzed against the simulated ARES index. The three methods are: reverse engineering, zero-autocorrelation, and REIT blending methods.

6.3.1 Reverse Engineering of Appraiser Behavior

6.3.1.1 Formula for Reverse Engineering

As seen in Section 6.2.4, α_s, or a semiannual adjustment factor, was used to simulate the effect of the appraisers' backward-looking behavior. The formula was:

$$r^*_{s\,t} = \alpha_s\, r_{s,t} + (1-\alpha_s)\, r^*_{s\,t-6} \qquad (6)$$

$$\alpha_s = (\sigma_a^2/2)/(\sigma_a^2/2 + \varepsilon_p^2), \quad 0 \leqq \alpha \leqq 1 \qquad (7)$$

Now, Equation (6) can be transformed as follows:

$$r_{s,t} = \{r^*_{s\,t} - (1-\alpha_s)\, r^*_{s\,t-6}\} / \alpha_s \qquad (16)$$

Thus, the true return $r_{s,t}$ can be solved for by reverse engineering Equation (6). However, this method should not directly be applied to the simulated ARES index, since the simulated ARES index is monthly and subject to temporal aggregation, whereas Equation (16) is for semiannual returns and should not be used to an index that is already affected by temporal aggregation as well as appraisal smoothing. Applying this method anyway would increase volatility and mitigate the lag in the simulated return, but would not restore the original "true" returns. Therefore, this method is not advisable in this case.

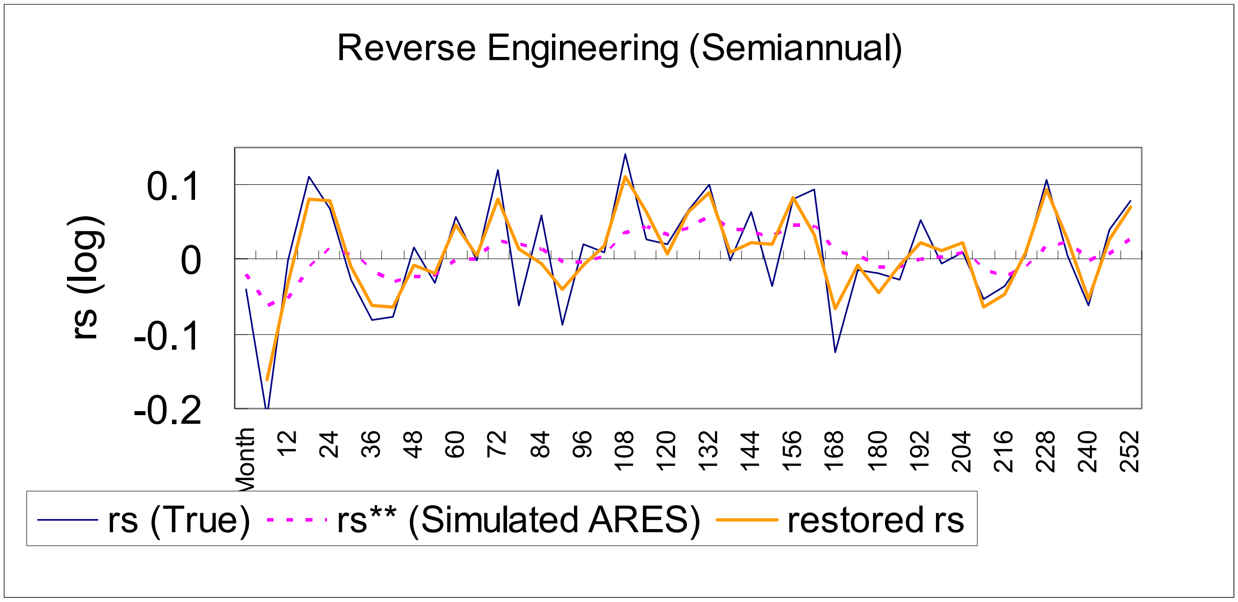
6.3.1.2 Simulation of Reverse Engineering

Table 6.3.1.2 shows the numerical results of applying this method and the following graphs visualize the results. This method did work to some extent. The reverse-engineered returns are certainly closer to the original "true" returns, but the restoration is far from perfect. The annualized standard deviation (σ_a) of r_s is 9.4%, whereas the σ_a of the imperfectly restored returns by this method is only 7.1%. The cross-correlation between the original and restored returns is 0.91. A high cross-correlation in this case means the unsmoothing/de-lagging model restored the original return well. The figure of 0.91 itself appears acceptable. However, comparing this figure to what we will see in the next method will tell us the inferiority of this method in this case.

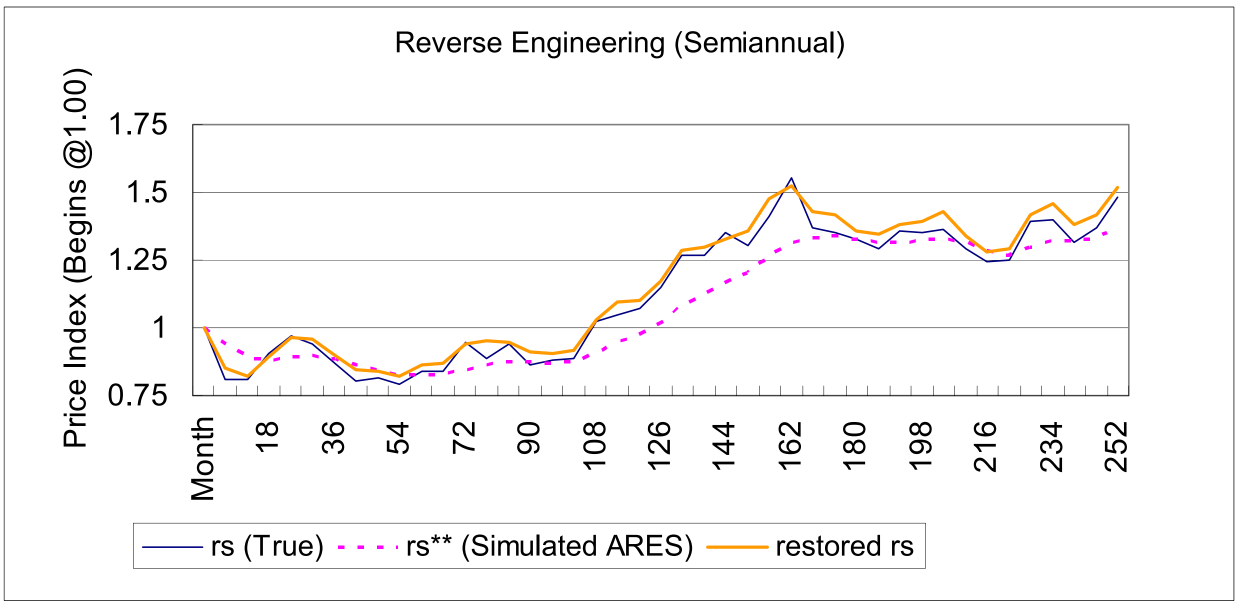
Table 6.3.1.2

	"True" r_s	Simulated ARES r_s^{**}	Unsmoothed r_s
Mean r_s (semiannual)	0.14%	0.22%	0.20%
Mean r_a (annual) σ_s (semiannual)	0.29% 6.68%	0.43% 2.55%	0.39% 5.02%
σ_a (annual)	9.44%	3.61%	7.11%
Correlation	"True" r_s	Simulated ARES r_s^{**}	Unsmoothed r_s
"True" r_s	1.00	0.61	**0.91**
Simulated ARES r_s^{**}		1.00	0.73
Unsmoothed r_s			1.00

Graph 6.3.1.2-1



Graph 6.3.1.2-2



6.3.2 Zero-Autocorrelation

6.3.2.1 Hypothesis for Zero-Autocorrelation

As seen, the simulated ARES index suffers persistent autocorrelation over a long time span. The idea of this method is to establish a hypothesis about the autocorrelation, express it with an equation, and extract the "true" information by regressing the equation. The following equation indicates the hypothesis about the autocorrelation seen in the simulated ARES index:

$$r_m{}^{**}{}_t = a_1 r_m{}^{**}{}_{t-1} + a_2 r_m{}^{**}{}_{t-2} + a_3 r_m{}^{**}{}_{t-3} + [\;\ldots.] + a_{11} r_m{}^{**}{}_{t-11} + \varepsilon_t \qquad (17)$$

$$= \sum_{k=1}^{11} (a_k\, r_m{}^{**}{}_{t-k}) + \varepsilon_t$$

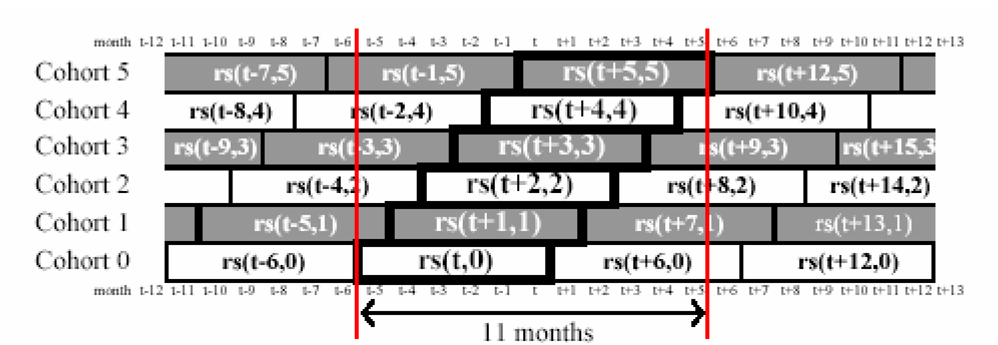
where a_k is the coefficient for $r_m{}^{**}{}_t$, $r_m{}^{**}{}_t$ is an published monthly return, ε_t is a residual.

The hypothesis is that $r_m{}^{**}{}_t$ is explained by past index-level returns ($r_m{}^{**}$) of every month from Month t-1 up to Month t-11.

The independent variables could be anything. The reason the eleven immediately preceding monthly returns are selected is related to how the ARES index is temporally aggregated. As previously seen, six semiannual returns overlap in the manner shown in Chart 6.3.2 below. As shown in Equation (13) before, in a cohort level, $r_m{}^{**}{}_{t+j-k,j}$ is one-sixth of $r_s{}^{*}{}_{t+j,j}$. Because appraisal-based semiannual returns, $r_s{}^{*}{}_{t+5,5}$ and $r_s{}^{*}{}_{t,0}$, overlap in Month t; $r_m{}^{**}{}_t$, $r_m{}^{**}{}_{t+5}$ and $r_m{}^{**}{}_{t-5}$ are correlated through this overlap. This range is a period of eleven months. As seen before, Equation (15) also eloquently tells this point. In this equation, by changing h, the span of V^* reaches from $V^*{}_{t-6}$ through $V^*{}_{t+5}$, a span of eleven months. The following chart visualizes this point.

$$r_m{}^{**}{}_t = 1/6\;\{\sum_{h=0}^{5} [\ln(V^*{}_{t+5-h}) - \ln(V^*{}_{t-1-h})]/6\} \qquad (15)$$

Chart 6.3.2.1



6.3.2.2 Simulation of Zero-Autocorrelation

Using the approximately one thousand observations of the simulated ARES monthly returns that were used in previous simulations, and regressing them with a spreadsheet, coefficients $a_{1\sim 11}$ can be obtained for Equation (17). The majority of the eleven independent variables are statistically significant and R square is very high (0.999). In this regression analysis, a residual (ε_t) is obtained for each observation. The series of these residuals contains little autocorrelation and therefore can be regarded as indicating the relative magnitude of the "news" that arrives in each month.[50]

A summary of this multiple-regression analysis is included in **Appendix A.**

ε_t of Equation (17) can be expressed as follows:

$$\varepsilon_t = \mu + \omega (r_t) \qquad (18)$$

where μ is the mean return of the original index, and ω is a coefficient to restore the volatility of the returns of the original index. In this case, by construction of the simulated returns (which was designed to have a mean of zero), μ should be close to zero, and ω should be a figure close to one minus the sum of all the coefficients (a_k, k=1~11).

Equation (18) therefore can be transformed into the following:

$$r_t = (\varepsilon_t - \mu)/(1 - \sum_{k=1}^{11} a_k) \qquad (19)$$

Depending on how well the model restores the original index, μ and ω (= $1 - \Sigma a_k$) can be adjusted.[51]

As seen, in this case, the model restores the volatility and trend of the original randomly-generated returns quite well. However, it de-lags the simulated ARES index too much; the restored series leads the original by approximately five months. The reason seems to be that the hypothesis (Equation 17) fails to incorporate part of the uniqueness of the way in which the ARES index is temporally aggregated. This may be that, as discussed previously, the monthly return in a month of the ARES index is also affected by the returns up to five months in the future as well as past returns.

While this zero-autocorrelation method is known to have a de-lagging effect as well as an unsmoothing effect, in the case of the simulated ARES index the lag is relatively minor compared to the severe smoothing. For this reason, it seems reasonable to remove part of the de-lagging effect, or "de-delagging". The amount of "de-delagging" in this case is by five months.

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50 Geltner & Miller (2000)

51 μ and ω may be a priori figures depending on the mean return and volatility that the restored (unsmoothed/de-lagged) index is to have. In this case, the solver function of a spreadsheet was used to restore the precise mean and volatility. See Geltner & Miller (2000). However, if major adjustments to these figures are necessary, the hypothesis (in this case Equation 17) may need to be reconsidered. In this case, the figures obtained by Equation (19) works well with minor adjustments.

The following table shows the result of this zero-autocorrelation method with the readjustment of the restored index by five months.

Table 6.3.2.2-1 (Monthly Returns)

	"True" r_m	Simulated ARES r_m^{**}	Unsmoothed r_m
Mean r_m (monthly)	0.03%	0.03%	0.03%
Mean r_a (annual)	0.33%	0.41%	0.33%
σ_m (monthly)	2.65%	0.43%	2.65%
σ_a (annual)	9.19%	1.50%	9.19%
Correlation	"True" r_m	Simulated ARES r_m^{**}	Unsmoothed r_m
True r_m	1.00	0.32	**0.80**
Simulated ARES r_m^{**}		1.00	0.31
Unsmooth/De-lag r_m			1.00

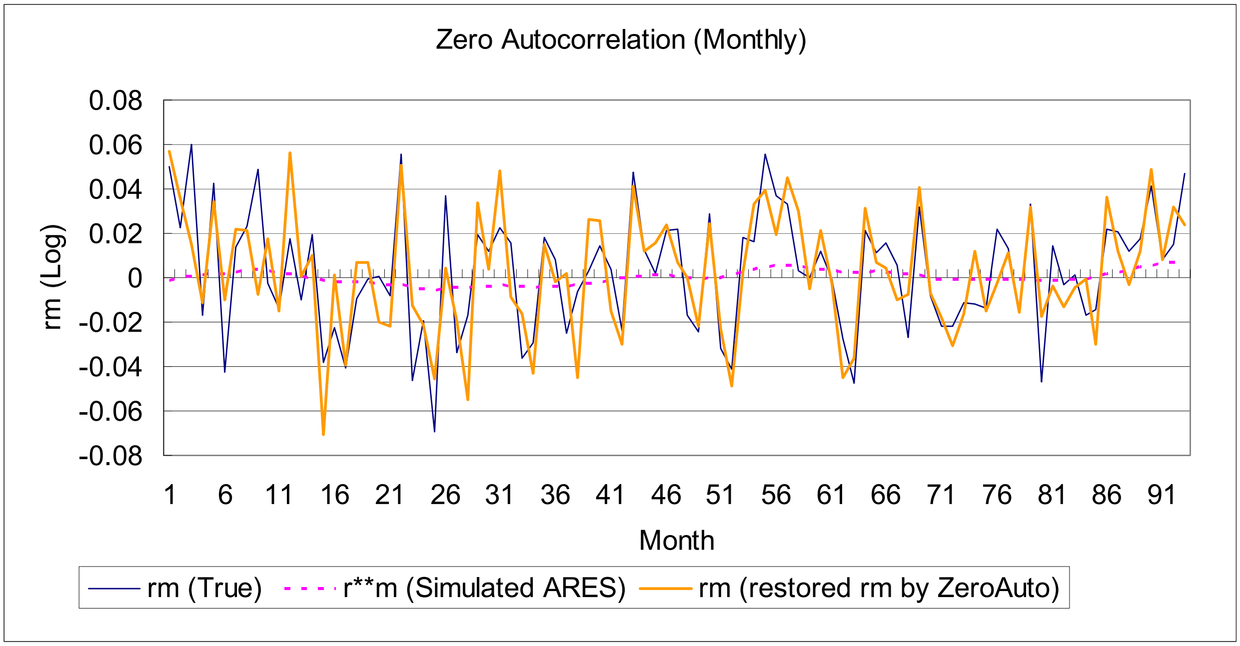
At first glance, the correlation between unsmooth/de-lagged returns and the "true" returns is 0.80, which is lower than the figure of 0.91 by the reverse engineering method. This is because apples and oranges are compared. The following is the correlation table for this method on a semiannual basis so a fair comparison can be made between this method and the previous reverse engineering method. Now, the figure is better, 0.97, which tells us this method works better than the reverse engineering method in the current case.

Table 6.3.2.2-2 (Semiannual Returns)

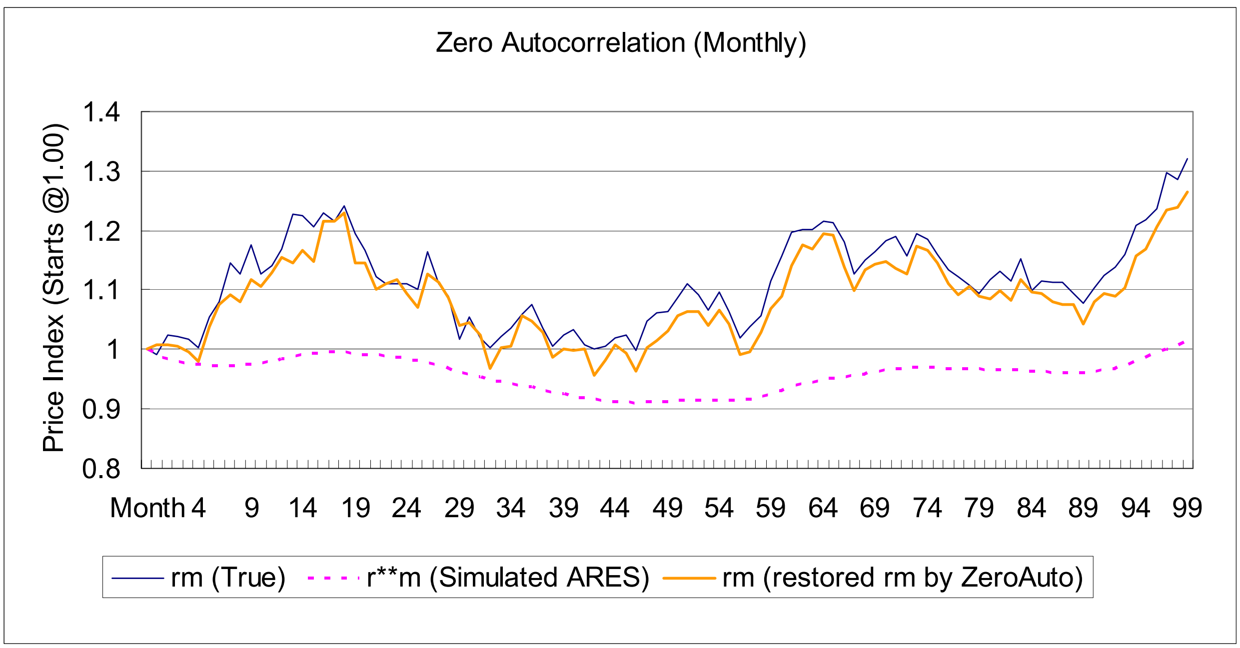
Correlation	"True" r_s	Simulated ARES r_s^{**}	Unsmoothed r_s
"True" r_s	1.00	0.58	**0.97**
Simulated ARES r_s^{**}		1.00	0.61
Unsmoothed r_s			1.00

By comparing the "true", simulated and restored returns, the following graphs visualize how the zero-autocorrelation method works in this case. Admittedly, the restoration is not perfect, but it recapitulates the trend of the "true" returns quite well.

Graph 6.3.2.2



Graph 6.3.2.3



6.3.2.3 Caveat about Zero-Autocorrelation

The above simulations on compiling the ARES index and restoring the index based on "true" returns is based on the weak-form market efficiency hypothesis, which is widely assumed in markets of liquid assets such as stocks and bonds. However, one could argue that private real estate returns do not follow a random walk and therefore should have some autocorrelation. The reason for such argument would be that private real estate markets are not as informationally efficient as stock markets. In actuality, somewhat strong autocorrelation is observed in the return series of RRPI, the transaction price-based index for residential real estate introduced in Section 5.3 and referred to in Section 6.2.3.5.

If this hypothesis that private real estate does not follow a random walk is correct, the zero-autocorrelation method needs to be qualified such that it does not remove autocorrelation completely.

However, a counterargument to this hypothesis is that, unlike residential real estate, commercial real estate still follows a random walk. The majority of residential condos within the RRPI database are probably traded between individuals as users instead of as investors. Therefore, unlike investment-grade commercial real estate, this type of residential real estate has the nature of consumption goods, upon which the imputed returns would be somewhat predictable. In support of this, Gau (1985) demonstrates the semi-strong-form market efficiency in Canadian investment real estate markets. Inoue, Ide and Nakagami (2003) find that returns on commercial real estate in Japan can't be predicted, at least within a short time frame, thus indicating the applicability of the efficient market hypothesis to commercial real estate in Japan.[52]

In short, using the zero-autocorrelation method has the danger of providing distorted returns containing excessive volatility as a replacement of the original "true" returns containing inertia if the efficient market hypothesis is not applicable to the subject real estate market. The applicability of the efficient market hypothesis to the commercial real estate remains to be seen.

[52] Inoue, Ide and Nakagami (2003) also find that returns on residential real estate in Japan can be predicted to a certain degree, unlike the returns on commercial real estate.

6.3.3. Blending Private Real Estate and REIT Indices

6.3.3.1 Rationale behind Blending Private Real Estate and REIT Indices

As seen in Section 5.2, there are roughly three types of real estate investment indices. In the order of nimbleness, or time necessary to respond, to news relevant to the "true" market value, the three are:

1. REIT indices;
2. Transaction price-based indices (such as RRPI); and
3. Appraisal-based indices (such as the ARES index).

REIT stocks have very high liquidity and therefore are more volatile than the underlying private real estate and lead it. REIT indices also lead the appraisal-base indices of the REITs' underlying private real estate[53]. Needless to say, appraisal-based indices lag behind the "true" market values of private real estate and are also smoother. Therefore, the "true" returns exist somewhere between REIT indices and appraisal-based indices, in terms of both volatility and lead/lag. The "true" returns would probably be closest to transaction price-based indices, which unfortunately are not available in this case. Therefore, it may be reasonable to blend a REIT index and an appraisal-based index, creating a proxy to an index representing the "true" private real estate returns.

6.3.3.2 Caveat about Blending Private Real Estate and REIT Indices

An argument against this method would be as follows: In a nutshell, this brings us to a very contradicting assumption on the same issue that we encountered in the zero-autocorrelation method. If the REIT index is regarded as representing returns following a random walk, this blending method is creating something in between a random-walking REIT index and an inert appraisal-based index. In other words, we would be assuming that commercial (private) real estate does not follow a random walk. This would mean that the randomly-generated returns which I used in the previous simulations represent not private real estate but REIT stocks, and would also mean that what I called the "simulated ARES index" turns out to be a hypothetical REIT stock index deformed in the way in which "true" private real estate returns are smoothed and lagged by appraisal and temporal aggregation.

However, a counterargument to the above would be that blending a REIT index and an appraisal-based index does not necessarily mean that the blended index does not follow a random walk. It would follow that, rather, this blending is to mitigate the "excess" volatility usually seen in stock markets and to reduce the lag. Thus, this counterargument assumes that both REIT stocks and the underlying (private) commercial real estate can follow a random walk with different volatilities. This counterargument depends on the following question: is it possible that two things follow a random walk and at the same time one lags behind the other? The answer to this question depends on the time frame within which the efficient market hypothesis is considered. Inoue, Ide and Nakagami (2003) find that the predictability of (private) commercial real estate returns increases as the time frame is extended, contrary to the lack of predictability in the short run. Based on this finding, the answer to the above question seems to be affirmative.

If the efficient market hypothesis works in the long run too, investors try to arbitrage between the REIT

[53] See Sawada (2006).

and private real estate markets. The US real estate markets have recently seen this phenomenon, as in the buyout of CarrAmerica Realty Corp. by Blackstone (a private-equity firm) in March 2006. It remains to be seen whether this type of inter-market arbitrage will emerge in Japan. If it will, the validity of this blending method needs to be reconsidered, because it means (private) commercial real estate will not follow REIT stocks.

With the above caveat noted, the following simulation blends a J-REIT index and the ARES index.

6.3.3.3 Simulation of Blending Private Real Estate and REIT Indices

Private Real Estate:	ARES J-REIT Property Index (Office), capital return
REIT:	STBRI Office J-REIT Index, capital return, unlevered for debt financing by J-REITs
Index Period:	January 2002 through September 2005
Periodic Return:	Monthly

To present the conclusion first, this simulation was aborted at its first stage due to the finding that the historical J-REIT returns so far probably have somewhat deviated from investors' long-term expectations. This is seen in the implied beta calculated from its ex post historical returns and the common perception about J-REIT among investors.

To begin with, this method would require STBRI Office J-REIT Index, which indicates returns levered with debt financing, to be unlevered because the counterpart, the ARES index, is unlevered. The returns of the STBRI Office J-REIT Index could be unlevered as follows:

The unlevered return is r_A (asset return):

$$r_A= (D/[D+E])\ r_D+(E/[D+E])r_E$$ [54]

Now, let's calculate the implied beta for J-REIT from the following information:

$$r_E = r_F + \beta_E RP_M$$
$$r_E = 14.6\% \text{ (historical average as of September 2005)}$$
$$r_F = 1.5\% \text{ (Japanese 10-year government bond in September 2005)}$$
$$RP_M = 3\sim7\% \text{ (empirical)}$$ [55]

Therefore, β_E= 1.87~4.37. This means β_A= 0.94~2.20 based on the following information.

$$\beta_A= (D/[D+E])\ \beta_D + (E/[D+E])\ \beta_E$$
$$D/(D+E) = E/(D+E) = 50\%$$ [56]
$$\beta_D = 0 \sim 0.3 \text{ (empirical)}$$

---

[54] Since most J-REITs are income-tax exempt, rA=WACC (weighted average cost of capital) in this case, since t=0 for WACC = (D/[D+E])(1-t)rD+(E/[D+E])rE.

[55] See Nakamoto et al. (2003) and Financial Modeling Association (2004).

[56] The value-weighted average debt-to-asset ratio is 52.8% for the twenty-six J-REITs which recently published B/S. This figure was rounded to 50%.

However, this contradicts the common perception that the beta for J-REIT is low.[57] This is probably due to the fact that β_E was derived from ex post r_E=14.6%, although an ex ante r_E should be used instead. J-REITs seem to have performed better than expected so far. J-REIT has a relatively short history and there is no empirical data about ex ante r_E.

Therefore, the unlevered return can not be calculated. Furthermore, during this period, no correlation or lag seems to exist between the capital returns of STBRI Office J-REIT Index and ARES index. Therefore, this method seems inadvisable in this case. Longer time-series data are necessary to examine the applicability of this method for Japanese public and private real estate markets.

[57] See Ohashi, Kamida and Mori (2003).

6.3.4 Conclusion about Unsmoothing/De-lagging the ARES Index

As discussed above, the zero-autocorrelation method seems the only viable method of the three methods to correct the actual ARES index at this point in time. However, the real challenge in correcting the actual ARES index by the zero-autocorrelation method is that, unlike in the simulation, the "true" return is not observable and there is no apparent target. It should also be noted that the quality of data, such as α, σ, ε p and ε a, is generally below par for this analysis and that some arbitrary judgments were involved in adjusting such variables for Japanese commercial real estate. It takes considerable time to accumulate such data. Ideally, all three methods should be used to reconcile them with each other. Time will help toward solving this problem.

7. International Portfolio Analysis

The characteristics of various real estate investment indices in Japan have been analyzed with special emphasis on the ARES index. Using one of these indices, this section tries to understand the relative positions of Japanese commercial real estate and other asset classes in an optimum international portfolio. A simplified US-to-Japan model is considered, where US investors have opportunities to invest in both the US and Japanese assets. The optimum portfolio under this international model will be compared to their previous domestic portfolios.

A significant part of this paper has been dedicated to analyzing the mechanism of the ARES index. This is because this index is unique in its construction and also is not affected by the Published Land Prices. Although the ARES index is subject to considerable smoothing under the simulation, accumulation of knowledge and further studies about this index will make it possible in the future to see the true picture of the returns of the underlying properties. However, in this portfolio analysis, the ARES index has to give way to another index due to its short time-series data. This is because a portfolio optimization analysis necessitates historical data covering a long period of time. For this reason, another Japanese appraisal-based index, STIX, which was introduced in Section 5.3 takes the place as the representative of Japanese private real estate.[58]

7.1 Unsmoothing/De-lagging STIX

Since STIX is an appraisal-based index, it needs to be unsmoothed/de-lagged for a portfolio analysis. Since its appraisals are annual and the periodic returns are also annual, unlike the ARES Index, STIX does not involve temporal aggregation of appraisals. This means that the only source of smoothing/lag is the appraisal behavior. Therefore, the reverse engineering method is considered the best method to use. As noted in Section 5.3, STIX has one model property to be appraised in each market it covers. Therefore, "the square root of N rule" or "the law of large number" discussed in Section 6.2.4 does not work for this index, and STIX probably has larger random dispersion from the MV than other appraisal-based indices that consist of numerous properties.

Since appraisals for STIX are annual, unlike for the ARES index, the appraisal updating factor α (Quan-Quigley Model) needs to be adjusted from ARES's 30%. The following is the same matrix that was used in Section 6.2.4.5 but adjusted for annual α.

58 The reason STIX is selected is that the author finds it is the only Japanese private real estate index that is for improved commercial properties and also is readily available to the general public.

Table 7.1

Sensitivity of α_a with varying σ_a and ε_p				**ε_p (from Canada's Data)**				
				-2 SE	-1 SE	Mean	1 SE	2 SE
				20.5%	14.2%	11.3%	9.4%	8.0%
Adjustment to σ_a	0%	σ_a	7.0%	10.4%	19.5%	27.9%	35.8%	43.3%
	+ 25%		8.8%	15.4%	27.4%	37.7%	**46.6%**	54.4%
	+ 50%		10.5%	29.1%	45.9%	57.6%	66.3%	72.8%
	+ 75%		12.3%	55.7%	72.2%	80.7%	85.7%	89.1%
	+ 100%		14.0%	83.4%	91.2%	94.3%	96.0%	97.0%

Based on the same reasoning as used in Section 6.2.4.5, the estimated α_a (annual) is 46.6%, which is rounded to 50% in applying it to the reverse engineering method.

The formula for the reverse engineering method can be derived by modifying Equation 16:

$$r_{a,t} = \{r_a^{**}{}_t - (1-\alpha_a)\, r_a^{**}{}_{t-12}\}/\alpha_a \qquad (20)$$

where $r_{a,t}$ is the "true" annual capital return for the year ending Month t. Returns with two asterisk are index-level returns. In the case of STIX, $r^{**}=r^{*}$ (returns based on individual or cohort-level appraisals) since there is no temporal aggregation of appraisals. By adding the income return of a year to the unsmoothed/de-lagged capital return in of the same year, the unsmoothed/de-lagged total return can be obtained. The above unsmoothing/de-lagging process is included in **Appendix B.**

7.2 Assumptions in the US-to-Japan Model[59]

- US investors initially own only domestic portfolios.
- Information is equally available to both Japanese and the US investors (no informational disadvantage).
- There is no direct cross-border cost (such as withholding taxes for repatriated capitals).
- Currency exchange risk can be hedged using forward contracts available in large and efficient foreign exchange markets.
- US investors are concerned about returns denominated in US Dollars.
- US investors assume that the long-term behavior of the return of an asset is very similar to its past behavior.
- The current risk-free asset for the US investors is the US treasury securities (5% in this case).
- The US assets are represented by:
  Stocks: S&P 500 Total Return
  Bonds: Dow Jones Corporate Bond Return Index
  Real Estate: MIT/CRE TBI (All Properties)[60]

[59] All the numerical data in this section were directly or indirectly obtained from Global Financial Data (http://www.globalfinancialdata.com), except for MIT/CRE TBI, which was from MIT Center for Real Estate, and STIX, which was from Sumitomo Trust Bank.

[60] Massachusetts Institute of Technology, Center for Real Estate, Transactions-Based Index of Institutional Commercial Property Investment Performance Index. For details, see http://web.mit.edu/CRE/research/credl/tbi.html.

MIT/CRE TBI is a transaction price-based index using hedonic regression. Therefore, unsmoothing is not necessary.

- The Japanese assets are represented by:
  Stocks: Nikkei TOPIX
  Bonds: Nikko Bond Index
  Real Estate: STIX (Unsmoothed)
  Correlations for the period of only 1977 through 2005 are analyzed.[61] Returns are annual periodic returns.[62]

7.3. Portfolio Simulations

In this section, the optimal portfolios for a US investor under the US-to-Japan model are analyzed under four scenarios. Excel spreadsheets are used. Multiple scenarios were prepared based on assumptions on exchange risks. The returns for each index used for this portfolio analysis are included in **Appendix C**. For ease of comparison, only the asset allocation under the market portfolio (MP) with a risk-free interest rate of 5% is shown for each scenario. [63]

[61] 1977 is the first year for which unsmoothed STIX is available.

[62] All the indices other than STIX have at least quarterly returns. STIX is annual. The subject periodic returns for this portfolio analysis are dictated by the asset with the longest return period.

[63] No matter what the risk/return preference is, there is a point on the portfolio frontier (called a tangent point) that every investor should logically select, which achieves the highest risk-to-return ratio. This is the market portfolio. Furthermore, by introducing a riskless asset, investors can have a combination of the market portfolio (risky assets) and a riskless asset. With this combination, an investor's portfolio can be located at any point on the Security Market Line (the straight-line passing through the two points representing the riskless asset and market portfolio) and can thus always achieve the same Sharpe Ratio as that of the market portfolio.

7.3.1 Scenario 1, No Currency Exchange Risk

First, the optimal portfolio allocation without assuming any foreign currency exchange risk is analyzed. This means the US investors are concerned about returns in Japanese Yen (JPY) for the Japanese assets.

The following is the mean total return, the total volatility for each index and the correlation table.

Table 7.3.1-1

$E(r_M) = 9.1\%$ $\sigma_a = 6.2\%$	S&P 500	DowJonesBond	MIT/CRE	TOPIX-JPY	Nikko-JPY	STIX JPY
Mean	13.49%	10.23%	7.71%	9.37%	6.26%	8.94%
Volatility	15.82%	10.18%	7.97%	24.23%	6.76%	25.70%
Sharpe Ratio @r_F=5%	0.54	0.51	0.34	0.18	0.19	0.15
Correlations :	S&P 500	DowJonesBond	MIT/CRE	TOPIX-JPY	Nikko-JPY	STIX JPY
S&P 500	1.00	0.28	-0.01	0.28	-0.07	0.14
DowJonesBond		1.00	-0.16	-0.05	0.29	0.44
MIT/CRE			1.00	0.06	-0.23	0.23
TOPIX-JPY				1.00	0.05	0.26
Nikko-JPY					1.00	0.08
STIX JPY						1.00

The following is the composition of the MP under this scenario.

Table 7.3.1-2

Asset Class	S&P 500	Dow Jones Corp Bond	MIT/CRE TBI	TOPIX-JPY	Nikko-JPY	STIX JPY
Ratio	17%	26%	36%	1%	19%	0%

As seen, there is no allocation to STIX. This is due to the combination of its low Sharpe Ratios and its not-especially-low correlations with other assets.

7.3.2 Scenario 2, Currency Exchange Risk (From US Dollar Perspective)

Secondly, the optimal portfolio allocation with foreign currency exchange risk is analyzed. Therefore, the US investors are concerned about all the returns in US Dollars (USD). The returns on the Japanese assets in USD can be calculated as follows:

$$r_{USD,t,J} = (1+r_{JPY,t,J})(JPY_{s,t-1}/JPY_{s,t}) - 1$$

where, $r_{USD,t,J}$ is the return on a Japanese asset in USD during Year t; $r_{JPY,t,J}$ is the return on a Japanese asset in JPY for Year t; $JPY_{s,t}$ is the spot exchange rate expressed as the amount of JPY per one USD as of the end of Year t. t-1 is one year before.

The following is the mean total return, the total volatility for each index and the correlation table.

Table 7.3.2-2

$E(r_M) = 9.8\%$ $\sigma_a = 5.5\%$	S&P 500	DowJonesBond	MIT/CRE	TOPIX-USD	Nikko-USD	STIX-USD
Mean	13.49%	10.23%	7.71%	14.44%	10.96%	14.24%
Volatility	15.82%	10.18%	7.97%	32.29%	18.79%	34.11%
Sharpe Ratio @r_F=5%	0.54	0.51	0.34	0.29	0.32	0.27
Correlations :	S&P 500	DowJonesBond	MIT/CRE	TOPIX-USD	Nikko-USD	STIX-USD
S&P 500	1.00	0.28	-0.01	0.24	-0.02	0.14
DowJonesBond		1.00	-0.16	-0.04	0.07	0.35
MIT/CRE			1.00	-0.05	-0.25	0.20
TOPIX-USD				1.00	0.58	0.49
Nikko-USD					1.00	0.50
STIX-USD						1.00

The following is the composition of the MP under this scenario.

Table 7.3.2-3

Asset Class	S&P 500	Dow Jones Corp Bond	MIT/CRE TBI	TOPIX-USD	Nikko-USD	STIX USD
Ratio	17%	28%	41%	0%	14%	0%

The Sharpe Ratio of STIX has improved from Scenario 1, but no allocation to STIX is suggested.

7.3.3 Scenario 3, Currency Exchange Risk Hedged with Forward Contract

Thirdly, the optimal portfolio allocation is considered with the assumption that the US investors can hedge the foreign currency exchange risk. This can be done by engaging in one-year forward contracts where the US investor sell JPY and buy USD of which the delivery is one year from the contract date.

This USD-JPY forward rate is based on the interest rate differentials between the US and Japan. Due to unavailability of certain data, 10-year treasury/national bond rates are used to calculate annual forward rates. These forward rates are used to calculate one-year periodic returns in investors' domestic currencies.[64]

The forward exchange rate is generally set as follows under the interest rate parity theory:[65]

$$JPY_{f,t-1,t} = JPY_{s,t-1} \times r_{JPY,t-1,rF} / r_{USD,t-1,rF}$$

where, $JPY_{f,t-1,t}$ is the 12-month forward JPY/USD rate that was available at the end of Year t-1 with the delivery date being the end of Year t (12-month forward); $JPY_{s,t-1}$ is the JPY/USD spot rate at the end of Year t-1; $r_{JPY,t-1,rF}$ is the risk-free rate in Japan as of the end of Year t-1; and $r_{USD,t-1,rF}$ is the risk-free rate in the US as of the end of Year t-1.[66]

In this case, the returns of the Japanese assets in USD are more predictable and can be calculated as follows:[67]

$$r_{USD,t,J} = (1+r_{JPY,t,J})(JPY_{s,t-1}/ JPY_{f,t-1,t}) - 1$$

where, $r_{USD,t,J}$ is the return on a Japanese asset in USD for Year t; $r_{JPY,t,J}$ is the return on a Japanese asset in JPY for Year t; $JPY_{s,t-1}$ is spot exchange rate expressed as the amount of JPY per one USD as of the end of Year t-1; and $JPY_{f,t-1,t}$ is the 12-month forward exchange rate available at the end of Year t-1 and expressed as the amount of JPY per one USD.

Since the interest rates have been much lower in Japan than in the US in the past decade, the US investors could have enjoyed the forward premium in JPY. As Hayashi (2005) reveals, Japan's low interest rate was one of the largest incentives for foreign investors investing in Japan.[68]

[64] The forward rate has always been a premium for JPY in recent years due to the lower interest rates in Japan. If invested in Japan using currency forward contracts, the return is enhanced for this forward-premium relative to the initial spot rate. Conversely, if Japanese investors invest in the US using same, the forward discount in USD erodes the returns.

[65] For the years for which the forward rates are available at globalfinancialdata.com, the forward rates are used (1998-2005). For the years such rates are not available, the implied forward rates are calculated this way.

[66] The 10-year risk-free rates of the US and Japan are used here. This is not desirable but used as proxy solely due to the unavailability of data on one-year interbank rates in the US and Japan.

[67] Of course, the returns on the Japanese assets, $r_{JPY,t,J}$, are ex ante and not guaranteed.

[68] Hayashi (2005) indicates that one of the other incentives for foreign investors was the low cost of debt financing available for private real estate in Japan.

The following is the mean total return, the total volatility for each index and the correlation table.

Table 7.3.3-1

$E(r_M) = 9.7\%$ $\sigma_a = 4.5\%$	S&P 500	DowJonesBond	MIT/CRE	TOPIX-USD Hedged	Nikko-USD Hedged	STIX-USD Hedged
Mean	13.49%	10.23%	7.71%	12.87%	9.53%	12.30%
Volatility	15.82%	10.18%	7.97%	25.58%	6.81%	26.67%
Sharpe Ratio @r_F=5%	0.54	0.51	0.34	0.31	0.67	0.27
Correlations :	S&P 500	DowJonesBond	MIT/CRE	TOPIX-USD Hedged	Nikko-USD Hedged	STIX USD Hedged
S&P 500	1.00	0.28	-0.01	0.27	-0.07	0.14
DowJonesBond		1.00	-0.16	-0.08	0.22	0.42
MIT/CRE			1.00	0.07	-0.17	0.23
TOPIX-USD Hedged				1.00	0.13	0.27
Nikko-USD Hedged					1.00	0.11
STIX-USD Hedged						1.00

The following is the composition of the MP under this scenario.

Table 7.3.3-2

Asset Class	S&P 500	Dow Jones Corp Bond	MIT/CRE TBI	TOPIX-USD Hedged	Nikko-USD Hedged	STIX USD Hedged
Ratio	13%	13%	28%	1%	45%	0%

The Sharpe Ratio of STIX has remained at the same level as in Scenario 2, and no allocation to STIX is suggested.

7.3.4 Scenario 4, Currency Exchange Risk only 50% Hedged with Forward Contract

Finally, the optimal portfolio allocation is seen with the assumption that the US Investors can hedge only 50% of the foreign currency exchange risk. In this case, the returns of the Japanese assets in USD are be calculated as follows:[69]

$$r_{USD,t,J} = (1+r_{JPY,t,J})\ \{1+[(JPY_{s,t-1} / JPY_{f,t-1,t})-1]/2\}\ -1$$

The following is the mean total return, the total volatility for each index and the correlation table.

Table 7.3.4-1

$E(r_M) = 9.9\%$ $\sigma_a = 5.5\%$	S&P 500	DowJonesBond	MIT/CRE	TOPIX-USD 50% Hedged	Nikko-USD 50% Hedged	STIX-USD 50% Hedged
Mean	13.49%	10.23%	7.71%	15.52%	11.66%	10.62%
Volatility	15.82%	10.18%	7.97%	33.12%	17.09%	26.17%
Sharpe Ratio @r_F=5%	0.54	0.51	0.34	0.32	0.39	0.21
Correlations :	S&P 500	DowJonesBond	MIT/CRE	TOPIX-USD 50% Hedged	Nikko-USD 50% Hedged	STIX-USD 50% Hedged
S&P 500	1.00	0.28	-0.01	0.27	0.06	0.14
DowJonesBond		1.00	-0.16	-0.04	0.09	0.43
MIT/CRE			1.00	-0.05	-0.24	0.23
TOPIX-USD 50%				1.00	0.62	0.22
Nikko-USD 50%					1.00	0.06
STIX-USD 50%						1.00

The following is the composition of the MP under this scenario.

Table 7.3.4-2

Asset Class	S&P 500	Dow Jones Corp Bond	MIT/CRE TBI	TOPIX-USD 50% Hedged	Nikko-USD 50% Hedged	STIX USD 50% Hedged
Ratio	15%	27%	41%	0%	16%	0%

No allocation to STIX is suggested.

[69] Of course, the returns on the Japanese assets are ex ante and not guaranteed.

7.3.5 Result of the Portfolio Analysis

The following chart summarizes the results of the analyses.

Table 7.3.5-1
Composition of US-Japan Market Portfolio (Data: 1977-2005)

Asset Class	S&P 500	Dow Jones Corp Bond	MIT/CRE TBI	TOPIX	Nikko	STIX Unsmthd
No Exchange Risk	17%	26%	36%	1%	19%	0%
Full-Exposure Exchange Risk	17%	28%	41%	0%	14%	0%
Exchange Risk Hedged	13%	13%	28%	1%	45%	0%
Exchange Risk 50% Hedged	15%	27%	41%	0%	16%	0%

Surprisingly, there is no asset allocation suggested at all for Japanese real estate (STIX). The simulation also indicates very little allocation to Japanese stocks (TOPIX). This result contradicts the aggressive acquisition of Japanese real estate and stocks by the US investors in recent years.

It should also be noted that the US real estate represented by MIT/CRE TBI comprises a significant part of the market portfolio under all scenarios.

The reason seems to be STIX's relatively high correlations with other asset classes and its low Sharpe Ratio. The low Sharpe Ratio may be because unsmoothed STIX contains more volatility than its underlying properties actually have had. The possibility is that the reverse engineering method excessively unsmoothed the original STIX

Perhaps, the US investors may not use the traditional MPT based on the belief that Japanese real estate markets have gone through a structural change. It is true that many market participants believe that what happened in Japanese real estate markets in the "bubble" economy won't occur in the future based on the ground that investors today check prices with the income approach, which they believe to prevent them from buying properties at absurd prices seen during the "bubble" economy. If any kind of significant structural change has occurred, the traditional MPT, which is based on historical data, will not work well, because in such case the future cannot be extrapolated from the past.

To see a example of how the result varies if the period included in the analysis is changed, the following table shows the composition of the market portfolio under this simplified model if the most recent ten years only is included in the portfolio analysis.

Table 7.3.5-2
Composition of US-Japan Market Portfolio (Data: 1996-2005)

Asset Class	S&P 500	Dow Jones Corp Bond	MIT/CRE TBI	TOPIX	Nikko	STIX Unsmthd
No Exchange Risk	17%	26%	36%	1%	19%	0%
Full-Exposure Exchange Risk	1%	64%	28%	7%	0%	0%
Exchange Risk Hedged	0%	51%	0%	7%	16%	26%
Exchange Risk 50% Hedged	0%	39%	1%	5%	0%	54%

This time, significant amount of allocation to Japanese real estate is suggested under the scenarios where exchange risk is hedged.

In short, the result of this portfolio analysis largely relies on what data are included in it and what assumptions are made as to the currency exchange risk. It also depends on how the investors perceive the structural change in Japanese real estate markets.

8. Conclusion

Real estate has become a major asset class and cross-border real estate investment has been surging. While significant amount of capitals has flowed into Japanese real estate markets in recent years, the markets are not as transparent as those of other developed nations. The primary reason is the lack of reliable investment indices for commercial real estate in Japan.

Despite its short track record, the ARES J-REIT Property Index has the potential to become the nation's standard appraisal-based index due to the fact that it does not rely on the controversial Published Land Prices and that the underlying properties are primarily appraised with the income approach.

The ARES index nevertheless is not free of problems; it suffers from both appraisal smoothing/lagging and temporal aggregation smoothing. The uniqueness of this index is that it can be said to be a series of central moving averages of multiple-cohorts returns. This is closely tied to the timing of the valuations, or staggered appraisals by J-REITs. The strong effect of the smoothing by the temporal aggregation was visualized in this paper.

There are traditional ways to unsmooth/de-lag appraisal-based indices that can be applied to the ARES index. It can be said with caveats that the zero-autocorrelation method seems to work quite well for the simulated ARES index. The reverse engineering method has limited reliability. It was also realized that more quality data are necessary as to the appraisers' behavior and mean/volatility of Japanese commercial real estate.

In the portfolio analysis, STIX took the place of the ARES index due to its limited historical data. The result of the portfolio analysis varies significantly depending on the period included in the analysis. For example, if the period of the so-called "bubble" economy during the 1980's is included in the analysis, little allocations is suggested to Japanese real estate and stocks. If the recent ten years only is included, the situation is totally different. The result depends largely on investors' assumptions and perceptions about the structural change that Japanese real estate markets have gone through. If investors believe that the history does not apply to the future in Japanese real estate markets due to the structural change, the traditional backward-looking mean-variance portfolio analysis does not function well. It may be time to consider a new framework for portfolio analyses.

This does not mean that knowing the "true" behavior of private real estate is not important. It is. Investors do need to figure out a new, forward-looking portfolio model, and the development in the analysis of private real estate behavior will certainly help accomplish this purpose.

Appendices

Appendix A
Section 6.3.2.2
Summary of the Result of the Regression Analysis

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.998509626
R Square	**0.997021473**
Adjusted R Squa	0.996987765
Standard Error	0.000191753
Observations	984

ANOVA

	df	SS	MS	F	ignificance F
Regression	11	0.0119634	0.00108758	29578.5252	0
Residual	972	3.574E-05	3.67692E-08		
Total	983	0.0119991			

Month		Coefficients	tandard Errc	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Jpper 95.0%
	Intercept	4.76802E-06	6.165E-06	0.773377643	0.43948695	-7.33E-06	1.68666E-05	-7.331E-06	1.687E-05
t-11	X Variable 1	0.091511638	0.0319071	2.868065971	0.00421921	0.0288969	0.154126354	0.02889692	0.1541264
t-10	X Variable 2	-0.128737519	0.0692996	-1.857695311	0.06351452	-0.264732	0.00725652	-0.2647316	0.0072565
t-9	X Variable 3	0.11945065	0.07568	1.578365049	0.11480713	-0.029064	0.267965637	-0.0290643	0.2679656
t-8	X Variable 4	-0.620342172	0.0729537	-8.503228668	6.8826E-17	-0.763507	-0.477177234	-0.7635071	-0.477177
t-7	X Variable 5	1.054258252	0.0645929	16.32157391	4.1352E-53	0.9275006	1.181015906	0.9275006	1.1810159
t-6	X Variable 6	-0.500986335	0.0625608	-8.007985506	3.3158E-15	-0.623756	-0.378216457	-0.6237562	-0.378216
t-5	X Variable 7	-0.011005419	0.0644724	-0.170699747	0.86449539	-0.137527	0.115515671	-0.1375265	0.1155157
t-4	X Variable 8	0.001239132	0.0726865	0.01704763	0.98640212	-0.141401	0.14387965	-0.1414014	0.1438797
t-3	X Variable 9	0.014527046	0.075405	0.19265366	0.84727046	-0.133448	0.162502359	-0.1334483	0.1625024
t-2	X Variable 10	-0.944597598	0.0691807	-13.65406781	5.8453E-39	-1.080358	-0.808836918	-1.0803583	-0.808837

Appendix B

Section 7.1
Unsmoothing STIX

STIX
Income and Capital Returns
(average of 8 Tokyo Metropolitan areas)

$$r_{a,t} = \{r_a{}^{**}{}_t - (1-\alpha_a)\, r_a{}^{**}{}_{t-12}\}/\alpha_a$$

$\alpha_a =$ 50%

Year	Income Return	Capital Return	Total Return	Unsmthd Capit	**Unsmoothed Total**
1976	7.47%	-3.94%	3.53%		
1977	8.01%	0.38%	8.39%	4.70%	**12.71%**
1978	8.46%	3.79%	12.24%	7.19%	**15.65%**
1979	7.74%	5.03%	12.77%	6.28%	**14.02%**
1980	7.26%	4.36%	11.61%	3.68%	**10.94%**
1981	6.74%	11.49%	18.23%	18.62%	**25.36%**
1982	6.93%	20.08%	27.02%	28.68%	**35.61%**
1983	6.06%	15.43%	21.49%	10.78%	**16.84%**
1984	5.72%	34.70%	40.42%	53.97%	**59.69%**
1985	4.08%	64.85%	68.93%	95.00%	**99.08%**
1986	2.29%	44.28%	46.58%	23.71%	**26.00%**
1987	1.55%	12.08%	13.63%	-20.11%	**-18.57%**
1988	1.66%	1.06%	2.72%	-9.96%	**-8.30%**
1989	1.90%	4.79%	6.69%	8.52%	**10.42%**
1990	2.23%	0.68%	2.92%	-3.42%	**-1.19%**
1991	2.72%	-6.34%	-3.62%	-13.36%	**-10.64%**
1992	2.82%	-18.94%	-16.13%	-31.54%	**-28.73%**
1993	2.91%	-26.38%	-23.47%	-33.82%	**-30.91%**
1994	3.60%	-21.81%	-18.22%	-17.25%	**-13.65%**
1995	3.92%	-19.24%	-15.32%	-16.67%	**-12.75%**
1996	4.48%	-7.59%	-3.11%	4.06%	**8.54%**
1997	4.97%	-1.42%	3.55%	4.75%	**9.72%**
1998	6.25%	-3.70%	2.55%	-5.97%	**0.27%**
1999	5.94%	-3.17%	2.77%	-2.64%	**3.30%**
2000	5.96%	-2.19%	3.77%	-1.21%	**4.75%**
2001	6.10%	-1.73%	4.37%	-1.28%	**4.82%**
2002	5.53%	-1.11%	4.42%	-0.49%	**5.05%**
2003	5.35%	-0.53%	4.82%	0.04%	**5.39%**
2004	5.77%	0.33%	6.10%	1.20%	**6.97%**
Mean	**4.98%**	**3.63%**	**8.61%**	**4.05%**	**8.94%**
STDEV	**2.07%**	**18.94%**	**19.13%**	**25.11%**	**25.70%**

Appendix C
Section 7.3
Portfolio Data
(1/2)

Year	S&P 500	DowJonesBond	MIT/CRE	TOPIX-JPY	Nikko-JPY	STIXUnsm-JPY	TOPIX-USD	Nlikko-USD	STIXUnsm-USD
1977	-7.16%	5.87%		-5.01%	28.15%	12.71%	**16.01%**	**56.53%**	**37.66%**
1978	6.57%	1.33%		24.27%	7.59%	15.65%	**53.49%**	**32.88%**	**42.83%**
1979	18.61%	-3.94%		8.59%	-9.92%	14.02%	**-12.20%**	**-27.18%**	**-7.80%**
1980	32.50%	-2.32%		10.70%	6.13%	10.94%	**30.97%**	**25.59%**	**31.25%**
1981	-4.92%	2.86%		25.15%	12.78%	25.36%	**15.64%**	**4.21%**	**15.84%**
1982	21.55%	41.97%		6.28%	9.72%	35.61%	**-0.47%**	**2.75%**	**27.00%**
1983	22.56%	10.89%		23.14%	9.80%	16.84%	**24.74%**	**11.22%**	**18.35%**
1984	6.27%	18.93%	1.67%	27.05%	9.60%	59.69%	**17.00%**	**0.93%**	**47.05%**
1985	31.73%	29.37%	11.05%	14.62%	8.66%	99.08%	**44.01%**	**36.52%**	**150.14%**
1986	18.67%	22.84%	8.16%	58.98%	10.42%	26.00%	**102.16%**	**40.42%**	**60.23%**
1987	5.25%	2.59%	-2.03%	8.77%	6.40%	-18.57%	**41.55%**	**38.46%**	**5.97%**
1988	16.61%	12.77%	1.55%	39.66%	5.89%	-8.30%	**35.28%**	**2.57%**	**-11.18%**
1989	31.69%	15.53%	-1.86%	22.30%	-0.88%	10.42%	**6.21%**	**-13.91%**	**-4.10%**
1990	-3.10%	8.57%	6.60%	-39.44%	2.48%	-1.19%	**-35.66%**	**8.87%**	**4.97%**
1991	30.46%	17.94%	1.28%	-0.39%	12.14%	-10.64%	**8.07%**	**21.66%**	**-3.05%**
1992	7.62%	13.97%	-5.77%	-23.02%	10.18%	-28.73%	**-23.02%**	**10.18%**	**-28.73%**
1993	10.08%	7.86%	10.81%	10.97%	12.86%	-30.91%	**23.88%**	**25.98%**	**-22.87%**
1994	1.32%	-3.95%	5.89%	9.11%	-1.51%	-13.65%	**22.36%**	**10.44%**	**-3.17%**
1995	37.58%	21.14%	9.54%	2.09%	12.13%	-12.75%	**-1.52%**	**8.17%**	**-15.83%**
1996	22.96%	5.85%	12.35%	-6.06%	4.90%	8.54%	**-16.24%**	**-6.46%**	**-3.21%**
1997	33.36%	10.26%	20.65%	-19.41%	5.49%	9.72%	**-28.49%**	**-6.39%**	**-2.63%**
1998	28.58%	10.26%	8.82%	-6.57%	0.45%	0.27%	**7.80%**	**15.90%**	**15.69%**
1999	21.04%	-2.85%	3.18%	59.69%	8.07%	3.30%	**76.86%**	**19.70%**	**14.41%**
2000	-9.10%	9.41%	7.81%	-24.96%	2.04%	4.75%	**-32.88%**	**-8.73%**	**-6.30%**
2001	-11.89%	10.73%	4.87%	-18.91%	3.36%	4.82%	**-29.60%**	**-10.27%**	**-9.00%**
2002	-22.10%	11.14%	13.17%	-17.50%	3.36%	5.05%	**-8.54%**	**14.58%**	**16.45%**
2003	28.68%	10.02%	7.81%	25.19%	-0.85%	5.39%	**38.87%**	**9.71%**	**16.62%**
2004	10.88%	6.25%	12.93%	11.34%	1.18%	6.97%	**15.60%**	**5.98%**	**12.05%**
2005	4.91%	1.40%	31.09%	45.23%	0.78%		**26.97%**	**-12.44%**	
	S&P 500	DowJonesBond	MIT/CRE	TOPIX-JPY	Nikko-JPY	STIXUnsm-JPY	TOPIX-USD	Nlikko-USD	STIXUnsm-USD
Mean	13.49%	10.23%	7.71%	9.37%	6.26%	8.94%	14.44%	10.96%	14.24%
Volatility	15.82%	10.18%	7.97%	24.23%	6.76%	25.70%	32.29%	18.79%	34.11%
Sharpe Ratio	0.54	0.51	0.34	0.18	0.19	0.15	0.29	0.32	0.27
r_F	5.00%								

Appendix C
Section 7.3
Portfolio Data
(2/2)

Year	TOPIX-Hedged	NIKKO-Hedged	STIXUnsm-Hedged	TOPIX-50%Hedge	NIKKO-50%Hedged	TIXUnsm-50%Hedg	JPY/USD Spot	PY Forward Premiur	JPY/USD Spot
1977	-4.03%	29.47%	13.87%	-4.52%	28.81%	13.29%	-18.12%	1.03%	¥239.98
1978	27.75%	10.60%	18.88%	55.64%	34.74%	17.27%	-19.03%	2.80%	¥194.30
1979	11.66%	-7.37%	17.24%	-10.96%	-26.15%	15.63%	23.67%	2.83%	¥240.30
1980	14.33%	9.61%	14.57%	33.12%	27.65%	12.75%	-15.48%	3.28%	¥203.10
1981	31.93%	18.89%	32.16%	18.77%	7.03%	28.76%	8.22%	5.42%	¥219.80
1982	8.78%	12.30%	38.80%	0.71%	3.96%	37.21%	6.78%	2.36%	¥234.70
1983	28.22%	14.33%	21.66%	27.31%	13.52%	19.25%	-1.28%	4.13%	¥231.70
1984	32.83%	14.58%	66.94%	19.66%	3.23%	63.31%	8.59%	4.55%	¥251.60
1985	17.71%	11.59%	104.45%	45.95%	38.36%	101.77%	-20.41%	2.69%	¥200.25
1986	61.80%	12.38%	28.24%	103.96%	41.66%	27.12%	-21.36%	1.77%	¥157.47
1987	12.83%	10.38%	-15.52%	44.19%	41.04%	-17.04%	-23.15%	3.74%	¥121.01
1988	45.61%	10.40%	-4.40%	38.16%	4.76%	-6.35%	3.24%	4.26%	¥124.93
1989	24.90%	1.23%	12.77%	7.34%	-12.99%	11.60%	15.14%	2.13%	¥143.85
1990	-38.73%	3.69%	-0.03%	-35.28%	9.51%	-0.61%	-5.87%	1.18%	¥135.40
1991	0.53%	13.18%	-9.81%	8.57%	22.22%	-10.22%	-7.83%	0.93%	¥124.80
1992	-21.67%	12.11%	-27.48%	-22.35%	11.15%	-28.10%	0.00%	1.75%	¥124.80
1993	13.80%	15.74%	-29.15%	25.46%	27.58%	-30.03%	-10.42%	2.55%	¥111.80
1994	12.48%	1.53%	-10.98%	24.25%	12.15%	-12.32%	-10.82%	3.09%	¥99.70
1995	4.46%	14.74%	-10.72%	-0.37%	9.43%	-11.73%	3.66%	2.33%	¥103.35
1996	-2.73%	8.61%	12.38%	-14.75%	-4.81%	10.46%	12.14%	3.54%	¥115.90
1997	-16.37%	9.48%	13.87%	-27.14%	-4.63%	11.80%	12.69%	3.78%	¥130.61
1998	-1.33%	6.08%	5.89%	10.82%	19.15%	3.08%	-13.33%	5.61%	¥113.20
1999	69.21%	14.51%	9.46%	82.13%	23.26%	6.38%	-9.71%	5.96%	¥102.21
2000	-20.74%	7.78%	10.65%	-30.99%	-6.16%	7.70%	11.80%	5.63%	¥114.27
2001	-16.97%	5.83%	7.33%	-28.76%	-9.20%	6.07%	15.19%	2.39%	¥131.63
2002	-16.36%	4.79%	6.50%	-7.91%	15.38%	5.77%	-9.79%	1.38%	¥118.74
2003	26.92%	0.52%	6.85%	39.82%	10.47%	6.12%	-9.63%	1.38%	¥107.31
2004	14.35%	3.92%	9.87%	17.17%	7.41%	8.42%	-4.53%	2.71%	¥102.45
2005	52.06%	5.52%		29.96%	-10.38%		15.10%	4.71%	¥117.92

	TOPIX-Hedged	NIKKO-Hedged	STIXUnsm-Hedged	TOPIX-50%Hedged	NIKKO-50%Hedged	STIXUnsm-50%Hedg	JPY/USD Spot	JPY Forward Premium	JPY/USD Spot
Mean	12.87%	9.53%	12.30%	15.52%	11.66%	10.62%	-2.23%		
Volatility	25.58%	6.81%	26.67%	33.12%	17.09%	26.17%	13.24%		
Sharpe Ratio	0.31	0.67	0.27	0.32	0.39	0.21	-0.55		

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