Designing Property Futures Contracts and Options Based on NCREIF Property Indices

Executive Summary. *Due to the heterogeneous nature of real estate assets, as well as the difficulty in selecting a reliable and representative underlying index, real estate markets are the last of the major asset classes not to have a liquid futures market. The design presented here for property futures contracts is based on a selection of NCREIF Property Indices (NPIs). Seventy-five potential underlying indexes / sub indexes in the NCREIF database are examined. The findings indicate that provided an innovative combination of contract specifications is selected, establishing NPI-based property futures and options is conceptually feasible. They would represent a notable improvement to the current situation where risk management tools are notoriously scarce for real estate investors.*

by Patrick Lecomte*
Will McIntosh**

*University of Cincinnati, Cincinnati, OH 45221-0020 or lecomtpp@email.uc.edu.

**University of Cincinnati, Cincinnati, OH 45221-0020 or mcintow@ucmail.uc.edu.

Futures contracts are among the oldest existing derivatives instruments. They have been actively traded for centuries with the first recorded case of organized futures trading being certified in Japan in the 1600s. Their development in the western capitalist economies was fostered by the introduction of the financial futures market in 1972 on the Chicago Mercantile Exchange.

Today, futures markets cover a wide array of risks including energy, credit, and weather. However, one major asset class is conspicuously missing from this list: real estate. Indeed, property markets are the last of the major asset classes not to have a liquid futures market.

Despite intense interest from the academic community for futures and options cash-settled on real estate prices (e.g., Case, Shiller, and Weiss, 1993) and the recent advent of over-the-counter swaps (Fisher, 2005), participants in real estate markets still have no efficient and cost-effective way to hedge their exposure to risks. Organized exchanges, wary of real estate's idiosyncrasies and possibly unnerved by the failure of past attempts to launch property futures (e.g., Fox Property Futures in the United Kingdom in the early 1990s), have seemingly given up on establishing property futures and options markets.

The overriding argument against the establishment of standardized derivatives on non-securitized real estate is the lack of reliable indices [i.e., indices that provide a real-time and representative pricing of underlying assets, which are inherently all different (e.g., Gordon and Havsy, 1999)]. As a matter of fact, how could an index with less than continuous observations be used as a measure of the change in real estate prices for a continuously traded derivative? How might standardized futures contracts on private commercial real estate be structured to best meet investors' hedging needs?

This paper answers these questions by examining real estate index-based futures and options in light of existing contracts on financial and non-financial assets. To do so, it contains six main sections organized as follows. In the first section, it analyzes fundamental conditions determining the success of a futures contract. In the second section, it reviews the concepts underlying the design of property futures contracts based on NCREIF Property Indices (NPIs). In the third section, it explains the choice of underlying index and develops methodologies for selecting the most appropriate sub-indices. In the fourth section, it describes other contract specifications including lagged settlement procedures, and an innovative template for a property futures market. In the fifth section, it introduces a series of property options, as well as Greek letters for property options traders. In the sixth section, it presents examples illustrating potential uses of property futures and options before concluding that a first step towards establishing property futures and options tied to private commercial real estate is conceptually feasible. Legal and regulatory issues potentially affecting derivatives are beyond the scope of this paper.

Conditions Determining the Success of a Futures Contract

Before getting into the nuts and bolts of designing property futures contracts based on NCREIF Property Indices, it is essential to understand why some contracts are successful whereas others fail. Conclusions identified by researchers who have worked on this topic provide useful clues for a successful design of property futures contracts.

Conditions that determine the success of a futures contract have been extensively analyzed. There are some important prerequisite conditions such as volume and liquidity that have to be met so that trading in the contract is profitable for exchanges (Duffie and Rahi, 1995; and Holder, Tomas, and Webb, 1999). In a nutshell, a successful contract is one that maintains a consistently high volume of trade and open interest (Black, 1986; and Holland and Vila, 1997). A successful contract is also one that is supported, at least in its nascent stage, by the futures exchange listing it (Case, Shiller, and Weiss, 1993). Innovative contracts often have a slow start and a substantial financial commitment is generally needed.

Factors Determining a Futures Contract's Success

Analyzing the FOX Property futures contracts, Patel (1994) lists four main factors that determine a futures contract's success: (1) the appeal and relevance of the futures markets to potential users; (2) the compatibility of the contract with the underlying cash market; (3) the liquidity and volatility in the cash and futures markets; and (4) price discovery in a centrally organized market with an open trading system. References to these factors are widespread in the academic literature. It appears that there is a large consensus as to which core conditions are conducive to the success of a futures contract.

Holland and Vila (1997) provide a good summary of this consensus. Their analysis is focused on the factors influencing turnover in a contract, which are twofold. First, the concept of "hedging effectiveness." Second, the characteristics of the spot market, the state of the competition, and the existence of options.

Hedging Effectiveness. Hedging effectiveness refers to the basic notion of risk transfer underlying all futures markets.[1] Research shows that failed contracts are less effective than successful contracts as hedging instruments (Johnston and McConnell, 1989). The contract has to be designed in a manner that provides maximum correlation with the risk to be hedged (Ederington, 1979; and Figlewski, 1985).

High basis risk translates into ineffective hedging. In the case of index-based derivatives, a hedge basically involves two types of basis risk. The first type, cross-hedge basis risk, results from a less than perfect correlation between the price of a property (or portfolio of properties) and the index. The second type, time-basis risk, is introduced if there is a discrepancy between the hedge termination date and the index contract delivery date.

Figlewski (1984) notes that for equities, cross-hedge basis risk is an issue whenever a hedge involves index-linked futures. When dealing with a heterogeneous asset class such as private direct real estate, it can become a major obstacle to hedging effectiveness.

Spot Market Characteristics. Holland and Vila (1997) find that a futures contract benefits from the existence of a large spot market. They note that a contract's success is highly correlated with the size of the underlying spot market and to a lesser extent with its volatility. Counter-intuitively, a volatile spot market is not a pre-requisite for the continuing success of a futures contract.

Additionally, Holland and Vila (1997) point out that liquidity is a feature of successful contracts but that it is not necessarily sufficient in itself to generate volumes that will guarantee success. As noted by Silber (1981) who reviews historical innovations on futures markets, a successful contract will always make it possible to cut the costs of contracting risk out. A futures contract's success is highly sensitive to minor changes in contract specifications and most of these apparently trivial components of contract design focus on transaction costs.

Likewise there is a first mover advantage insofar as the exchange that is first to list a contract significantly increases the contract's probability of success. According to Duffie and Rahi (1995), this may be due to the pre-emptive value of liquidity that regulators try to protect by withholding approval for copycat contracts. Finally, Holland and Vila (1997) explain that existence of an option on the futures contracts does not materially affect the futures volumes, i.e., its success in the long run.

Hedgers versus Speculators

Addressing the attractiveness of a new futures contract from the viewpoint of the various participants in a futures exchange market, Black (1986) explains that two groups of stakeholders have to be interested for a contract to be successful: hedgers and speculators. Hedgers on the one hand, are those people for whom contract specifications are essential as they will define the effectiveness of the hedge. Hedgers have to be attracted with contract specifications that are compatible with commercial practices.[2] Speculators, on the other hand, play a crucial role in ensuring a contract's success, by providing the liquidity that enables hedgers to effectively transfer their risks at low cost.

Significant hedging interest will attract speculators to the market and both groups will ensure the long-term viability of a new contract. An exchange would indeed rarely find it attractive to introduce a contract aimed at speculators only insofar as speculators depend for trading opportunities on the existence of hedgers (Duffie and Rahi, 1995). Thus, futures exchanges are faced with a 'marketing problem': they have to translate economic prerequisites into contract specifications designed to appeal to both hedgers and speculators (Silber, 1981).

The Need for Transparency

No matter how appealing the contract specifications, hedgers and speculators will not use a market if there is a danger of manipulation. Actual or even suspected manipulation will entail the demise of any futures contract (Black, 1986).

FOX Property Futures' failure is quite revealing in that respect. Patel (1994) mentions that when the new market failed to generate sufficient trading volume, "false market prices were apparently being maintained," which totally flawed the price discovery mechanism paramount to any futures market.

The concept of transparency pertains as much to the way the market is run as to the necessary procedures guaranteeing the reliability and trustworthiness of the underlying indices.

Designing Property Futures Based on NCREIF Property Indices

Key Concepts

Designing property futures can be a daunting task if one does not keep in mind some simple facts. The line of thinking underpinning the methodology presented in this paper can be summarized into four basic ideas:

1. Futures are primarily about managing risks. No matter how idiosyncratic the underlying asset (and private, direct real estate investing is very heterogeneous), one should always go back to the basic question: What is the nature of the risks to be hedged? Hedging effectiveness is the absolute priority.
2. Real estate will never be comparable to financial assets (e.g., the NPI is very different from the S&P 500). Therefore, property derivatives should not be modeled after equity-index derivatives.
3. By definition, index-based futures can only address systematic risk. However, as repeatedly mentioned in the academic literature (e.g., Miles and McCue, 1984; and Hartzell, Hekman, and Miles, 1986) real estate risk is overwhelmingly idiosyncratic. Thus, in order to offer effective hedging, NPI-based futures will have to modify the structure of real estate risk, by increasing the scope of systematic risk in the total risk components of the hedged properties. The amount of total risk will become larger as the contracts' characteristics get closer to those of the hedged properties.
4. Any futures contract based on NPIs will necessarily be a compromise and will require a trade-off between hedging effectiveness and the constraints of a standardized derivatives market. This is hardly satisfactory for scientific minds but a 'second best' solution would already represent an important, practical improvement in risk management needed by portfolio managers.

Lessons from Weather Derivatives

In many respects, weather derivatives traded on the Chicago Mercantile Exchange (CME) provide an interesting example of how futures contracts can be designed to hedge localized risks. Overall, the CME is currently offering 58 weather futures contracts: 36 for US cities, 18 for European cities, and 4 for Japanese cities. Monthly contracts are traded in parallel to seasonal contracts (7-month period): 18 monthly contracts and 18 seasonal contracts for US cities, 9 monthly contracts and 9 seasonal contracts for European cities, 2 monthly contracts and 2 seasonal contracts for Japanese cities. European Style Options on futures are proposed for all contracts. Futures are based on a set of scientifically established and certified underlying indices.

What can be learned from weather derivatives?

- A large number of open contracts is not an obstacle to success provided they meet a specific need for hedging vehicles. For instance, in the case of weather derivatives, 'underlying cities' were carefully selected based upon population, the variability in their seasonal temperatures, and the activity seen in OTC derivatives.
- Contract months and settlement procedures have to be adapted to the risks to be hedged.
- If convinced, futures exchanges are willing to put their resources and expertise at work to ensure the success of the most specific contracts.
- Procedures standardizing the release and establishment of the underlying indices have to be put in place between the index provider and the futures exchange listing the contracts.

The Choice of Underlying Indices

A futures contract is defined by four basic specifications whose combination ultimately defines the usefulness of the contract: underlying index, contract size, contract months and horizon, and settlement procedures.

Choosing an appropriate set of underlying indices is probably the single most important component of contract design. Cross-hedge basis risk hinges on that choice.

Two existing families of indices are relevant to the analysis: the NAREIT and NCREIF Indices, which respectively track securitized and unsecuritized real estate.[3]

This situation of dual real estate markets trading in parallel, which allows the choice between two indices known for their credibility and robustness, represents a unique opportunity for firmly installing property derivatives. Importantly, it positions the US as the most advanced country in the world in terms of both organizing its real estate markets and researching the dissimilarities between securitized and unsecuritized real estate.

What is at Stake in the Choice of an Index?

A brief comparative analysis of the two indices shows that the NAREIT and NCREIF Indices differ in at least four important points:

1. **Types of Properties**: REITs and NCREIF members tend to hold different types of properties and manage them differently (Gatzlaff and Geltner, 1998). Contrary to NCREIF Property Index,[4] the NAREIT Index includes non-core properties. Risk attributes are different for non-core and core properties (Pagliari, Scherer, and Monopoli, 2003).
2. **Risk Premiums**: Although the fundamental determinants of commercial real estate returns are similar for NAREIT and NCREIF, associated risk premiums are significantly different for the two indices (Ling and Naranjo, 1998).
3. **Volatility**: The historical volatility of NAREIT is much higher than that of NCREIF: over the period 1978–2002, 12.8% for equity REIT Total Returns versus 3.4% for the annualized NCREIF (Giliberto, 2003).
4. **Leverage**: The NCREIF database is constructed unleveraged whereas REITs typically use leverage [which may account for the increased volatility according to Giliberto, (2003)].

As stated in the introduction of this paper, the property futures presented here are based on NCREIF Property Indices.

Why not NAREIT?

Notwithstanding the fact that NAREIT indices are real time, reliable, and relatively transparent, there is strong evidence that futures written on REITs could not be efficiently used in non-REIT applications. Overall, the academic community agrees that REIT values do not reflect the value of the underlying private real estate market for the following reasons:

- There is a poor statistical relationship between securitized and unsecuritized real estate returns (Pagliari and Webb, 1995);
- Unsecuritized real estate does not appear to play much a role in driving REIT returns (Clayton and McKinnon, 2001); and
- REITs are poor substitutes for direct investment in real estate because their returns incorporate a significant equity market component (Georgiev, Gupta, and Kenkel, 2003).

Hence, NAREIT Indices would not provide efficient hedging instruments aimed at investors in the direct property market.

The Case for NCREIF

NCREIF is widely recognized as a 'milestone in the real estate industry' (Geltner, 2000).[5] However, the NCREIF Property Index, which is an appraisal-based index (as opposed to a transaction-based index) suffers from random appraisal error and appraisal smoothing error. These two errors are responsible for most of the index's shortcomings, namely 'stale values,' seasonality, smoothing, and lagging.

These shortcomings, which have been extensively analyzed in the academic literature (e.g., Geltner, 1998) will not be covered here in depth. Basically, as a result of these deficiencies, the NPI is not well suited to fulfill the demand for a short-term value-change indicator of commercial property market whereas it is "a reasonably accurate indicator of average performance across time, preferably extended spans of time" (Fisher and Geltner, 2000). This concept has to be incorporated into the design for property futures and it seems as a major impediment to the establishment of short-term contracts.

Nevertheless, there are some very compelling arguments in favor of the NPI. In addition to the fact that they are the only professional indices that truly reflect private commercial real estate in the US, NCREIF Property Indices benefit from three very positive factors:

1. They are the products of permanent efforts from NCREIF and its committees working with researchers to improve their reliability and representativeness (e.g., 'constant liquidity' transaction-based index initiative, improvements in index timeliness, and 'freeze' taskforce in charge of historical revisions).
2. Contrary to hedonic or transaction-based indices, they are well understood and enjoy a high level of acceptance by industry participants. For a futures exchange considering developing property futures, this wide acceptance by professionals in the real estate industry is paramount (Lecomte and McIntosh, 2005a).
3. They are widely used as benchmarks in the industry, with appraisal-based indices being more appropriate than transaction-based indices for evaluation (Geltner, 1998). As noted by Gordon and Havsy (1999), futures contracts should be based on industry standards rather than "alliances between exchanges and index providers." It would indeed be utterly counterproductive to induce a 'benchmark basis risk' because the proposed contracts are based on a different index than the benchmark customarily used by professional investors.

The Need for Procedures Surrounding the Establishment and Release of the NPIs

For NCREIF Property Indices to be considered as underlying to futures contracts, adequate procedures ironing out potential market manipulations and guaranteeing the trustworthiness of the indices will have to be put in place. This is an absolute pre-requisite to the establishment of NPI-based futures contracts as exemplified by weather derivatives.

In particular, because NPIs are self-reporting, procedures standardizing the release of these indices as well as insuring that they are established in accordance with the strictest code of conduct will have to be defined by NCREIF in cooperation with the futures exchange listing the contracts. All underlying indices will have to be certified by the exchange.

Potential conflicts of interest that may arise either at the valuation level (e.g., a data contributing member in the NCREIF database trying to influence the valuation process in order to profit from a futures position) or at the aggregation level (e.g., NCREIF staff member trading on privileged insider information) have to be eradicated beforehand.

Quantitative Analysis

The NCREIF database is constructed in such a way that it gives immediate access to three levels of analysis according to both property type classification and geographic division (Exhibit 1). In addition to the classic national index, the NPI covers five property types (Apartment, Industrial, Office, Retail, Hotel) and four main regions (East, South, Midwest, West). Although there are also eight sub regions (Northeast, Mideast, Southeast, East North Central, South West, West North Central, Mountain, Pacific), only the four main regions will be considered in the analysis that follows.

The three levels of analysis are:

- **Level 1**: National (1 generic index);
- **Level 2**: Property Type or Region (respectively 5 generic indices and 4 generic indices); and
- **Level 3**: Property Type and Region (20 generic sub-indices).

These three levels of analysis are available for three different types of return used in the establishment of NPIs: (1) total return; (2) income return; and (3) capital appreciation return.

In this conceptual framework, Level 3 sub-indices represent the closest available proxies to actual well diversified portfolios of properties (i.e., each level sub index is as close as possible to a market portfolio for that level of analysis). This approach

Exhibit 1
NCREIF Database as of 2004:Q4

	Number of Properties	Percent of Total	Market Value (Millions)	Percent of Total	Average Value of Properties (Millions)
Panel A: Breakdown by Property Type					
Apartments	819	19.73	28,202	19.39	34.43
Hotel	58	1.40	2,535	1.74	43.71
Industrial	1,562	37.62	27,271	18.75	17.46
Office	1,116	26.88	54,100	37.20	48.48
Retail	597	14.38	33,335	22.92	55.84
Total Index	4,152	100.00	145,443	100.00	35.03
Panel B: Breakdown by Region					
East	949	22.86	46,299	31.83	48.79
Midwest	685	16.50	19,349	13.30	28.25
South	1,145	27.58	29,480	20.27	25.75
West	1,373	33.07	50,315	34.59	36.65
Total Index	4,152	100.00	145,443	100.00	35.03

for evaluating real estate systematic risk is initially preferable to statistical studies between constructed portfolios and indices insofar as it allows easy comparisons among a large set of indices/sub-indices. Studies on real estate risk structure (e.g., Miles and McCue, 1984) have traditionally mimicked research on financial assets' risk components (after Elton and Gruber, 1977; and McEnally and Boardman, 1979), overlooking the multi-layered structure of real estate indices.

Exhibit 2 presents the three levels of analysis. Hotel properties are excluded for lack of sufficient data. There are potentially 75 indices/sub-indices readily available to serve as underlying to futures contracts. Noticeably, there are: 25 indices/sub-indices for each type of return, 15 indices/sub-indices for each property type, and 15 indices/sub-indices for each region.

In this paper, all Level 1 and Level 2 NPIs are called indices whereas Level 3 NPIs are designated as sub-indices. For the sake of clarity, a different index code has been attributed to each of these 75 indices/sub-indices based a simple acronym system: two letters for an index, three letters for a sub index (e.g., TN = Total return National, IOE = Income return for Office properties in the Eastern region, CAM = Capital appreciation return for Apartment properties in the Midwest).

Exhibit 3 presents three panels in which the 75 index/sub index codes are organized by type of return. Realistically, 75 contracts cannot be launched at the same time without taking the risk of totally overwhelming the market. In fact, it seems there will be a necessary trade-off between the objective to provide appropriate hedging instruments and the viability of the contracts. As stressed by Duffie and Rahi (1995), designing new futures contracts is a highly empirical process (see Endnote 2). Property futures will be no exception to that rule.

So, how many contracts should be opened initially? What criteria (geographic division, property type, type of return) are the most important? Which underlying indexes/sub-indexes would best answer to the largest range of hedging needs? How deep into the NCREIF database (i.e., level 1, level 2, level 3 or lower) should the process be carried out in order to achieve hedging effectiveness?[6]

The following quantitative analysis provides an answer to these questions. The analysis covers 14 years: from 1990:Q1 to 2003:Q4. All computations are based on quarterly returns.

Exhibit 2
The Three Levels of Analysis

	# Indexes/ Sub-indexes	Explanation
Level 1: National NPI	3	3 types of return
Level 2: Property Type NPI	12	4 property types × 3 types of return
Level 2: Regional NPI	12	4 regions × 3 types of return
Level 3: Property Type × Region NPI	48	4 property types × 4 regions × 3 types of return
	75	including Hotel, Total = 90

Exhibit 3
NCREIF Index/Sub-Index Codes

	East	Midwest	South	West	Property Type
Panel: A: Total Return Indices/Sub-Indices					
Apartment	TAE	TAM	TAS	TAW	TA
Industrial	TIE	TIM	TIS	TIW	TI
Office	TOE	TOM	TOS	TOW	TO
Retail	TRE	TRM	TRS	TRW	TR
Region	TE	TM	TS	TW	TN[a]
Panel B: Income Return Indices/Sub-Indices					
Apartment	IAE	IAM	IAS	IAW	IA
Industrial	IIE	IIM	IIS	IIW	II
Office	IOE	IOM	IOS	IOW	IO
Retail	IRE	IRM	IRS	IRW	IR
Region	IE	IM	IS	IW	IN[b]
Panel C: Capital Appreciation Returns Indices/Sub-Indices					
Apartment	CAE	CAM	CAS	CAW	CA
Industrial	CIE	CIM	CIS	CIW	CI
Office	COE	COM	COS	COW	CO
Retail	CRE	CRM	CRS	CRW	CR
Region	CE	CM	CS	CW	CN[c]

Notes:
Level 1
Level 2
Level 3

[a] TN: National NPI Total Return
[b] IN: National NPI Income Return
[c] CN: National Capital Return

Standard Deviation and Corresponding Correlation Analysis

The mean return, standard deviation, and correlations for all 75 indices/sub-indices were examined. Correlation analysis was conducted according to the following methodology: for each Level i index/sub index (i = 2,3), the correlations were computed with corresponding Level i − 1 indices/sub-indices and if applicable with corresponding Level i – 2 indices/sub-indices.

Concretely,

- Level 1 (National NPIs): No correlation analysis.
- Level 2 (Regional NPIs): Correlation coefficient between each 'Region × Type of Return' NPI and corresponding 'National × Type of Return' NPI (Level 1), e.g., Total Return Midwest and Total Return National or *r*(TM, TN).
- Level 2 (Property Type NPIs): Correlation coefficient between each 'Property Type × Type of Return' NPI and corresponding 'National × Type of Return' NPI (Level 1), e.g., Income Return Retail and Income Return National or *r*(IR, IN).
- Level 3 (Property Type × Region NPIs): For each sub index ('Property Type × Region × Type of Return' NPI), three correlations are computed as follows:
  - Correlation with corresponding 'National × Type of Return' NPI (Level 1), e.g., Capital Appreciation Return Industrial in the South and Capital Appreciation Return National or *r*(CIS, CN).
  - Correlation with corresponding 'Region × Type of Return' NPI (Level 2), e.g., Income Return Office in the Midwest and Income Return Midwest, or *r*(IOM, IM).
  - Correlation with corresponding 'Property Type × Type of Return' NPI (Level 2), e.g., Total Return Apartment in the East and Total Return Apartment or *r*(TAE, TA).

This simple methodology does not account for downward bias induced by positive serial autocorrelation exhibited by NCREIF data (Giliberto, 2003). Hence, results presented thereafter only provide a meaningful basis for analysis in comparative terms but should not be used to assess absolute levels of risk in each individual index/sub-index. However, problems of autocorrelation do not flaw the analysis, considering volatility is a positive factor for derivatives.

The results are reported in Exhibits 4 and 5. Overall, 75 standard deviations and 168 correlations were analyzed (24 for Level 2 indices and 144 for Level 3 sub-indices).

Exhibit 5 ranks standard deviations of quarterly returns. Unsurprisingly, standard deviation of capital appreciation return is systematically much higher than that of income return, suggesting more pressing hedging needs for capital appreciation risk than for income risk.

Furthermore, returns on office properties are significantly more risky than those of other property types. This is especially true for total return on office properties in the West region, which records the highest standard deviation of all indices/sub-indices analyzed (3.09% over the period compared with 2.60% for office properties nationwide and 2.05% for the West region). By contrast, total returns on apartment properties show low volatility, in particular in the South where they record the smallest standard deviation of all indices/sub-indices in the study (1.02% for their total return compared with 1.21% for apartments nationwide and 1.39% for the South region).

With regard to correlation, as shown on the correlation table (Exhibit 6) in which the largest correlation for each Level 3 sub-index is highlighted, in a majority of cases, returns stratified by property type and geographic region are most strongly correlated with Property Type NPIs. For apartment properties and retail properties, the dominance of Property Type NPIs is overwhelming. There are two notable exceptions for which regional NPIs provide the largest correlation: industrial properties in the South and office properties in the Midwest.

In only four cases do Level 3 NPIs record their largest correlation with National NPI returns (e.g., office properties in the East, both in terms of total return and capital appreciation return).

R-square Analysis

Regressions of Level 3 sub-indices (dependent variable) were run against corresponding Level 1 and Level 2 indices (independent variable). Exhibit 7 presents three panels that report the coefficients of determination of these regressions.

Exhibit 4
Standard Deviation and Correlation Analysis

Level 1: National NPI (3 Indices)

Quarterly Returns*	TN	IN	CN
Mean %	1.63%	2.01%	−0.38%
Std. Dev. %	1.73%	0.19%	1.62%

Level 2: Property Type NPI (12 Indices)

	Apartment			Industrial			Office			Retail		
Quarterly Returns*	TA	IA	CA	TI	II	CI	TO	IO	CO	TR	IR	CR
Mean %	2.21%	1.98%	0.23%	1.85%	2.16%	−0.31%	1.32%	2.04%	−0.72%	1.70%	1.92%	−0.22%
Std. Dev. %	1.21%	0.21%	1.14%	1.79%	0.18%	1.68%	2.60%	0.23%	2.49%	1.52%	0.22%	1.41%
Correlation with corresponding National NPI	0.857	0.648	0.857	0.947	0.939	0.941	0.974	0.965	0.970	0.742	0.821	0.719

Level 2: Region NPI (12 Indices)

	East			Midwest			South			West		
Quarterly Returns*	TE	IE	CE	TM	IM	CM	TS	IS	CS	TW	IW	CW
Mean %	1.66%	2.02%	−0.36%	1.45%	2.03%	−0.58%	1.61%	2.02%	−0.41%	1.73%	1.99%	−0.26%
Std. Dev. %	1.93%	0.20%	1.81%	1.55%	0.19%	1.46%	1.39%	0.19%	1.28%	2.05%	0.20%	1.95%
Correlation with corresponding National NPI	0.979	0.627	0.973	0.933	0.942	0.919	0.941	0.950	0.936	0.965	0.959	0.962

Level 3: Apartment (12 Sub-indices)

	East			Midwest			South			WEST		
Quarterly Returns*	TAE	IAE	CAE	TAM	IAM	CAM	TAS	IAS	CAS	TAW	IAW	CAW
Mean %	2.36%	2.00%	0.36%	2.21%	2.00%	0.21%	2.06%	1.97%	0.09%	2.39%	1.97%	0.42%
Std. Dev. %	1.52%	0.24%	1.45%	1.42%	0.27%	1.31%	1.02%	0.21%	0.92%	1.53%	0.22%	1.48%
Correlation with corresponding Property Type NPI	0.917	0.851	0.926	0.873	0.872	0.867	0.866	0.964	0.854	0.908	0.964	0.902
Correlation with corresponding Regional NPI	0.882	0.615	0.872	0.737	0.422	0.745	0.740	0.695	0.738	0.802	0.640	0.801
Correlation with corresponding National NPI	0.865	0.671	0.848	0.725	0.465	0.747	0.659	0.650	0.667	0.790	0.567	0.784

Exhibit 4 (continued)
Standard Deviation and Correlation Analysis

Level 3: Industrial (12 Sub-indices)

	East			Midwest			South			West		
Quarterly Returns*	TIE	IIE	CIE	TIM	IIM	CIM	TIS	IIS	CIS	TIW	IIW	CIW
Mean %	1.85%	2.18%	−0.33%	1.67%	2.18%	−0.52%	1.68%	2.19%	−0.51%	2.02%	2.14%	−0.12%
Std. Dev. %	1.91%	0.20%	1.76%	1.39%	0.20%	1.26%	1.60%	0.19%	1.48%	2.20%	0.20%	2.11%
Correlation with corresponding Property Type NPI	0.946	0.857	0.938	0.894	0.883	0.875	0.829	0.849	0.823	0.975	0.966	0.974
Correlation with corresponding Regional NPI	0.919	0.845	0.909	0.882	0.876	0.874	0.873	0.872	0.850	0.957	0.937	0.954
Correlation with corresponding National NPI	0.926	0.871	0.913	0.892	0.869	0.881	0.819	0.831	0.811	0.896	0.857	0.887

Level 3: Office (12 Sub-indices)

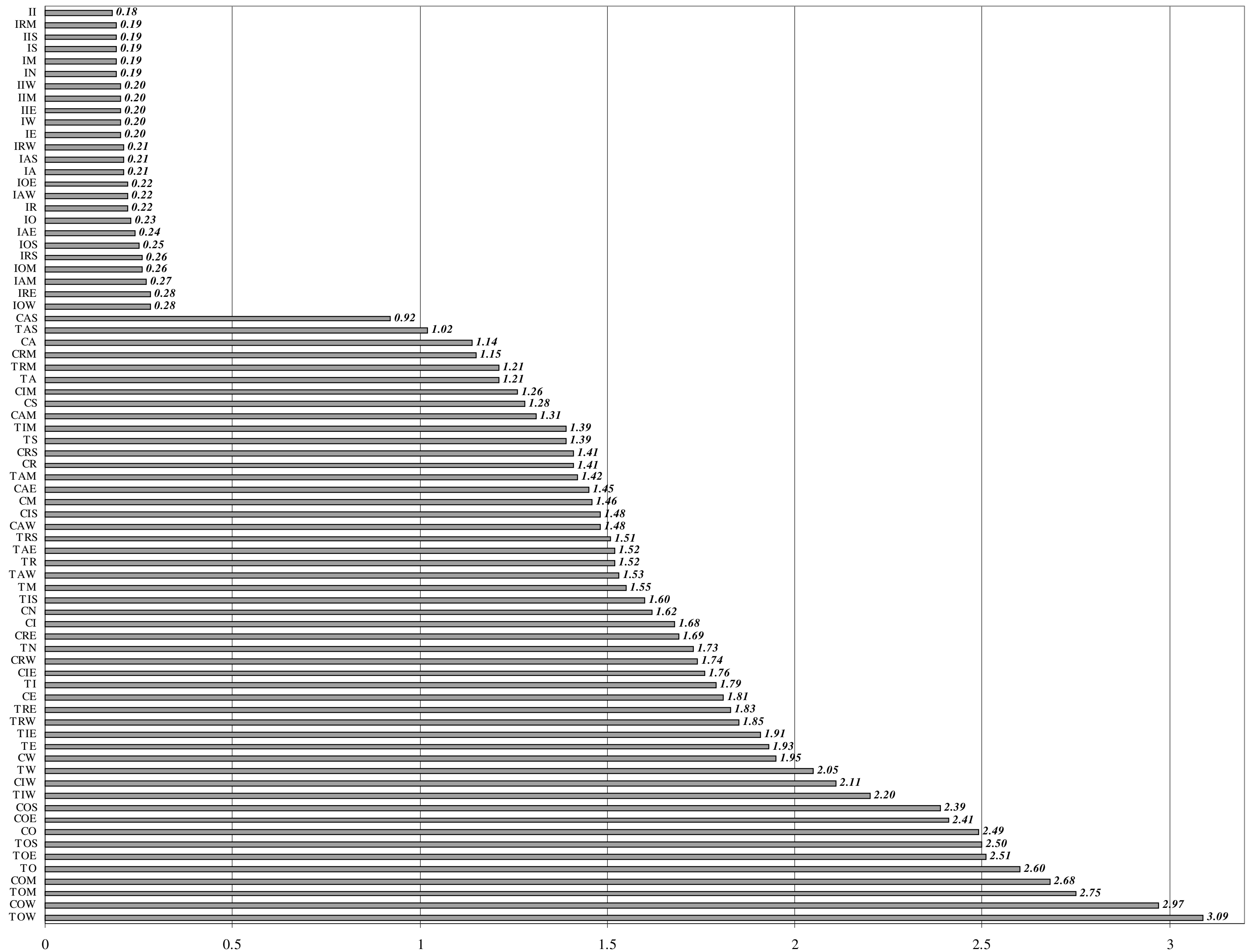
Quarterly Returns*	East			Midwest			South			West		
	TOE	IOE	COE	TOM	IOM	COM	TOS	IOS	COS	TOW	IOW	COW
Mean %	1.52%	2.08%	−0.55%	1.01%	2.11%	−1.10%	1.19%	2.08%	−0.89%	1.35%	1.94%	−0.60%
Std. Dev. %	2.51%	0.22%	2.41%	2.75%	0.26%	2.68%	2.50%	0.25%	2.39%	3.09%	0.28%	2.97%
Correlation with corresponding Property Type NPI	0.967	0.950	0.966	0.922	0.902	0.915	0.934	0.849	0.926	0.958	0.937	0.958
Correlation with corresponding Regional NPI	0.978	0.921	0.976	0.959	0.915	0.956	0.918	0.839	0.898	0.951	0.963	0.944
Correlation with corresponding National NPI	0.982	0.914	0.980	0.889	0.875	0.882	0.910	0.809	0.898	0.898	0.902	0.889

Level 3: Retail (12 Sub-indices)

	East			Midwest			South			West		
Quarterly Returns*	TRE	IRE	CRE	TRM	IRM	CRM	TRS	IRS	CRS	TRW	IRW	CRW
Mean %	1.58%	1.85%	−0.27%	1.55%	1.93%	−0.38%	1.66%	1.95%	−0.29%	1.87%	1.95%	−0.08%
Std. Dev. %	1.83%	0.28%	1.69%	1.21%	0.19%	1.15%	1.51%	0.26%	1.41%	1.85%	0.21%	1.74%
Correlation with corresponding Property Type NPI	0.932	0.968	0.921	0.846	0.925	0.822	0.902	0.919	0.896	0.944	0.963	0.932
Correlation with corresponding Regional NPI	0.709	0.798	0.671	0.732	0.858	0.716	0.786	0.836	0.758	0.688	0.746	0.677
Correlation with corresponding National NPI	0.634	0.731	0.603	0.653	0.776	0.606	0.744	0.816	0.686	0.729	0.814	0.721

*All quarterly return data are from 1990:Q1 to 2003:Q4.

Exhibit 5
Standard Deviation Analysis of the 75 Indices/Sub-indices



% Standard Deviation of Quarterly Returns: 1990:Q1–2003:Q4

Exhibit 6

Correlation Table for Level 3 Sub-indices

		Level 1: National			Level 2: Region												Level 3: Property Type											
					East			Midwest			South			West			Apartment			Industrial			Office			Retail		
		TN	IN	CN	TE	IE	CE	TM	IM	CM	TS	IS	CS	TW	IW	CW	TA	IA	CA	TI	II	CI	TO	IO	CO	TR	IR	CR
Level 3	TAE	0.865			0.882												**0.917**											
Apartment	IAE		0.671			0.615												**0.851**										
12 sub-indices	CAE			0.848			0.872												**0.926**									
36 correlations	TAM	0.725						0.737									**0.873**											
	IAM		0.465						0.422									**0.872**										
	CAM			0.747						0.745									**0.867**									
	TAS	0.659									0.740						**0.866**											
	IAS		0.650									0.695						**0.964**										
	CAS			0.667									0.738						**0.854**									
	TAW	0.790												0.802			**0.908**											
	IAW		0.567												0.640			**0.964**										
	CAW			0.784												0.801			**0.902**									
Level 3	TIE	0.926			0.919															**0.946**								
Industrial	IIE		**0.871**			0.845															0.857							
12 sub-indices	CIE			0.913			0.909															**0.938**						
36 correlations	TIM	0.892						0.882												**0.894**								
	IIM		0.869						0.876												**0.883**							
	CIM			**0.881**						0.874												0.875						
	TIS	0.819									**0.873**									0.829								
	IIS		0.831									**0.872**									0.849							
	CIS			0.811									**0.850**									0.823						
	TIW	0.896												0.957						**0.975**								
	IIW		0.857												0.937						**0.966**							
	CIW			0.887												0.954						**0.974**						
Level 3	TOE	**0.982**			0.978																		0.967					
Office	IOE		0.914			0.921																		**0.950**				
12 sub-indices	COE			**0.980**			0.976																		0.966			
36 correlations	TOM	0.889						**0.959**															0.922					
	IOM		0.875						**0.915**															0.902				
	COM			0.882						**0.956**															0.915			
	TOS	0.910									0.918												**0.934**					
	IOS		0.809									0.839												**0.849**				
	COS			0.898									0.898												**0.926**			
	TOW	0.898												0.951									**0.958**					
	IOW		0.902												**0.963**									0.937				
	COW			0.889												0.944									**0.958**			
Level 3	TRE	0.634			0.709																					**0.932**		
Retail	IRE		0.731			0.798																					**0.968**	
12 sub-indices	CRE			0.603			0.671																					**0.921**
36 correlations	TRM	0.653						0.732																		**0.846**		
	IRM		0.776						0.858																		**0.925**	
	CRM			0.606						0.716																		**0.822**
	TRS	0.744									0.786															**0.902**		
	IRS		0.816									0.836															**0.919**	
	CRS			0.686									0.758															**0.896**
	TRW	0.729												0.688												**0.944**		
	IRW		0.814												0.746												**0.963**	
	CRW			0.721												0.677												**0.932**

Notes: Three correlations are computed for each sub-index. Shading marks the Level 1 or Level 2 index displaying the largest correlation with the analyzed Level 3 sub-index.

Exhibit 7
Regression R-Squares for Level 3 Sub-indices

	NPI Property Type (TA, TI, TO, TR)	NPI Region (TE, TM, TS, TW)	NPI National (TN)
Panel A: Total Return			
Apartment			
East (TAE)	0.8403	0.7770	0.7480
Midwest (TAM)	0.7616	0.5427	0.5254
South (TAS)	0.7507	0.5477	0.4349
West (TAW)	0.8241	0.6433	0.6246
Industrial			
East (TIE)	0.8943	0.8443	0.8583
Midwest (TIM)	0.8000	0.7784	0.7959
South (TIS)	0.6870	0.7629	0.6712
West (TIW)	0.9503	0.9165	0.8030
Office			
East (TOE)	0.9347	0.9558	0.9639
Midwest (TOM)	0.8506	0.9195	0.7909
South (TOS)	0.8727	0.8429	0.8285
West (TOW)	0.9182	0.9037	0.8066
Retail			
East (TRE)	0.8682	0.5029	0.4015
Midwest (TRM)	0.7149	0.5360	0.4264
South (TRS)	0.8129	0.6171	0.5529
West (TRW)	0.8916	0.4727	0.5318

	NPI Property Type (IA, II, IO, IR)	NPI Region (IE, IM, IS, IW)	NPI National (IN)
Panel B: Income Return			
Apartment			
East (IAE)	0.7242	0.3782	0.4502
Midwest (IAM)	0.7604	0.1781	0.2162
South (IAS)	0.9293	0.4830	0.4225
West (IAW)	0.9293	0.4096	0.3215
Industrial			
East (IIE)	0.7344	0.7140	0.7586
Midwest (IIM)	0.7797	0.7674	0.7552
South (IIS)	0.7208	0.7604	0.6906
West (IIW)	0.9332	0.8780	0.7344
Office			
East (IOE)	0.9025	0.8482	0.8354
Midwest (IOM)	0.8136	0.8372	0.7656
South (IOS)	0.7208	0.7039	0.6545
West (IOW)	0.8780	0.9274	0.8136
Retail			
East (IRE)	0.9370	0.6368	0.5344
Midwest (IRM)	0.8556	0.7362	0.6022
South (IRS)	0.8446	0.6989	0.6659
West (IRW)	0.9274	0.5565	0.6626

Exhibit 7 (continued)
Regression R-Squares for Level 3 Sub-indices

	NPI Property Type (CA, CI, CO, CR)	NPI Region (CE, CM, CS, CW)	NPI National (CN)
Panel C: Capital Appreciation Return			
Apartment			
East (CAE)	0.8575	0.7604	0.7191
Midwest (CAM)	0.7517	0.5550	0.5580
South (CAS)	0.7293	0.5446	0.4449
West (CAW)	0.8136	0.6416	0.6147
Industrial			
East (CIE)	0.8798	0.8263	0.8336
Midwest (CIM)	0.7656	0.7639	0.7762
South (CIS)	0.6773	0.7225	0.6577
West (CIW)	0.9487	0.9101	0.7868
Office			
East (COE)	0.9332	0.9526	0.9604
Midwest (COM)	0.8372	0.9139	0.7779
South (COS)	0.8575	0.8064	0.8064
West ST (COW)	0.9178	0.8911	0.7903
Retail			
East (CRE)	0.8482	0.4502	0.3636
Midwest (CRM)	0.6757	0.5127	0.3672
South (CRS)	0.8028	0.5746	0.4706
West (CRW)	0.8686	0.4583	0.5198

Note: Period 1990:Q1 through 2003:Q4.
Highest R-Square
Medium R-Square
Lowest R-Square

The analysis confirms the dominance of Property Type over Region. The case of retail properties is particularly striking. For the three types of return, gaps in R-square between National NPI and Regional NPI on the one hand, and Property Type NPI on the other hand, are the most important of all property types. They exceed a 1:2 ratio in the case of capital appreciation return in the East. More than any other property type, retail properties seem to be subject to property type criteria.

At the other end of the spectrum, office properties display consistently high R-squares with National, Regional, and Property Type NPIs for the three types of return. This finding is hardly surprising considering the significant weight of office properties in the NPI (as of 2004:Q4, office accounts for 37.2% of total market value of properties in the NPI).

For every property type, patterns are relatively similar between income return and capital appreciation return. However, it appears that overall, capital appreciation returns are better explained by the regressions than income returns, which bodes well to the objective of developing hedging tools that cover the brunt of real estate risks.

In many cases, differences between Property Type R-square and Region R-square are small enough to hint that regional factors, though not predominant, may be at work too. This point will justify further research on Level 3 sub-indices.

Systematic Risk Optimization: Total Return

Total return's risk components were examined in order to investigate how by using different indices as underlying the scope of systematic risk covered by the contracts can be increased. The objective is to select underlying indices that will best capture total risk by turning unique risk into systematic risk. This paper focuses on total return for the sake of simplicity. Similar analysis could be conducted on income and capital appreciation returns.

First, the Level 3 sub-indices' betas were determined with Level 1 and Level 2 indices. For each Level 3 sub-index, unique risk was then computed using the beta and standard deviation of underlying index:

$$\sigma_{\epsilon i} = [\sigma i^2 - \beta_i^2 \, \sigma_{(Underlying\ Index)}{}^2]^{1/2}$$

where:

$\sigma_{\epsilon i}$ = The Level 3 NPI's unique risk as measured against the underlying index;
σi = The Level 3 NPI's standard deviation;
β_i = The Level 3 NPI's beta as measured against the underlying index; and
$\sigma_{(Underlying\ Index)}$ = The underlying NPI's standard deviation.

Finally, the ratio of unique risk over total risk ($\sigma_{\epsilon i}/\sigma i$) was calculated and the potential underlying indices were ranked based on their ability to reduce unique risk (i.e., to best capture total risk).

Exhibits 8 and 9 present the results organized by property type. As shown in Exhibit 8, unique risk starts at very high levels: compared with National NPI, retail properties' and apartment properties' total risks are idiosyncratic for 66.8% and 51.6%, respectively. In most cases, unique risk is substantially reduced by selecting Property Type NPIs as underlying (Exhibit 9). Nonetheless, it remains substantial. In the best case (office properties in the East vs. National NPI), it still stands at 18.19% of total risk. In six cases pertaining to apartment properties, industrial properties and retail properties in the Midwest and the South, unique risk is close to 50% of total risk even under the best scenario. Interestingly, office properties display the lowest amounts of remaining unique risk after optimization.

Summary and Preliminary Conclusion

Three levels of NCREIF database corresponding to 75 potential underlying indexes/sub-indexes were analyzed. The findings indicate that National NPIs are markedly irrelevant for hedging real estate risks at the crossover 'Property level × Region' (the only notable exception being the office market in the East).

Likewise, in most cases, regional NPIs are not appropriate for hedging risks at Level 3 or 'Property Type × Region' level (exceptions: Midwestern Office market, Southern Industrial market). In fact, there is a very significant gap in terms of R-square and ability to capture unique risk between regional NPIs and Property Type NPIs. Indeed, both R-square analysis and total return's risk analysis show that unique risk is best captured at the 'Property Type × Region' level by Property Type NPIs.

These findings are consistent with existing academic literature on commercial real estate portfolio diversification (e.g., Miles and McCue, 1982, 1984), which shows that diversification by property type generates better characteristics than a strategy based on geographic region.

What Does it Mean Concretely? A first step towards developing property futures is possible. Using Property Type NPIs as underlying for property futures would offer relatively efficient risk management tools for most properties (as represented in the NCREIF database).

How Many Contracts Should be Opened? To start with, twelve futures contracts based on Property Type NPIs should be opened simultaneously (TA,

Exhibit 8
Total Return: Risk Analysis

		NPI Apartment (TA)			NPI Region (TE, TM, TS, TW)			NPI National (TN)		
	Total Risk %	Beta	Unique Risk	% Total Risk	Beta	Unique Risk	% Total Risk	Beta	Unique Risk	% Total Risk
Panel A: Apartment										
NPI National (TN)	1.73									
NPI Apartment (TA)	1.21							0.5991	0.6244	51.60%
East (TAE)	1.52	1.1564	0.5939	39.07%	0.6973	0.7067	46.49%	0.7624	0.7555	49.70%
Midwest (TAM)	1.42	1.0275	0.6860	48.31%	0.6779	0.9552	67.27%	0.5964	0.9756	68.70%
South (TAS)	1.02	0.7325	0.5048	49.49%	0.5419	0.6877	67.42%	0.3896	0.7656	75.06%
West (TAW)	1.53	1.1530	0.6282	41.06%	0.5998	0.9105	59.51%	0.7014	0.9319	60.91%
		NPI Industrial (TI)			NPI Region (TE, TM, TS, TW)			NPI National (TN)		
	Total Risk %	Beta	Unique Risk	% Total Risk	Beta	Unique Risk	% Total Risk	Beta	Unique Risk	% Total Risk
Panel B: Industrial										
NPI National (TN)	1.73									
NPI Industrial (TI)	1.79							0.9827	0.5602	31.30%
East (TIE)	1.91	1.0095	0.6189	32.41%	0.9129	0.7376	38.62%	1.0257	0.7065	36.99%
Midwest (TIM)	1.39	0.6911	0.6340	45.61%	0.7907	0.6559	47.19%	0.7149	0.6344	45.64%
South (TIS)	1.60	0.7392	0.8996	56.23%	1.0014	0.7890	49.31%	0.7578	0.9172	57.33%
West (TIW)	2.20	1.1990	0.4834	21.97%	1.0290	0.6244	28.38%	1.1432	0.9637	43.80%
		NPI Office (TO)			NPI Region (TE, TM, TS, TW)			NPI National (TN)		
	Total Risk %	Beta	Unique Risk	% Total Risk	Beta	Unique Risk	% Total Risk	Beta	Unique Risk	% Total Risk
Panel C: Office										
NPI National (TN)	1.73									
NPI Office (TO)	2.60							1.4656	0.5756	22.14%
East (TOE)	2.51	0.9335	0.6398	25.49%	1.2747	0.4972	19.81%	1.4267	0.4566	18.19%
Midwest (TOM)	2.75	0.9751	1.0654	38.74%	1.7063	0.7533	27.39%	1.4151	1.2527	45.55%
South (TOS)	2.50	0.8972	0.8990	35.96%	1.6449	1.0111	40.45%	1.3157	1.0341	41.37%
West (TOW)	3.09	1.1396	0.8766	28.37%	1.4337	0.9537	30.86%	1.6075	1.3469	43.59%

Exhibit 8 (continued)
Total Return: Risk Analysis

		NPI Retail (TR)			NPI Region (TE, TM, TS, TW)			NPI National (TN)		
	Total Risk %	Beta	Unique Risk	% Total Risk	Beta	Unique Risk	% Total Risk	Beta	Unique Risk	% Total Risk
Panel D: Retail										
NPI National (TN)	1.73									
NPI Retail (TR)	1.52							0.6539	1.0153	66.79%
East (TRE)	1.83	1.1169	0.6833	37.34%	0.6724	1.2902	70.50%	0.6696	1.4167	77.41%
Midwest (TRM)	1.21	0.6726	0.6473	53.50%	0.5742	0.8198	67.75%	0.4579	0.9146	75.59%
South (TRS)	1.51	0.8918	0.6653	44.06%	0.8491	0.9418	62.37%	0.6485	1.0107	66.94%
West (TRW)	1.85	1.1492	0.6093	32.94%	0.6216	1.3411	72.49%	0.7824	1.2610	68.16%

Note: All data cover the period 1990:Q1 to 2003:Q4. Region NPI: TE = 1.93%; TM = 1.55%; TS = 1.39%; and TW = 2.05%.

Exhibit 9
Total Return: Unique Risk as a % Total Risk

	NPI Property Type (TA, TI, TO, TR)	NPI Region (TE, TM, TS, TW)	NPI National (TN)
Apartment			
East (TAE)	39.07	46.49	49.70
Midwest (TAM)	48.31	67.27	68.70
South (TAS)	49.49	67.42	75.06
West (TAW)	41.06	59.51	60.91
Industrial			
East (TIE)	32.41	38.62	36.99
Midwest (TIM)	45.61	47.19	45.64
South (TIS)	56.23	49.31	57.33
West (TIW)	21.97	28.38	43.80
Office			
East (TOE)	25.49	19.81	18.19
Midwest (TOM)	38.74	27.39	45.55
South (TOS)	35.96	40.45	41.37
West (TOW)	28.37	30.86	43.59
Retail			
East (TRE)	37.34	70.50	77.41
Midwest (TRM)	53.50	67.75	75.59
South (TRS)	44.06	62.37	66.94
West (TRW)	32.94	72.49	68.16

Notes:
- (dark shading) Lowest remaining unique risk (i.e., futures based on underlying index would be most successful at capturing total risk.)
- (light shading) Medium remaining unique risk
- (no shading) Highest remaining unique risk (i.e., futures based on underlying index would be least successful at capturing total risk.

TI, TO, TR for Total Return and so forth). Additionally, contracts based on National NPIs (TN, IN, CN), which may be attractive to speculators as well as non-hedging investors, should be launched in parallel. Overall, fifteen futures contracts should be initially established.

From a pure hedging perspective, total return and/or capital appreciation return contracts should have priority over income return contracts. Likewise, office properties should be on top of the list (i.e., largest standard deviation and lowest unique risk). A tentative embryonic market focused on office properties' total/capital appreciation returns may even be envisioned.

Exhibit 10 reports selected underlying indices along with other contract specifications for the proposed contracts.

The analysis presented here is only a first approach. Indeed, unique risk remains high even under the best correlation scenario (20%–50%).[7] Additional research needs to be conducted.

How the Contracts Would Work

Contract for Difference

The proposed contracts would be based on a contract for difference, which allows counter parties to take opposite positions on the performance of the underlying NCREIF Property Index over a specific timeframe. This format is similar to the one used for the London FOX contracts (see Endnote 11).

The mechanics of the contract implies that the delivery of the face value of the contract never occurs. Contracts are cash-settled upon expiration. Long and short positions are simply marked to a final settlement price, based on the index return. Concretely, the Index Return is equal to (EI-BI)/BI where BI and EI are respectively the index beginning and ending values.[8]

The Index Amount for one contract is given by: Notional amount for a contract × Index Return.

If the Index Amount for an expiry date is positive, a sum in USD equal to such an amount will be payable by the futures seller to the futures buyer. If the Index Amount is negative, its absolute value will be payable by the futures buyer to the futures seller on settlement date.

Contract Size

There are two basic ways to determine the size of an index-based futures contract: either as a multiple of the underlying index (e.g., equity index futures on the CME), or using a lump sum as a notional principal (e.g., credit derivatives such as 10-year Interest Rate Swap Futures on the Chicago Board of Trade, or CBOT).[9]

The use of the latter method is preferred as it alleviates the shortcomings due to the lag in revised

Exhibit 10
Summary of Proposed Property Futures Contracts

Contract Specifications	Total Return	Income Return	Capital Appreciation Return
Number of Contracts	5	5	5
Underlying Indices	National NPI and 4 Property Type NPIs Index codes: TN, TA, TI, TO, TR	National NPI and 4 Property Type NPIs Index codes: IN, IA, II, IO, IR	National NPI and 4 Property Type NPIs Index codes: CN, CA, CI, CO, CR
Contract Size	Notional principal: $1,000,000 per lot	Notional principal: $1,000,000 per lot	Notional principal: $1,000,000 per lot
Horizon	Yearly and multi-year contracts (up to three years).	Yearly and multi-year contracts (up to three years).	Yearly and multi-year contracts (up to three years).
Contract Months	Based on calendar years (initially).	Based on calendar years (initially).	Based on calendar years (initially).
Starting Trading Day	Release date of revised NPI ($t - 1$) in year (t).	Release date of revised NPI ($t - 1$) in year (t).	Release date of revised NPI ($t - 1$) in year (t).
Last Trading Day	Release date of preliminary NPI ($t - 1 + n$) in January ($t + n$) where n is the contract's horizon ($n = 1$ for yearly contracts).	Release date of preliminary NPI ($t - 1 + n$) in January ($t + n$) where n is the contract's horizon ($n = 1$ for yearly contracts).	Release date of preliminary NPI ($t - 1 + n$) in January ($t + n$) where n is the contract's horizon ($n = 1$ for yearly contracts).
Expiry Day	Release date of revised NPI ($t - 1 + n$) in year ($t + n$) where n is the contract's horizon ($n = 1$ for yearly contracts).	Release date of revised NPI ($t - 1 + n$) in year ($t + n$) where is the contract's horizon ($n = 1$ for yearly contracts).	Release date of revised NPI ($t - 1 + n$) in year ($t + n$) where n is the contract's horizon ($n = 1$ for yearly contracts).
Period Covered	January (t) to December ($t - 1 + n$) where n is the contract's horizon ($n = 1$ for yearly contracts).	January (t) to December ($t - 1 + n$) where n is the contract's horizon ($n = 1$ for yearly contracts).	January (t) to December ($t - 1 + n$) where n is the contract's horizon ($n = 1$ for yearly contracts).
Settlement Price	Contract for difference based on underlying revised NPI's beginning and ending values	Contract for difference based on underlying revised NPI's beginning and ending values.	Contract for difference based on underlying revised NPI's beginning and ending values.
Maximum Price Movement[a]	No limits.	No limits.	No limits.
Margin Requirements[b]	Small given the expected low volatility.	Minimal given the expected very low volatility.	Small given the expected low volatility.

Notes:
[a] Equity-index futures have daily price limits corresponding to 5% to 20% declines (e.g., S&P 500 Futures on the CME).
[b] For equity-index futures, the level of performance (and maintenance) margin is determined on the basis of market risk incurred (e.g., hedging, speculative) and contract value.

index values. Contracts have a fixed value notwithstanding the uncertainty surrounding the true index value.

Contract size is an important factor insofar as it impacts transaction costs. Commercial property contracts have to be sufficiently large to keep dealing costs reasonable and to make the transacting of commercial-sized hedges feasible.

The expected low volatility of the contracts implies that larger contracts (with larger tick sizes) will be more attractive to traders as it will be easier for them to cover trading costs and still profit from one or two tick price movements. A relatively large tick size should also be helpful to traders.

Considering the average values of properties in the NCREIF database (as reported in Exhibit 1), a contract size of $1,000,000 per lot is proposed. The commercial real estate market is a professionals' market and there may be no need for initially opening smaller size contracts. Additionally, given the contracts' expected low volatility, margin requirements should be small for total return and capital appreciation return futures, and minimal for income return futures. Coupled with large tick size, low margin requirements should encourage speculators to intervene in the market. Finally, there should be no limit on maximum price movement.

Contract Months and Horizon

The choice of contract months and horizon will influence the time basis risk that hedgers incur when dealing with the contracts. Effective hedging depends on it. Significantly, NCREIF indices' shortcomings tend to lessen as the measurement period increases (Gatzlaff and Geltner, 1998; Geltner, 1998; and Fisher and Geltner, 2000).[10] In addition, although dependent on market conditions, holding periods for institutional commercial real estate are customarily over ten years (Fisher and Young, 2000).

These factors support the case for a long-term contract. Looking at existing examples of index contracts traded on the CME and CBOT, apart from weather derivatives' seasonal contracts, most contracts follow a quarterly cycle (e.g., S&P 500 Futures on the CME or housing futures presented in Exhibit 13). Indeed, futures exchanges seem to have given away the business of long-dated contracts to over-the-counter markets (Shiller, 1993a).

However, the only way to use NCREIF indices as underlying vehicles to futures contracts is to select an extended contract life. The contracts' maturity has to reflect the nature of the underlying asset (i.e., illiquid cash market) rather than to set up an artificially liquid market at the expense of true reliability and significance. In that respect, FOX Property Futures were wrongly modeled after equity index futures.[11] As a result, they disregarded the fact that private real estate and stocks are intrinsically two very different asset classes. This comment also applies to the rent review cycle. Interestingly, academic literature on index-based hedges shows that because of arbitrageurs, basis as a fraction of total risk tends to decrease as the duration of the hedging horizon increases, thus supporting the concept of long dated contracts as well (e.g., Figlewski, 1984).

In short, yearly and multiyear contracts (up to three years) are proposed. Underlying indices should be based on calendar year returns to reduce the impact of seasonality identified in appraisal-based indices (see Endnote 10).

Settlement Procedures

Settlement procedures for property futures have to accommodate two of NCREIF Property Indices' shortcomings, which represent a major challenge for finding a reasonable real-time and reliable underlying:

1. **Index Timeliness**: Initial NPIs are currently released about three weeks after the end of the quarter.
2. **Index Revision**: Treatment of sold properties, late data submission, new members contributing historical data, and errors are responsible for backward adjustments in the value of the indices.

To take into account the lack of index timeliness and potential historical revisions in the underlying index value, settlement should be completed only after the release of revised NCREIF indices. In the worst case scenario, this would not be before the end of the quarter following the end of the contract.

Practically, both the beginning underlying index and the ending underlying index are subject to backward adjustments, thereby affecting the rate of return over the period. Consequently, the beginning date of the contracts should also be postponed so that the contracts' beginning value is based on a revised index. The key to what is in effect a 'lagged settlement' (Shiller, 1993b) is the separation between the last trading day and the expiry day, and the correspondence of these two days with preliminary and revised release dates for the NPI. The following time lines illustrate the analysis for a yearly contract starting in January:

	Index	Futures
Year *t*		
January	Preliminary NPI ($t - 1$)	
February		
March	Revised NPI ($t - 1$) is released	Futures contracts start trading based on revised NPI ($t - 1$). (first trading day).
Year $t + 1$		
January	Preliminary NPI (t)	Futures contracts stop trading (last trading day).
February		
March	Revised NPI (t) is released	Settlement based on revised NPI (t) (expiry day).

Thus, the last trading day is in January ($t + 1$) and settlement date is in March ($t+1$) when the revised NPI (t) is released. Beginning and Ending Values are respectively revised indices released in March (t) and March ($t + 1$). Ideally, the indices' release date should be as close as possible to the end of the previous quarter and follows consistent standardized procedures. In addition, lags between preliminary and revised indices' release dates should be reduced to a minimum (i.e., in theory, the index should be frozen).

In this simulation, the selection is for what seems like the longest acceptable lag (approximately two months). In effect, the proposed contracts would only be traded during ten months or so (from March (t) to January ($t + 1$)) although they cover market fluctuations over a twelve-month period [from January 1 (t) to December 31 (t)].

The model can easily be adapted to any revised index lag and be extended to contracts that would trade similarly to the one presented here but covering multiyear periods (as described in Exhibit 10) or starting with different contract months. Simpler settlement procedures accomodating index timeliness only would be applied in case of frozen indices (see Exhibit 11 for a comparison of lagged settlement procedures for a one-year contract on frozen and non-frozen underlying indices).

Template for a Property Futures Market: Where the Contracts Would Trade

Are Long-Dated Property Futures Contracts a Realistic Proposition? Long-term contracts have earned a very bad reputation in the futures industry. In many ways, they appear like an aberration that has repeatedly been proven to fail. It is commonly agreed that the longer the horizon, the less satisfactory are exchange-traded derivatives as risk management tools (Kolb, 1996). As explained by Case, Shiller, and Weiss (1993), in most futures markets, volume tends to be concentrated with the shortest maturity contracts, hence the usual bias against longer-term contracts. In effect, despite market participants' widespread need to hedge against long-term risks, long-dated contracts are customarily plagued with low liquidity resulting in high transaction costs (i.e., large bid-ask spreads). For example, researching Treasury Futures traded in 1993, Fleming and Sarkar (1999) identified that 90% of total trading volume occurred in the shortest maturity contract, and that distant contracts generally had far lower trading volumes and larger spreads.

Understanding the conceptual underpinning of this situation is crucial. It will condition our ability to propose an optimal market setting for property futures. Imbalances stemming from a lack of liquidity in long-term contracts might eventually doom all attempts to launch a sustainable market, by precluding agents from effectively transferring risk. Therefore, one can legitimately wonder whether long-term property futures contracts are

Exhibit 11
Lagged Settlement
Settlement Procedures for NPI-Based Property Futures

	Frozen Underlying Index		Non-Frozen Underlying Index[a]	
	Index	Futures	Index	Futures
Year *t*				
January	NPI ($t-1$) is released.	Contract starts trading based on NPI ($t-1$) (first trading day).	Preliminary NPI ($t-1$).	
March			Revised NPI ($t-1$) is released.	Contract starts trading based on revised NPI ($t-1$) (first trading day).
End of December		Contract stops trading (last trading day).		
Year $t+1$				
January	NPI (t) is released.	Contract is cash-settled based on NPI (t) (expiry day).	Preliminary NPI (t)	Contract stops trading (last trading day)
March			Revised NPI (t) is released.	Contract is cash-settled based on revised NPI (t) (expiry day).

Notes: Frozen Index: One-year contracts trade during 11 months or so, although they cover market fluctuations over a 12-month period. Non-Frozen Index: One-year contracts trade during 10 months or so, although they cover market fluctuations over a 12-month period.

[a] Lag = 2 months

a realistic proposition at all. Should shorter maturity contracts be selected? Are property futures currently unfeasible given the available underlying indices' weakness in terms of short-term capture? The analysis has focused on hedging effectiveness: yearly and multi-year contracts provide the best hedging tools by accommodating the NPI's shortcomings and avoiding inefficient roll-overs of short-term contracts. Likewise, they reflect commercial real estate's intrinsic nature as a comparatively 'slow,' long-term asset. However, recent academic research coupled with past experiments reveals that it cannot be that simple.

The Theory Behind Long-Dated Futures Contracts. While futures academic literature has been very concerned with optimal hedging strategy of long-term risk exposures using short-term instruments (e.g., Gardner, 1989), the question of open interest in long dated futures contracts has been scarcely researched.

Samuelson (1965) identified that when there is a mean reverting component in the spot price process, the return volatility of a futures contract monotonically rises as the contract expires. This finding whose relevance is sometimes questioned in practice [e.g., weak evidence in financial futures as shown by Bessembinder, Coughenour, Seguin, and Smoller (1996)] is known as the 'Samuelson hypothesis' or 'maturity effect.' It would explain the greater liquidity in near term contracts as users are supposed to be attracted by greater volatility. Hong (2000) characterizes the 'Samuelson hypothesis' by developing a model that incorporates the concept of asymmetric information. While classic models after Samuelson assume that investors are symmetrically informed, Hong shows that in case of large information asymmetry, the maturity effect need not hold. In fact, the time-to-maturity pattern of open interest in the futures market depends on information asymmetry in the economy. Bernhardt, Davies, and Spicer (2006) build on Samuelson and Hong as well as studies on informed trading in equity to develop a model of pooling equilibrium where hedgers and informed speculators trading in short-lived securities are jointly faced with the choice of trading in short-dated and long-dated futures. Their research, which underlines the importance of asymmetric information, yields some interesting insights into hedgers' and speculators' trading behaviors.

The Long-Dated Futures Puzzle. Although futures exchanges have tried in the past to meet market participants' demand for long-term hedging instruments, industry evidence suggests that establishing long-term futures is statistically bond to fail. Why? Common knowledge holds that when offered the choice, hedgers systematically opt for longer-term contracts that match their horizon in order to avoid the costs associated with rolling the hedge (commissions, spread, basis) while speculators will in all probability prefer futures with shorter maturities. Hence, speculators are the ones to be convinced to trade in longer maturity instruments.

Interestingly, Bernhardt, Davies, and Spicer (2006) show the exact opposite. They explain that informed speculators will intuitively prefer distant contracts because by selecting longer maturity they are more likely to benefit from their information being revealed before the futures expire. Conversely, in reasonable settings (i.e., as long as fixed trading costs are not too large), hedgers defined as "liquidity traders" will choose to incur extra costs to rollover their short-term positions, rather than trade distant contracts. This apparently illogical behavior is due to adverse selection costs (i.e., costs linked to the extent of private information in the market). Hedgers associate distant contracts with greater adverse selection costs and these costs more than offset the increased fixed trading costs resulting from frequent rollover of nearby contracts. If all hedgers select the short-term contract, then speculators have no choice but to trade it as well. When information is likely to remain private, increasing relative trading costs in short-term contracts to entice hedgers to use longer maturity futures is counterproductive insofar as such an increase reduces the attractiveness to speculators of trading on long-term information, thereby lowering adverse selection costs.

The Importance of Asymmetric Information. Because of these trading behaviors, long-dated contract markets may only succeed in environments where informational asymmetries are small (e.g., weather derivatives). Bernhardt, Davies, and Spicer (2006) note that "unless long-term private information is both extremely rare and unlikely to be revealed in the short-term, most long-dated obligations are hedged with short-dated contracts." Hence, factors tied to information (e.g., its diversity across market participants, its rate of arrival) are paramount in determining the feasibility of long dated futures.[12] How do these findings apply to commercial real estate and property futures?

The Case of Commercial Real Estate. Information asymmetry is a well-researched feature of real estate markets (e.g., Cooper, Downs, and Patterson, 2000). Compared with other major asset classes, real estate is classically described as a quintessentially heterogeneous asset trading on markets dominated by large asymmetric information. For instance, Garmaise and Moskowitz (2004) show that information considerations are critical in the US commercial real estate market and demonstrate the importance of adverse selection in direct investments. What is the significance of these studies for the proposed futures? Actually, their compelling results seem enough to condemn the contracts as useless pipe dreams. There are, however, several factors in favor of long-dated property futures that should be considered.

First, compared with the previously described model centered on short-lived securities, other variables might be at play in the case of commercial real estate. Real estate assets are intrinsically 'long-lived' securities. As such, they might be more prone to sustain longer maturity contracts than those being researched in the classical academic literature on futures markets. This point will have to be analyzed further before any definitive answer can be provided.

Furthermore, for all the reasons mentioned thus far (e.g., private real estate indices' idiosyncrasies, investment horizon), there is ample heuristic evidence that short-term NPI-based contracts would generate significant basis. In fact, given the level of basis that the use of short-term property futures (e.g., quarterly contracts) would entail, one might wonder whether hedgers would have any incentive whatsoever to disregard long-dated contracts. Basis which is an integral part of hedge costs would potentially be so large that it could far outweigh any adverse selection costs.

Another noteworthy point is that contrary to, say, equity, commercial real estate is a professionals' market. Information asymmetries still exist among informed users but they might not be as prevalent as in markets attracting both professional and non-professional traders. This might be all the more the case as the proposed property futures are not based on individual buildings or even highly specific sub-indices, but on broad aggregate indices (i.e., Level 1 and Level 2 NPIs).[13] In other words, as commercial real estate has become more liquid, more public and more global, how asymmetric does information pertaining to nationwide and property type returns remain?

More generally, applying the framework of Bernhardt, Davies, and Spicer (2006) to commercial real estate, hedgers will probably be the most informed users of property derivatives and might not value so much adverse selection costs in distant futures. Given the sizeable initial investment that will be required to enter the property futures market (e.g., margin on a contract's notional set at $1 million), uninformed users should be scarce (a situation that might be different in the options market). In that sense, a property futures market would hinge on an intrinsic distinction between informed and uninformed agents, only the former being active in the market. Such market segmentation identified by Garmaise and Moskowitz (2004) as a source of efficiency in the direct investment market might contribute to the success of long maturity instruments. This point will have to be researched as well as its implications in terms of a link between the property futures market and its underlying cash market. Likewise, market participants' motives for using property futures (i.e., trade liquidity vs. information driven) and the importance of differences in beliefs as incentives to trade in commercial real estate cash and derivatives markets will have to be precisely analyzed. Bernhardt et al. allude to these points and recognize their key role in determining the open interest patterns of futures contracts.

In sum, the commercial real market presents a number of unique characteristics that support the case for long-dated property futures. Nonetheless, will it be enough to sustain a market focused on very long-dated contracts deliverable in several years? Can commercial real estate prove derivatives academic literature wrong? It would be adventurous to answer positively. There are still myriad open questions to be addressed and more research is obviously needed. Besides, organized derivatives exchanges are known for being rather conservative institutions (Shiller, 1993b, 2004). Long-dated contracts are definitely in their bad books. The proposed template for a property futures market has therefore to be a realistic compromise and, given the large amount of uncertainty surrounding the issue, both theoretically and practically, it will chiefly aim at providing a basis for further exploratory analysis.[14]

Practical Implementation. Based on the previous analysis, there is no doubt that a property futures market will not cover all maturities, from one to three years, at least initially. In all probability and without major breakthroughs either in product design or in academic research, very long-dated contracts will not realistically trade on organized exchanges in the near future. Consequently, a gradual approach is adopted. A two-tier property futures market is proposed where exchange-traded shorter-maturity futures are listed in parallel to over-the-counter longer maturity instruments. Yearly contracts would be listed as ETD while any contract over one year (i.e., very long dated contracts) would be traded as OTC.

The choice of one year as the cut-off point between the two markets is obviously a bet insofar as if successful, these futures would be the longest futures traded on a standardized exchange. However, given all the factors identified in this paper in support of long-dated contracts, one year appears like a reasonable and feasible horizon for NPI-based property futures. Nevertheless, certain conditions conducive to the contracts' success will have to apply. As mentioned, contracts will follow a calendar year cycle. Hence, there will only be one contract month (i.e., open contract) for each trading year. Likewise, only current year contracts will be open during most of the trading year, with immediately subsequent year contracts being tentatively open during the last quarter (in part for the sake of information efficiency). This should enable the exchange to concentrate all open interests on a single contract for each underlying vehicle, thereby fostering liquidity and momentum. As identified by Shiller (1993a), drastically reducing the number of contracts might be an efficient way to force trading volume to converge on a limited series of long-term futures. However, there are clear-cut limitations to a systematic implementation of this strategy. For instance, agents looking for short term hedges will be driven out of the market unless they are willing to accept substantial time basis risk (all the more so as they are intervening in circumstances justifying hedging (e.g., when the market's underlying volatility is high or expected to increase). Research on hedging long-term risk exposure (Neuberger, 1999) confirms that optimal hedging is usually achieved when futures contracts with different maturities coexist. Therefore the property futures market might be complemented by shorter term derivatives called 'Strip Property Futures.' These instruments modeled after CME Strip Seasonal Weather Futures would trade on the exchange alongside regular yearly contracts.

Strip Property Futures would allow users to customize their individual horizon within the standard one-year maturity of listed contracts. They would represent an expansion of current year open contracts, by offering scalability and flexibility. In practice, users would be able to select any quarter(s) they would like to trade: from a minimum of one quarter to a maximum of three quarters. In the case of multiple-period strips, quarters will not have to be consecutive. Strips will follow similar settlement procedures as those applied to regular yearly contracts but on a quarterly (or multi-quarterly) basis. The exchange will ensure that users are fully aware of NPIs' idiosyncrasies before they initiate a trade. The strip format will emphasize the fact that the main property futures contract is not quarterly but yearly.

Multi-year contracts cannot realistically be listed as exchange-traded futures. Therefore, it is proposed that they trade on a specifically designed over-the-counter market that would be open in parallel to the yearly and strip property futures market. This OTC market would be innovative insofar as:

- It would be organized and managed by the exchange listing yearly futures. Counterparty matching and clearing would be carried out by a central counterparty facility (CCP) linked to the organized exchange.
- Market participants would be registered as accredited users with the CCP to guarantee their creditworthiness and register their collaterals (e.g., physical buildings).
- Accredited users would be allowed to take part in private auctions organized by the exchange. These auctions could follow the Auction Markets™ format defined by Goldman Sachs and the CME (Shiller, 2004).[15] This process would generate periodically updated forward price curves for NCREIF Property Indices/sub-indices. This information would be publicly available.
- OTC property derivatives would take the form of standardized forward contracts strictly modeled after yearly futures contracts and following the exact same cycle. A multi-year contract would be constituted of as many forward contracts as the contract's horizon. For instance, a three-year contract would contain three forward contracts as follows: (1) a one-year forward contract starting when the trade is initiated; (2) a one-year forward contract starting one year from inception; or (3) a one-year forward contract starting two years from inception.
- Standardized multi-year contracts would be subject to virtual marking to market. 'Notional' performance bonds would not give rise to cash outflows but would be used to keep track of users' risk exposure. The process would be entirely managed by the CCP. Margin requirements would be relaxed for users with substantial and high quality collaterals. As collaterals might be associated with a particular trade (e.g., in the case of a hedge for a particular property or set of properties), contracts will be permanently tied to their initial counterparties and as a general rule, secondary sales and purchases of yearly forward contracts would not be allowed whereas swaps among accredited users would be acceptable subject to the CCP's approval.

The arbitrage relationship between property forwards and property futures will be achieved by establishing the transferability, albeit within strict boundaries, of forward contracts into futures contracts.[16] In effect, forward contracts could be transferable into corresponding current year listed futures contracts. For instance, a standardized forward contract with a one-year horizon could turn into a one-year futures contract with the exact same set of specifications (i.e., same underlying). As only current year futures will be listed and therefore eligible, only current year forwards will be transferable. Transfers would obviously be optional (i.e., users could hold multi-year contracts until maturity). Once a contract has been transferred, notional initial and maintenance margins would become effective and callable. Due to forwards' transferability feature, a multi-year contract could be seen as a yearly futures contract and one or two forward contracts (for two- and three year contracts respectively). Combined with strips, it can even reach the quarterly level (see Exhibit 14). The advantage for accredited users would be the opportunity to manage their long-term derivatives positions at limited cost, if any [the issue of frictionless convertibility between the two types of contract as well as its consequences in terms of hedge accounting would have to be analyzed; see Cox, Ingersoll, and Ross (1981) who describe the concept of 'quasi-futures contracts']. The ability of gradually closing out multi-year contracts by converting them into a succession of yearly futures should reduce adverse selection costs in distant contracts and thereby spur the use of longer term derivatives as hedging instruments. By the same token, trades carried out in the OTC market would fuel liquidity and momentum in the exchange-traded property futures market. In essence, the decomposition of multi-year contracts into a combination of futures and stacked forwards should contribute to both liquidity and efficiency in the two segments of the proposed property futures market.

Exhibit 12
Comparison OTC Swaps vs. Exchange-Traded Futures

	Over the Counter Swaps	Exchange-Traded Futures
Contract Terms	Tailored, negotiated and confidential.	Standardized.
Contract Size	Anticipated Notional Amount: $25M +	Proposed Contract Face Value: $1M
Underlying Indices	Level 1 NPI Level 2 NPIs: 4 property types	Level 1 NPI Level 2 NPIs: 4 property types
Types of Return	Capital Appreciation of the National NPI (1), total return for property type sub-indices (6). Hence, 7 different contracts.	All three types of return for all underlying indices/ sub-indices. Hence, 15 different contracts, 5 for each type of return.
Delivery	From 2 to 3 years. Delivery will be negotiable. Contracts will very often go to delivery.	From 1 to 3 years. Defined delivery dates but majority of contracts might be closed out before delivery. Flexible options allow coverage over any period (up to 3 years).
Product Structure	CR NPI Swap: Fixed and floating legs. Property Type TR Swaps suppose investors take both a long and a short position. Pay off is based on difference in the performance of the indices (i.e., swap property types not just one property type). TRS Swaps involve a fixed spread depending on property types.	Contract For Difference (CFD)
Credit Risk	Risk is with counterparty. All contracts will be CSFB contracts backed with a Aa3 A+ rating.	Clearing house becomes counterparty to all trades and manages risk through daily margin calls.
Liquidity	Negotiated so liquidity can take time and be limited by available counterparties. Contracts could be cleared through central counterparty facility.	Liquidity should be good for main contracts.
Option On Contract	None	Flexible options on potentially all eligible NPI-based futures.

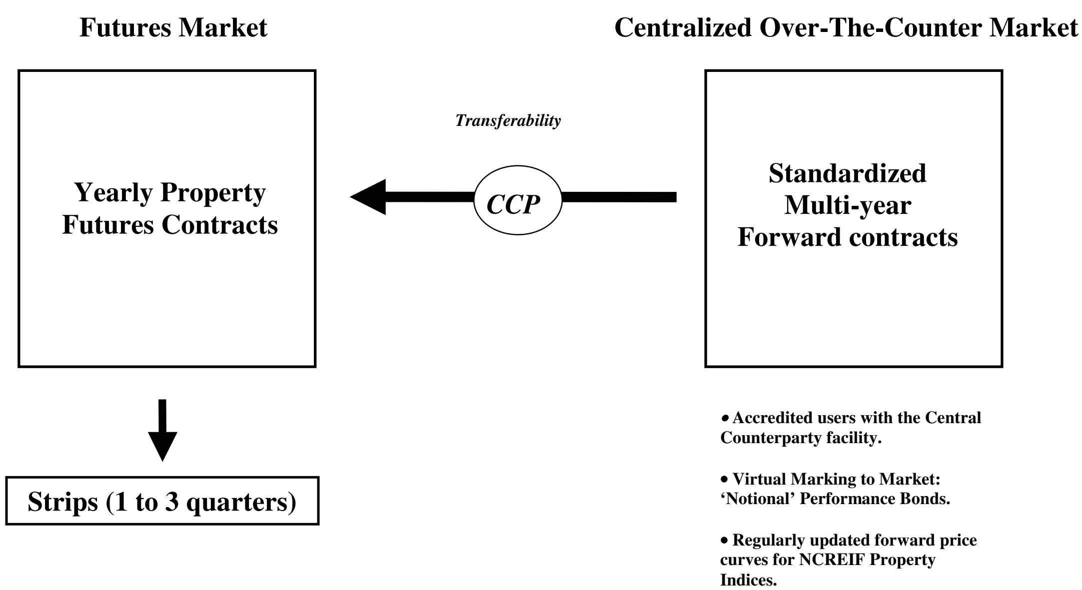
Note: The source is Fisher (2005) for OTC swaps.

Exhibit 13
Housing Futures & Options vs. NPI-Based Futures & Options

	Housing Futures & Options	NPI-Based Futures & Options
Panel A: Futures		
Underlying Indices	Case Shiller Indexes (CSI): 10 Metropolitan Statistical Areas 1 Composite Index representing all 10 MSAs Main factor: Region	NCREIF Property Indexes: 4 Property Type Sub-indexes 1 Composite National Index Main factor: Property Type
Types of Return	One type of return: Sale prices for single family residential dwellings. CSIs are intended to be representative of all single family homes within the subject MSA. Hence, 11 different contracts.	Three types of return: total return, income return, and capital appreciation for all underlying indexes. Hence, 15 different contracts, 5 for each type of return.
Contract Size	$250 times the CSI	Notional: $1 million
Contract Months	February Quarterly Cycle: February, May, August, and November.	Yearly and multi-year contracts (up to 3 years) based on calendar year cycle.
Final Settlement Date	Last Tuesday of contract month.	Release date of revised NPIs or release date of NPIs (if index frozen).
Panel B: Options On Futures		
Contract Size	One futures contract.	One futures contract.
Contract Months	February Quarterly Cycle: February, May, August, and November.	Flexible options: any eligible futures contract can serve as underlying.

Note: The source is Labuszewski (2006) for CME CSI Housing Futures and Options.

Exhibit 14
Template for a Property Futures Market



Although this template is obviously highly experimental and will have to be further researched, the need for such a market is supported by evidence from the current UK experiment with OTC property swaps. Some market participants consider over-the-counter markets’ atomized structure as a definite brake on the potential development of a liquid property derivatives market in the long run. This is mainly due to inadequate risk management possibilities for financial intermediaries supplying derivatives on such illiquid and non tradable underlying as indices on private commercial real estate. Illiquidity and/or the absence of tradable underlying curb intermediaries' ability to hedge market exposure associated with trade facilitation. Most of the time, this exposure can only be addressed by basic static hedging based on sporadic offsetting transactions, which tends to considerably slow down and limit the whole process. The auction format coupled with a central counterparty facility should overcome this classic limitation of OTC markets.

Property Options

Property options would be an interesting addition to futures contracts, by providing more trading opportunities for speculators and other non-hedging investors. Research shows that options can be used to 'complete' incomplete markets by covering a space where there are not enough or inadequate assets to trade (Ross, 1976). Likewise, property options could play an important information aggregation role that would provide a means for hedgers and speculators to coordinate their beliefs about underlying real asset values (e.g., Kluger and Wyatt, 1995), thereby reducing information asymmetries.

Overall, the option template is particularly well suited to address the timing uncertainty inherent to commercial real estate activities, whether development, purchase, or sale. However, because of real estate indices' shortcomings, as well as underlying cash markets' illiquidity, short-term options on NCREIF Property Indices seem hardly feasible. Instead, the preference is for the establishment of long-term options on NCREIF Property Indices as well as flexible options tied to NPI-based futures contracts.

Long-Term Options on NCREIF Property Indices

First, the proposed design is for long-term multi-year options on NCREIF Property Indices, as is currently done for equity index options (LEAPS of up three years listed on the Chicago Board Options Exchange). The stable nature afforded to these options owing to their long term expirations will target the more conservative investors (e.g., non real estate uninformed investors willing to diversify their portfolios of financial assets by adopting a passive index strategy). Strike prices will be expressed in terms of the underlying index price. One index option contract will be for 100 times the underlying index, as is customary of equity-index options. Options will trade on a selected set of revised annual indices. American-style options will offer the flexibility that is missing in the futures market. Although intrinsically of a long-term nature (e.g., expiration dates ranging from one to three years), these options will still be sensitive to quarterly updates and thus potentially attract a wider range of market participants than the futures contracts, which are clearly aimed at hedgers. Establishing this market is just a matter of commercial willingness. New technology applied by the Chicago Mercantile Exchange in its Economic Derivatives Auction Markets™ (Baron and Lange, 2006) enables the advent of liquid and transparent option markets on any illiquid underlying (see Endnote 15). The NPI seems like a perfect candidate. Therefore, irrespective of the prospects of the other products described in this paper, it is recommended that plans for setting up a NPI-based options market be undertaken without delay.

FLEX Options on NPI-based Futures Contracts

One major advantage of exchange-traded derivatives over their over-the-counter counterparts is that they allow the establishment of liquid options markets. Drawing from the examples of index derivatives traded on the CME, options on NPI-based futures (or futures options) would be an appropriate way to add liquidity and trading opportunities to a somewhat 'stale' property futures market. Options on NPI-based futures contracts are significantly preferable to options on NCREIF Property Indices. Indeed, based on Hull (2003), it seems that a NPI-based futures contract will be more liquid and easier to trade than the NPI or the corresponding real estate assets. Its price will be known immediately from trading on the futures exchange, whereas the spot price of the NPI (or the corresponding real estate assets) will not be so readily available. In addition, although NPI-based futures options will theoretically require the delivery of an underlying futures contract when exercised, they will be settled in cash in practice. Likewise, NPI-based futures and futures options will be traded in pits side by side in the same exchange, thus facilitating hedging, arbitrage, and speculation. This will tend to make the market more efficient.

To accommodate real estate's idiosyncrasies, property futures options should be flexible. Flexible options known as FLEX options are enhancements to the usual options on futures that allow users to customize option contract specifications in terms of expiration date, underlying futures, strike price, and exercise style (European or American). Users will be able to choose any underlying futures contract independent of the flexible option expiration date. In essence, as is the case for index FLEX options listed on the CME, any property futures contract eligible for trading could be specified as the underlying vehicle for a FLEX property futures option. Thanks to their tailor-made features, these options will enable hedgers to fine-tune their strategies, thereby reducing time-basis risk.

Greek Letters for Property Options

To manage risks involved in option positions, traders at financial institutions have developed variables called the "Greek letters" or "Greeks," which capture different dimensions to the risk in an option (Hull, 2003). Among those letters are first derivatives that measure rate of change of the option price with respect to: (1) the price of the underlying asset (*delta*); (2) the passage of time with all else remaining the same (*theta*); (3) the volatility of the underlying asset (*vega*); and (4) the interest rate (*rho*). In addition, a second partial derivative measures change in the option delta with respect to change in price (*gamma*).

These variables, which were developed for options linked to assets traded on liquid cash markets, (e.g., equity) will be appropriate for property options as well. Nonetheless, they markedly ignore one fundamental dimension of real estate markets: illiquidity. Fisher, Gatzlaff, Geltner, and Haurin (2003) note that in public markets, "a single statistic, the change in asset transaction prices, completely reflects the change in the market's condition. This is in contrast to private markets, where the complete change in the market's condition can be tracked only by including changes in two dimensions: average transaction price and average time on the market." Hence, property options will require additional Greek letters reflecting the intrinsically illiquid dimension of real estate markets. Ideally, liquidity indicators such as time to sale should be used to construct these new Greeks. In practice, such indicators are not readily available. Therefore, one might have to consider alternative proxies for liquidity such as transaction volume.

Two first derivative 'liquidity' Greeks could be envisioned: (1) *Lefta* or the rate of change of the option price with respect to time to sale; and (2) *Hydra* or the rate of change of the option price with respect to the transaction volume of the underlying cash market. In general mathematical form, Lefta (L) $= -\delta C/\delta TS$, where C is the price of the call option and TS is the time to sale; and Hydra (H) $= \delta C/\delta TV$, where C is the price of the call option and TV is the transaction volume. Lefta and Hydra respectively stand for money and water creature in Greek. These words, which are not letters per se, were chosen for their link with the dual concept of liquidity.

Additionally, a second partial derivative linking real estate markets' two dimensions (i.e., price and transaction) can also be considered. This Greek, *Zeta*, would be the rate of change in the property option delta with respect to change in the underlying cash market's liquidity. In general mathematical form, using the same notations as before with Δ as the call option's delta: Zeta (Z) $= -\delta\Delta/\delta TS$ based on time to sale, or Zeta (Z) $= \delta\Delta/\delta TV$ based on transaction volume.

Hedgers will look for a portfolio of options that is both delta and lefta (or hydra) neutral, which might be quite a challenge to achieve in practice.[17] Interestingly, liquidity Greeks could open the door to new instruments aimed at hedging liquidity risk in commercial real estate. One way to do so would be to set up options on first derivative liquidity Greeks in a similar fashion to what Scholes (1999) and Bakstein and Howison (2003) propose for options on financial assets. These options could trade in parallel to plain-vanilla options based on any reliable liquidity indicator extracted from the NCREIF database.

Examples

Examples presented in this paper are voluntarily simplified to illustrate basic principles. Most notably, in case of hedging, they tend to assume a low basis risk and overlook the costs. Actual use of property futures would obviously involve more sophisticated strategies led by risk professionals, expert in both real estate and derivatives. The emergence of a new profile of risk manager should indeed logically follow the establishment of an efficient derivatives market. As demand grows for more sophisticated strategies, specific tools could be developed to help risk professionals fine-tune their use of property futures, e.g., tables reporting quarterly updates of risk/return characteristics of actual properties selected in the NCREIF database for their representativeness or, to preserve data contributing members' confidential information, risk/return characteristics of generic properties as identified by a set of ad hoc criteria (such as property type, sub region, metropolitan area, and other characteristics inferred from hedonic models), as well as correlations and betas of these properties' returns with underlying indices of property derivatives. These tables will allow hedgers to customize their hedge ratios. By combining NPI-based instruments with an approach centered on properties' physical characteristics, they are part of the process of 'standardized customization' mentioned by Lecomte and McIntosh (2005b).

Example 1: Suppose that an investor wants to hedge a $250,000,000 commercial property real estate portfolio. The investor writes a 250 contract on the National Total Return NPI (Index Code: TN in Exhibit 3, Panel A). Over the year, the Index appreciates by 5%. Hence, the Index Return is 5% and the Index Amount is equal to: 250 × $1,000,000 × 5% = $12,500,000. On settlement, the investor pays the Index Amount to the buyer of the contract. In this example, a perfect hedge is assumed. In reality, the beta of the investor's portfolio with the selected underlying index would be needed in order to adjust the hedge ratio.

Example 2: A plan sponsor wants to gain exposure to the Eastern US commercial real estate market but does not have enough capital to achieve proper diversification by investing directly nor does the individual want to risk capital. An advisor recommends that 3-year call options be purchased on the East Region Total Return NPI (Index Code: TE). If at the end of the period, the position is profitable, the options will be exercised. Otherwise, the sponsor will just lose the premiums initially paid on the options.

Example 3: Suppose an investor is long one FLEX call option contract on the Apartment Total Return NPI (Index code: TA) 2006, settlement in 2007:Q1. The strike expressed in terms of index return percentage is 5%. The option is European style with a maturity of one year similar to that of the underlying futures contract (Any duration of up to one year would have been possible.) At settlement, Index Return is 8.5% and Index Amount is equal to $85,000. Since Index Return is greater than strike, the option is exercised and the investor's payout is:

$$\$1{,}000{,}000 \times [\text{Index Return} - \text{Strike}]$$
$$\text{or } \$1{,}000{,}000 \times [8.5\% - 5\%] = \$35{,}000$$

Example 4: Suppose an insurance company wants to sell an office building valued at $100 million. However, the timing of the sale is uncertain. The owner estimates that up to eight months might be necessary to complete the transaction. In order to hedge the risk resulting from this uncertain timing, the insurance company can buy 100 American-style FLEX put options written on any Office Total Return NPI-based futures contracts (Index Code: TO) having a maturity of minimum eight months. In case the final selling price is inferior to the initially estimated value of $100 M, then the options will be exercised and the corresponding profit on the option position should make up for the shortfall (depending obviously on the amount of basis risk incurred).

Example 5: Suppose an investment fund owns a shopping center in California. It is concerned the value of the property currently appraised at $50 million may go down as a result of the flagging local economy. On top of a depressed outlook for commercial property, it is also concerned that rising interest rates and weak job creations nationwide may impact consumption and hence its tenants' rent-paying abilities (resulting ultimately in increasing vacancy rates). To hedge both risks, the investment manager can use a combination of futures contracts and options: (1) sale of 50 futures contracts written on the Retail Capital Appreciation NPI (Index code: CR); or (2) purchase of FLEX put options on any Retail Income Return NPI-based futures contracts (Index Code: IR).

Conclusion

Success of property futures will depend on their promoters' ability to align their products with market participants' various needs. As a matter of fact, there is nothing complex or mysterious about the success of a futures contract. Research gives us good indication of what needs to be done to succeed. Most notably, hedging effectiveness and liquidity have to be met at the same time, which is admittedly a challenge for futures exchanges.

Real estate index-based futures should not be modeled after equity-index futures but rather stick to the characteristics of the underlying real estate cash market. One alternative that is sometimes considered is to turn real estate into an 'engineered' financial asset by developing indices akin to those found on equity markets. The research in this study goes in the opposite direction by trying to adapt futures contracts' features to the fundamental characteristics of real estate. This paper has shown that the fact that real estate does not behave like a financial asset should not be an impediment to developing risk management tools.

The only way to establish an active property futures market is to be innovative in terms of contract specifications while continuing to improve NCREIF property indices. This is clearly a challenge for both NCREIF and futures exchanges. NCREIF has demonstrated that it is extremely proactive in addressing its indices' shortcomings. In particular, advances in the field of transaction-based indices potentially hold many promises for property derivatives, provided these new indices meet practitioners' approval. Improving the NPI's short-term capture would solve many of the issues covered in this paper. As far as futures exchanges, this paper contains elements that might give some hints of a workable solution. Notably, using a selected series of NCREIF property indices would offer relatively efficient hedging tools and represent a first step toward developing a full-fledged standardized property futures and options market in the US.

The form property derivatives eventually take will depend on the level of basis and associated product complexity that investors are willing to accept. Compared with over-the-counter swaps, NPI-based futures present many advantages: they would be simpler, more liquid, and overall more cost efficient to use (Exhibit 12). In essence, property futures and options have the potential to open up a new world of hedging and diversification for participants in the commercial real estate market and investors alike. The benefits would be enormous for all. There will obviously be many hurdles before property futures become a reality but they are indeed feasible. It is time that serious efforts as well as appropriate resources are devoted to creating these risk management tools whose potential to revolutionize real estate is only partly foreseen as of today.

Further research avenues will have to be explored concerning the contract's specifications, especially with respect to finding the best underlying indices and devising creative ways to foster hedging effectiveness. For instance, further segmentations by property type (e.g., property type subcategories) and geographic division at both the sub-region and metropolitan levels should be conducted in order to analyze the validity of so-called 'Level 3' sub-indices as potential underlying. Micro-analysis simulating hedged/unhedged returns for actual properties/portfolios of properties should also be carried out. Models studying optimal hedging strategies of commercial real estate using derivatives as well as probable time-to-maturity patterns of open interest for property futures and options should be actively developed. Likewise, the optimal configuration of a property futures market apt to provide efficient hedges for long-term exposure will have to be extensively analyzed. Finally, pricing those instruments will be the next big challenge.

Endnotes

1. The Minimum Variance model described by Ederington (1979) is the conventional method for measuring hedging effectiveness. Hedging effectiveness is defined as the reduction in the variance of the value of a position hedged with futures. The objective of a hedge is to minimize the risk of a given position. A naïve hedge is defined as: futures position = -spot position. Concretely, a hedge is effective if the R-square of the OLS regression explaining the relationship between the futures and the spot positions is high (i.e., between 0.80 and 0.99). In US GAAP, derivatives positions are qualified as 'highly effective hedges' if hedging effectiveness is larger than 80% at periodic testing intervals (FAS 133).
2. Duffie and Rahi (1995) describe the process of innovation in futures market: an analysis of the projected hedging demand typically includes interviews with potential users as well as statistical estimates of the "correlation between the contract's designated payoff and the risks associated with changes in the value of the potential users' market commitments." Nevertheless, they acknowledge that the design of new futures contracts involves much guesswork. More generally, it is evident that banks and relevant institutional parties will have to be very much involved in the process of establishing a property futures market (for instance by taking part to a Practitioners Committee). As noted by Gordon and Havsy (1999), 'the presence of sophisticated institutional investors who have both the skills and the need to manage risk' is one the prerequisites for the development of an active and liquid derivatives market. The examples of currency and interest rate futures show that large institutional investors play a crucial role in ensuring the necessary liquidity of a new futures contract. Their commitment and dedication will be key in the initial growth and sustainability of the market. This implies that regulatory constraints (e.g., SEC and CFTC regulations, accounting, and tax issues) affecting banks and potential institutional users (e.g., life insurers) ought to be taken into account when defining the contracts' legal framework. By the same token, Case, Shiller, and Weiss (1993) mention the need for a 'trial period.' In practice, a trial period for property futures would necessarily involve potential institutional users. This point is corroborated by the example of weather derivatives in which activity seen in OTC derivatives was instrumental in selecting the contracts that were eventually opened.
3. Shiller (1993a) proposes an interesting theoretical alternative that would enable the establishment of index-based futures without relying on NAREIT or NCREIF. He recommends the use of a hedonic repeated measures index that follows individual assets through time. The index would be used as an underlying vehicle to derivatives markets for perpetual claims on cash flows matching indices of rents of commercial property, or 'perpetual futures.'
4. NCREIF has added non-core properties to its database. Nonetheless, as reported in Exhibit 1, as of 2004:Q4, the sample was still very small (only 58 properties, amounting to 1.74% of total index value).
5. As explained by Geltner (2000), by sharing some of their private information to the NCREIF database, data contributing members "perform a public service for the common good of the private real estate investment industry as a whole." This implies that NCREIF should consider carefully the implications of licensing its indices. In particular, no decision should be taken that could possibly go against its data contributing members' (and their parent companies') strategic interests. This point is particularly relevant for OTC derivatives, which should preferably involve non exclusive licensing agreements or be based on private indices. Conversely, futures could easily be granted exclusive licenses insofar as futures exchanges are not involved in competing with data contributing members.
6. By focusing on homeowners' risk, Case, Shiller, and Weiss (1993) de facto adopt a 'Level 3' approach at the MSA level. They write: "Because [. . .] enormous booms and bursts occurred at different times in different parts of the country, a single national futures contract would not serve to insulate an individual homeowner against risk in his or her market. We need regional futures contracts covering regions [. . .]". CME housing futures [as described in Exhibit 13 and Labuszewski (2006)] follow this same logic. They are only based on geographic criteria, thereby disregarding potential impacts of real assets' physical characteristics (e.g., sub-property types within the broadly defined category of 'single-family dwellings').
7. Previous research (e.g., Hartzell, Hekman, and Miles, 1986) shows that analyses based on quarterly data, as opposed to annual figures, tend to underestimate systematic risk in appraisal-based real estate indices. By using quarterly data, the aim is to conservatively determine the minimum level of systematic risk for each index/sub-index, regardless of what the optimal horizon might eventually be for futures. Likewise, the analysis presented here emphasizes individual property hedging. However, for portfolios of properties, there is evidence that increasing portfolio size can lead to a very significant reduction in specific risk (Byrne and Lee, 2003). Thus, large portfolio managers who are primarily concerned with systematic risk would probably benefit the most from the proposed futures.
8. The value of the NPI was set at 100 at 1977:Q4. Index return will be based on revised NPI values.
9. Notional principal refers to the principal used to calculate payments in interest rate swaps. It is called 'notional' because it is neither paid nor received.
10. Gatzlaff and Geltner (1998) note that the smoothing effect is most serious at the quarterly level. Fisher and Geltner (2000) explain that the "NPI provides a reasonably accurate indicator of average performance across fairly extended spans of time." They write: "lagging and smoothing do not greatly affect the measurement of average returns aggregated across multi-year spans of time" whereas they do "in the index affect the ability of the NPI to provide timely and precise indication of quarterly market direction and behavior." Furthermore, with respect to seasonality, there is ample evidence that the NPI is more up-to-date at the end of the calendar year than in previous quarter. Clayton and Hamilton (1999), Fisher and Geltner (2000) both estimate the average lag at approximately three to four quarters. For all these reasons, it seems preferable to base

the futures on calendar year performances (e.g., contract with a maturity of one year or even several years) rather than quarterly returns. Incidentally, for corporate users, such a choice of periodicity and corresponding contract horizon makes a lot of sense in practical terms considering it corresponds to FAS 133's basic review requirements.

11. The London Fox Property Futures market proposed two types of contract for difference on commercial real estate: Commercial Property Futures and Commercial Rent Futures. Both contracts were based on IPD Growth Indices (capital and rental respectively) and had similar specifications:
    - Trading unit was £500 per index point (at inception, Commercial Capital Futures amounted to £70,700 and Commercial Rental Futures to £86,400 whereas Residential Property Futures were equal to £112,100. The way those values were determined seems to have had little connection with the underlying cash markets);
    - Contracts' horizon was quarterly and contract months were March, June, September, December. It was initially planned to list 12 contract months, providing trading and hedging opportunities three years forward;
    - Expiry day was the last Friday of Calendar Month one month following Contract Month;
    - Settlement price was based on the IPD Growth Indices released on the last Friday of the month following the Contract Month; and
    - Tick size was 0.05 of an index point, i.e., £25.
12. In a recent speech on derivatives securities (December 8, 2005), Chester Spatt, Chief Economist at the U.S. Securities and Exchanges Commission (www.sec.org) noted the importance of adverse selection costs in derivative design. He explained: "a crucial facet of design of the derivative instrument is the extent to which the seller discloses information, which is either part of the instrument's voluntary design or to meet regulatory requirements."
13. Based on the findings of Bernhardt, Davies, and Spicer (2006), the potential of using highly specific hedonic indices to establish full-scale property derivatives markets (e.g., Shiller, 1993b) seems fairly limited. At best, such hedonic indices could be selected as underlying for short term contracts resulting in a cluster of—probably OTC—markets aimed at hedgers only (Lecomte and McIntosh, 2005b). The economic advantage of these instruments would be measured in terms of relative gains in basis (due to their hedonic underlying) over additional trading costs incurred as a result of frequent rollovers and the absence of speculators. Garbarde and Silber (1983) support this intuition. They show that for commodities existing in multiple varieties (e.g., corn), a "market-basket" underlying enables the division of large residual risk (i.e., after hedging) among market participants in a more effective way than a "non-standard" underlying. In effect, contracts based on "non-standard variety" (e.g., highly specific sub-indices) impose most of the residual risk on those hedging the standard variety whereas in a market framework, it is better for all hedgers to bear "some residual risk some of the time." Therefore, whenever assets are heterogeneous, it makes sense to design futures contracts that reflect "the average value of different varieties of a commodity." Applying this analysis to property derivatives, underlying indices, be they hedonic or Level 3 sub-indices, will have to be broad enough to encapsulate a large definition of the standard assets while enabling holders of non-standard assets to find efficient hedges as well. This empirical process of striking the right balance between standardization and customization will be instrumental in the success of property futures.
14. Reflecting on radical financial innovation, Shiller (2004) asserts that: "the history of invention shows that formidable obstacles stand in the way of implementing simple ideas, but that innovations in design can eventually make them possible. [. . .] Achieving radical financial innovation is never easy. Doing so requires careful attention to design, experimentation to find the right design, and extensive marketing, and it requires cooperation from more of society than just [. . .] isolated innovating firms."
15. The technology applied in CME Auction Markets™ is based on pari-mutuel principles described in Lange and Economides (2005). This auction system builds a market with no need to match orders, in contrast to a traditional derivatives market that relies on liquid underlying markets to work properly. Prices are determined by relative demand for all derivatives while liquidity is aggregated across all derivatives. Initially conceived for trading options, this very promising format has successfully been applied to economic derivatives (not only options but also forwards) and could easily be extended to other derivatives products. Indeed, commercial real estate should be on top of the list.
16. The relation between forward prices and futures prices has been extensively researched in the academic literature [e.g., Black (1976) who identified the difference in payment schedules between the two contracts]. In a seminal article, Cox, Ingersoll, and Ross (1981) characterize the two prices based on an arbitrage argument and show the critical role of stochastic interest rates. Without a constant interest rate, forward markets and futures markets differ in fundamental ways. In the proposed template, another important factor will be the moment of transfer between the two types of contract. In essence, the transferability feature amounts to a set of embedded options given to holders of multi-year contracts. These options may be American (i.e., exercise chosen at any point in time before futures' last trading day) or Bermudan-style where there exist windows of transfer (e.g., first trading day following the quarterly release of underlying NPI). The moment of transfer will determine the necessary adjustment between forward and futures prices as hinted by the concept of virtual marking to market. If transferred later than futures' first trading day, forward hedges will have to be adjusted to account for the fact futures are marked to market. The tailing adjustment comparable to that described in the academic literature (e.g., Kawaller, 1986; and Figlewski, Landskroner, and Silber, 1991) will deal with financing costs pertaining to margin cash flows that differentiate hedging a cash position with futures from hedging via forwards. This point will have to be carefully considered when building a pricing model for transferable multi-year contracts.
17. Implicit in the formula for liquidity Greeks is the fact that a real estate asset's cash price is negatively correlated with time to sale and positively correlated with transaction volumes. When time-to-sale increases, price tends to decrease, resulting in a call property option losing value (and a put property option gaining value). Alternatively, when transaction volume increases, price tends to increase, resulting

in a call property option gaining value (and a put property option losing value).

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