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A 30-Year Perspective on Property Derivatives: What Can Be Done to Tame Property Price Risk?

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Movements in property prices can pose severe risks to those who hold real estate assets as well as to the financial sector and even macroeconomic stability. A vivid example is the global financial crisis of 2007–2009, when approximately eight million American homes were foreclosed, and $7 trillion dollars in home equity vanished (in this journal, Goodman and Mayer 2018). The sharp decline in US housing prices and how it echoed through the US financial system was a primary driver of the Great Recession of 2007–2009 (Gertler and Gilchrist 2018). This connection goes well beyond the US economy. Many past financial crises have shown a connection to house-price risk because irrational and exuberant periods are often paired with property booms and bubbles. It is well known that in many major economies, house-price growth is related to financial stability, particularly in those countries that use variable-rate mortgages and market-based property valuation for mortgage loans (Tsatsaronis and Zhu 2004). The interaction of housing price, household debt, and the financial sector can help explain how the Great Recession affected high-income countries around the world as well as explain economic fluctuations around the world going back to the 1970s (for example, see Mian and Sufi 2018).

Yet the financial instruments available in financial markets to control this globally omnipresent risk remain in a state of infancy. For example, consider a

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homebuyer circa 2005 or 2006 who faced conflicting expert opinions about whether housing prices might fall in the near-term. For example, McCarthy and Peach (2004) and Himmelberg, Mayer, and Sinai (2005) argue that house prices were not going to collapse. Conversely, Shiller (2006) presents ample historical evidence that house prices at the time were far from the norm suggested by historical patterns, and Shiller (2005) writes: "Significant further rises in these [housing] markets could lead, eventually, to even more significant declines." But that concerned homebuyer had no mechanism to hedge against the risk that the price of the specific house they were purchasing would decline. Nor did investors purchasing mortgage-backed securities have any straightforward way to hedge against the risk of a widespread decline in the average property prices, either within an urban area, region, or nationally.

The main objective of this paper is to offer a perspective on the principal obstacles hindering the development of financial derivatives based on real estate prices—especially housing prices—and what could be done to overcome these difficulties. By the late 1980s, Case and Shiller (1989) started a research agenda dedicated to the search for financial solutions that could mitigate house price risk.

We first provide an overview of some basic financial derivatives and their benefits. We then discuss some history about the volatility of property prices and their interaction with the financial sector. Between 1870 and the middle of the 20th century, available data suggest that real house prices remained fairly stable in many places worldwide (Jordà, Schularick, and Taylor 2015). Some financial derivatives were then developed to reduce the risk for originators of mortgages. But the lack of development of financial derivatives based directly on property prices probably had only a modest effect up to the 1970s, when a combination of inflationary and real increases in housing prices shook up these markets. We discuss early attempts to create property derivatives in the 1990s, which either failed or were very limited in scope. However, after 2006 a functional market did emerge in real estate derivatives, both in the United States (on housing) and in the United Kingdom (on commercial property). We discuss the empirical evidence on benefits that have arisen from these financial derivatives as well as their flaws and limitations.

Finally, we then discuss the main specific obstacles to a more complete development of a property derivatives market: problems in matching a suitable property index to the property derivatives themselves, concerns about a limited number of parties in the market, problems of modelling property derivatives, and concerns about how regulations may affect the participation of large financial institutions in these markets. Our study is complementary to the review of housing finance in Shiller (2014), where the slow pace of innovation with respect to the development of tools for controlling property risk is also criticized.

Advantages of Real Estate Derivatives

A number of studies starting with Case and Shiller (1989) have pointed out the benefits of introducing property derivatives—for housing prices in particular.

Table 1
Some Examples of Simple Financial Derivatives

Derivative	*Definition*	*Example*
Futures and forwards	An agreement to buy or sell a certain asset at a certain price at a specific date in the future.	An airline, agreeing to buy fuel in the future at a certain price; a farmer, agreeing to sell a crop in the future at a certain price. If the contract is on an exchange there are margin payments subject to a marking-to-market process that must be paid in order to remove counterparty risk, and this is a futures contract. If the contract is directly between two parties over-the-counter then the contract is paid off only at maturity. Futures are standardized while forwards are bespoken.
Call option	The right to purchase an underlying security at a predetermined future time and "strike price."	Some companies grant workers a call option to purchase company stock in the future at a certain strike price.
Put option	The right to sell an underlying security at a specified price and date.	A put option on the S&P 500 can be exercised by the holder if the value of the S&P500 at some future maturity falls below the chosen exercise threshold. Hence, an asset manager may recoup portfolio losses by buying a put as a hedge against a market decline.
Total return swap	The "payer" agrees to send the total return from a certain asset to the "receiver," and the "receiver" agrees to either a make a payment based on a benchmark interest rate or the total return on a different asset.	An asset manager agrees to pay a funding market floating rate plus a fixed spread to a counterparty in return for the return on some property index. Basically, the asset manager creates a leveraged position in the property index funded at LIBOR plus the fixed spread.

Examples focused on the US market include Shiller (1993c) and Shiller and Weiss (1999), while Case, Shiller, and Weiss (1991, 1993) explain the need for house price index futures and options. For the case of the United Kingdom, Gemmill (1990) argues for the benefits of futures trading for the house price market in the United Kingdom and Baum (1991) make the case for commercial property futures (see also Thomas 1996). Table 1 provides a quick definition of some common financial derivatives. In this section, we discuss four types of gains that financial derivatives provide: 1) improved information about the path of future prices, 2) hedging against risk, 3) a tool for broadening investment portfolios, and 4) a basis for new financial products.

Information about the Future of Evolution of Property Prices

The principal role of property derivatives is that they allow end-users to extract more reliable information about the future evolution of property prices. Of course, for the introduction of property derivatives (residential and commercial) to be successful, their usage must appeal to sophisticated market players who find it advantageous to take on property risk such as hedge funds, pension funds, insurance funds and speculators. Such market players provide deep pockets that help to keep the market liquid along with deep expertise in valuation of assets.

Voicu and Seiler (2013) and Uluc (2018) investigate the theoretical impact of introducing house price futures on managing house price risk. For example, Uluc (2018) adapts the De Long et al. (1990) model of noise traders to the housing market: that is, the market is made up of noise traders who have imperfectly predictable beliefs about waves of property values up and down and sophisticated investors who try to predict the noise traders—and in doing so, the sophisticated investors can magnify the size of the waves. The model demonstrates that there are three channels by which house price futures may affect house prices. First, the noise traders who are looking to benefit from momentum in prices no longer need to purchase houses themselves but can now focus on trading the financial derivative of housing futures. The market for buying and selling actual houses is slow and somewhat illiquid, while trades in the synthetic (paper) domain are settled very quickly. Depending on the noise traders' perception of the market, it is possible for house price futures trading to trigger either an increase or decrease in the price volatility of residential property. Second, a housing futures market allows for short selling. Thus, when noise traders begin to display irrational exuberance, they become the only market players buying in expectation of higher housing prices, while sophisticated (knowledgeable) households and investors use house price futures for short-selling for the investment part of the housing asset—and during that time are more likely to rent than to buy. Third, Uluc (2018) argues that when house price futures overall become attractive to sophisticated investors, the volatility of house prices decreases. Moreover, the presence of sophisticated risk-neutral investors in this model will in the long run eliminate the imperfections and distortions in the housing market.

A market in property derivatives can also clarify certain prices that are now bundled together. For example, Case and Shiller (1996) explain how financial institutions and investors could use futures and options to extract information and manage two major interrelated risks that lenders face: price risk and default risk.

Hedging Housing Price Risk

Property derivatives offer certain end users the opportunity to hedge or control property-related risks—perhaps especially those concerned about a price fall. An obvious use would be that some homebuyers, at the time they purchase their house, might wish to purchase an insurance policy against the risk of a decline in house prices. Shiller and Weiss (1999) expanded this idea to explain how residential property futures would facilitate the selling of home equity insurance. Hence, house price futures, for example, could help insurance companies remove the risk of endemic house price declines. The existence of house price futures may allow the coexistence of another financial innovation: insurance that you will not lose the value of the down payment on your home and even price guarantees on new homes. Shiller (1993c) put forth theoretical arguments for this financial innovation which almost ten years later proved to be effective in 2002 in Syracuse, New York, when a home equity insurance program was launched (Caplin et al. 2003).

In addition, residential property derivatives could be employed by mortgage insurers to hedge the risk of higher defaults that occur when housing prices fall (Case et al. 1993; Case and Shiller 1996). All major banks are now required to pass regular stress tests imposed by regulators and some of these tests involve severe house price market collapses. Thus, using house price derivatives could be a solution to mitigate the banks' overall portfolio downside risk exposure in order to pass stress tests.

One can also imagine those who wish to hedge against a rising price of housing. Say that a young household lives in an area where real estate prices seem to be rising faster than incomes, but they are not yet ready to purchase a home. By purchasing housing futures based on an index of local real estate prices, or an option, they can reduce the chance of being "priced out" of a real estate market where prices are rising.

Portfolio and Investment Decisions

When seeking to optimize an investment strategy, property derivatives provide an additional tool with distinctive characteristics of risk and return. For example, some investors might seek to acquire exposure to real estate profit and losses in a synthetic manner, in this way obtaining exposure to real estate sectors where it would be almost impossible to trade on the spot market (like shopping centers and warehouses). Other possible actions could involve moving between asset classes or sectors or "relative value trading" where the investor seeks to benefit from a change in the spread between the outcome of the property derivative and some other asset. As Englund (2010) pointed out, property derivatives would enable households to disentangle their housing consumption decisions from their housing investment decisions: for example, a renter could use property derivatives to benefit from rising real estate prices.

The development of property derivatives markets has been hampered by the fact that, for long periods of time, property markets were one-sided—specifically, with a lack of investors willing to be counterparties in property derivatives transactions. But with a market for property derivatives, investment banks and investment funds should be willing to buy the property risk because they cannot plausibly claim that they are fully diversified without holding positions in property markets. For investors who want to use property derivatives for managing their exposure to this asset class, one of the major problems in trading in this asset class is the lack of fungibility and the implied impossibility of short selling of the spot asset. As noted earlier, not being able to short-sell an asset when market values appear to be inflated relative to fundamentals may be a direct contributor to increased market sentiment, ultimately resulting in real estate bubbles.

New Financial Products: Reverse Mortgages

The discussion has already mentioned how property derivatives can provide a basis for new financial products like down-payment insurance. Another emerging financial product where housing price risk is highly relevant is "reverse mortgages," in which a homeowner receives periodic payments for a fixed period or life, secured by the value of the property that will be sold after death. Reverse mortgages may be especially beneficial for elderly households with low-income, poor health, and limited non-housing wealth (Nakajima and Telyukova 2017). The UK equivalent of a reverse mortgage is called an "equity release mortgage." It allows the borrower, a senior person over a certain age, to get a lump-sum or to draw regular or when-needed sums from a credit line. The loan accrues interest that will be paid only at the termination event, when the borrower dies, moves into long-term care, or prepays. The loan can be granted to individuals or couples who own and live in a house that is used as a collateral to pay back the loan at termination.

However, an obvious concern for the reverse mortgage market is the risk of a decline in property values. In a US-style reverse mortgage, the issuer must embed in the deal an insurance policy against a house price decline. This insurance policy serves several functions: that the borrower will not absorb the negative equity when the loan is terminated, that the loan will continue to pay its installments even if the lender goes bankrupt, and that the reinsurer will pay the lender if the negative equity guarantee insurance policy is triggered. In essence, these products depend crucially on a put option on the house price at an uncertain time in the future (which can be priced depending on the actuarial characteristics of the borrower), along with a strike price equal to the accumulated balance at a fixed rate. In the United Kingdom, the regulator requires the insurer issuing the loan to cover the risk that the house price at termination is lower than the loan balance to be repaid.

Because an expanding market for reverse mortgages is highly dependent on the no-negative equity guarantee, house price hedging instruments would help to satisfy regulators and help improve the linkages between the housing market and the health care market (Tunaru 2017). This problem could be solved immediately if a futures contract on house prices existed, along with the use of put options.[1] But with such markets still at their early stages, the price of providing a no-negative equity guarantee remains higher than it needs to be, thus impeding growth of the market for reverse mortgages.

Why Did the Need for Real Estate Derivatives Rise in the 1970s?

Over time, many assets have served as a basis for derivative contracts, including stock prices, bond prices, and commodities prices like oil or wheat. One reason why house prices have not done so is that house prices in the majority of developed

[1] In the UK market for equity release mortgages, for example, regulators accept the application of the Black-Scholes (1973) option pricing model to evaluate the risks. However, it is well-accepted among researchers and industry that with this approach, the valuations of the necessary house price options are quite inflated due to the way the Black-Scholes model builds in volatility. Regulators naturally prefer to be conservative. In contrast, insurers argue that the very high capital limits imposed are impeding the development of this market. Issues with appropriate modelling of property derivatives will be discussed in more detail later in this paper.

economies remained relatively constant in real terms from the 19th century to the 1960s (Knoll, Schularick, and Steger 2017). Of course, there's a lot of detail buried in that word "relatively." Knoll, Schularick, and Steger (2017) provide ample evidence that house prices stayed stable before World War I, although income per capita increased and then, relative to income, they decreased until the 1960s. Glaeser (2013) argues that the United States has been, for a long time, a nation of property speculators, with local and regional boom-bust periods that created substantial social costs and financial instability. However, these movements in housing prices often evened out in the long run. As one example, using a repeat sales index based on 86 properties in New York City's borough of Manhattan over a century, Wheaton, Baranski, and Templeton (2009) show that in every decade, property prices increased between 20 and 50 percent and then declined the same way such that in the late 2000s, real estate in that city was worth almost the same as at the turn of the 19th century in real terms. The international historical evidence suggests that, since 1870, house prices in Australia outpaced income; in the United States and European countries like Belgium, Sweden, and Germany, house price growth was substantially behind income growth; and for Canada, Japan, and the United Kingdom, house prices grew more or less in line with income (Jordà, Schularick, and Taylor 2015).

Still, the fact that house prices in high-income countries were "relatively" constant for a sustained time means that the perceived need for financial derivatives to hedge against movements in these prices was not large. This may explain why there was little motivation for introducing futures contracts related to house prices.

Moreover, there is a long history of other financial instruments that protected the originators of mortgage loans from risk of fluctuating housing prices by creating financial securities based on a pool of mortgage loans, which can then be sold to investors. The primary historical example is covered bonds: these debt securities are specialized instruments issued by financial institutions under specific legislative measures. Covered bonds are basically a hybrid between corporate bonds and mortgage-backed securities. The collateral for a covered bond is a pool of mortgage loans (commercial and residential) and some other public sector assets. The payments to the holders of covered bonds are a liability of the issuer. Covered bonds may receive a credit rating higher than the issuer's credit rating, although the credit rating mainly reflects the issuer. This apparent paradox can be explained by the legislative measures supporting covered bonds. Unlike corporate bonds, the mortgage loans are segregated to the benefit of the security holders so that the credit of the covered bonds also depends on the credit quality of the collateral. Covered bonds were first issued in Germany (then Prussia) in 1769 where they are called *pfandbriefe*, and in 1797 in Denmark where they are called *realkreditobligationer* (Kothari 2012). Covered bonds are commonly used today in many European countries. They are now issued in Australia, New Zealand, and Canada, but rarely issued in the United States (although after the subprime mortgage crisis, the US Department of the Treasury formulated a plan to promote the issuance of covered bonds). From a global perspective, covered bonds constitute the largest bond market after the US bond market.

Table 2
Two Forms of Property Loans Securitization: Covered Bonds and Mortgage-Backed Securities

Characteristic	*Covered bonds*	*Mortgage-backed securities*
Asset composition	Defined by law and substitutable	Cannot be exchanged after issuance
Support from issuer	Allowed use of other assets by issuer	Not allowed
Balance sheet	On issuer's balance sheet	Off balance sheet
Issuer's absorption of default risk	Yes	Only pro-rata to their equity tranche
Issuer's absorption of prepayment risk	Yes	No
Number of issuances from one collateral pool	Multiple issuances allowed	One pool one issuance.

In Table 2, we contrast the two main forms of property loans securitization, covered bonds and the mortgage-backed securities more common in the United States. In a US context, mortgage-backed securities have a much shorter history. US mortgage securitization was first used in the 1920s by insurance companies who issued mortgage participation certificates backed by a pool of mortgage loans that they guaranteed (Goetzmann and Newman 2010). Up until the real estate crash that accompanied the Great Depression, these securities were actively traded.

The Great Depression triggered spectacular innovations in mortgage designs in the United States. Until that time, mortgages were not fully amortized; instead, they were balloon instruments in which the principal was only partially amortized (or not amortized at all) at maturity. Thus, the end of the mortgage left the homeowner with the problem of refinancing the balance and exposed the lender to considerable default risk. Sometimes the lender (typically a depository institution at the time) had the power to require repayment of the outstanding balance on demand or upon relatively short notice, even if the mortgager had been making payments on time. This type of mortgage designed proved disastrous during the Great Depression and contributed to both its depth and personal distress, as banks afflicted by losses on their loans and by depositors' withdrawals found it necessary to liquidate their mortgage loans at a time when debtors found it impossible to refinance. The disastrous experience led to the widespread adoption of the current fixed-rate, level payment, fully amortized mortgage by the mid-1930s. As Fabozzi and Modigliani (1992) note, the level-payment mortgage was a great success, contributing to the recovery of the housing market after the Great Depression. This mortgage design continued to perform a valuable role in financing residential real estate in the first two decades of the post-World War II period until the inception of the era of high inflation in the 1970s.

During this time, one of the main changes in housing finance was an effort to develop a secondary mortgage market in the United States. The Government National Mortgage Association (Ginnie Mae) and the Federal National Mortgage Association (Fannie Mae) were created in 1968 and then the Federal Home Loan Mortgage Corporation (Freddie Mac) followed in 1970. These three entities worked with qualified mortgage originators to create mortgage-backed securities that were guaranteed by one of these entities. These "agency mortgage pass-through securities" represented the first generation of mortgage-backed securities. Later, other mortgage originators issued securities that were backed solely by the credit quality of the underlying mortgage pool, referred to as private-label, mortgage-backed securities. It was not until the 1990s that the first mortgage-backed securities backed by a pool of commercial mortgage loans were issued.

However, the fixed-rate, level payment, fully amortized mortgage—and the mortgage-backed securities based on it—were unprepared when the inflation of the 1970s produced devastating effects on the housing industry in all countries.[2] Adjustable-rate mortgages shifted the risks of inflation to borrowers, rather than lenders. But the rise in mortgage interest rates that accompanied, and roughly matched, the rise in inflation pushed homeownership out of the reach of major segments of the population—notably the young and the first-time homebuyers. Various alternative mortgage designs sought to deal with the "tilt problem" created by inflation: specifically when nominal house prices rise over time, a standard mortgage then causes the purchaser to have a higher real value of mortgage payments in the earlier years, resulting in potential cash flow problems for homeowners that will increase the risk of default. Several mortgage designs (with many variants) were developed that led to mortgages with systematically higher real payments over time, including graduated payment mortgages, growing equity mortgages, tiered payment mortgages, shared appreciation mortgages, price-level adjustment mortgages, and dual rate mortgages (Fabozzi and Modigliani 1992).

By the 1980s, the financial sector had certainly recognized that a number of financial risks had increased and needed to be hedged, both in the property sector and from other areas. The property markets in the United States and the United Kingdom became more integrated with their financial markets. In the United

[2] The savings and loan crisis of the 1980s and 1990s was not directly related to changes in property prices. Instead, the key problem was that savings and loan institutions held large portfolios of fixed-rate mortgages, and under existing laws in the early 1980s, they faced a regulatory limit on the interest rate they could pay on deposits. When US inflation and nominal interest rates rose dramatically in the 1970s, savings and loans faced a double-whammy: their deposits flowed away to money market funds, which could pay higher nominal interest rates, and the value of their fixed-rate mortgage assets declined sharply (for discussion, see the three-paper "Symposium on Federal Deposit Insurance" in the Fall 1989 issue of this journal). However, the savings and loan debacle does illustrate a case where issues in the mortgage finance industry led to development of financial derivatives. The development of the interest rate swap market in the 1980s—which made it much easier to exchange fixed-rate and variable-rate securities—is primarily attributable to the need to manage interest risk emerging from the fixed-rate mortgage loan portfolios that were common in the 1970s and earlier.

Kingdom, for example, the Housing Act of 1980 introduced a right-to-buy policy that transformed the UK residential market from a majority of renters to a majority of houseowners. Then 1983 brought the “Big Bang” deregulation of the financial sector (Coakley 1994) at a time when UK bank systems became the custodians of large portions of property risk through large mortgage origination programs.

Many futures contracts were introduced on exchanges throughout the world in the 1980s, including those for the purpose of managing the risks associated with various types of assets from commodities to stock indices and Treasury bonds. But somehow, there were no attempts to introduce futures related to the price of property, whether in the form of residential houses or commercial property. One futures contract of this time was tangentially related to real estate: the Government National Mortgage Association (Ginnie Mae) Collateralized Depositary Receipt (CDR) futures contract. However, this contract focused on interest rates, not property prices. The main users of this contract were mortgage bankers who were holding large undiversified mortgage portfolios which they intended to resell in the secondary market. This financial contract was a modest success for a few years, but then the bulk of investors interested in taking positions on interest rates shifted to a futures contract based directly on US Treasury bonds instead. The story of the six-year rise and fall of the GNMA CDR interest rate futures contract is told in Johnston and McConnell (1989).

However, another property derivative from this time would last longer. Due to the option granted to borrowers to prepay their loan in whole or in part at any time and without penalty, there was considerable uncertainty about what the actual maturity of a mortgage pass-through security might end up being. This “prepayment risk” could result in a security with either a very short maturity or an extremely long maturity. Prepayment risk made mortgage pass-through securities unappealing to traditional investors. In the early 1980s, a new type of mortgage-backed security was created called a collateralized mortgage obligation (CMO) to deal with prepayment risk and the uncertainty of maturities. A CMO was made up of different bond classes (popularly referred to as tranches) backed by a pool of mortgage loans, and it had a set of rules for the distribution of the interest and principal payments to the different bond classes. The rules were such that some of the bond classes carried more prepayment risk than others. When issued by Ginnie Mae, Fannie Mae, and Freddie Mac, there was no concern with credit risk. Other entities also issued CMOs, referred to as private-label CMOs, where the different bond classes had a different credit rating and there were rules not only for the distribution of the interest and principal payments but the allocation of losses to the different bond classes. Overall, these securities resulted in a redistribution of credit risk as well as prepayment risk. The wide range of risk profiles made these securities more appealing to a wide range of institutional investor seeking targeted risk profiles. Unfortunately, it was private-label CMOs backed by a pool of mortgage loans consisting of borrowers with impaired credit ratings (that is, subprime borrowers), which were a main part of the story behind the subprime mortgage crisis of 2007–2008 (Fabozzi 2015, Chapter 11).

The volatility of real house prices had started increasing substantially after the 1970s: one principal reason is the strong increase in residential land prices following World War II (Knoll, Schularick, and Steger 2017). From the late 1980s up to the 2007 subprime crisis and the Great Recession, the rate of growth of real house prices was significantly faster than the rate of income growth.[3] However, this rise has been unequally distributed across locations. Metcalf (2018) reports the changes in the real median house prices for the core-based areas in the United States between 1996 and 2016. The percentage increase varied from 16 percent in Atlanta-Sandy Springs-Roswell to 75 percent in New York-Newark-Jersey City and a maximum of 168 percent in San Francisco-Oakland-Hayward. Thus, many households found themselves in a situation where housing equity represented a large proportion of their personal wealth and where housing equity also seemed like an asset with a degree of risk it would be unwise to disregard.

From the standpoint of the financial sector and the economy as a whole, the total wealth tied up in real estate is extremely high in all developed economies. Since 1870, for the majority of developed economies, the banking sector has gradually moved from business loans to mortgage loans, particularly after World War II. In western countries, total mortgage loans outstanding have risen (on average) from about 20 percent of annual GDP at the beginning of the 20th century, increasing to 70 percent of GDP by 2010 (Jordà, Schularick, and Taylor 2015). The value of US real estate owned by households and nonprofits (that is, not counting property owned by firms) is approximately $30 trillion (Federal Reserve Board of Governors 2019), approaching the value of the US equity market. The estimated value of all developed real estate worldwide, including residential, commercial, and agricultural land is $217 trillion (Savills 2016). However, in 2014, considering all futures and options contracts traded at 78 exchanges around the world, the contracts targeting the property cash market are counted in the "other" category, representing less than 1.4 percent of all derivatives traded (according to the Futures Industry Association website at http://www.fia.org). Hence, there is a clear mismatch between property's market value and the existing property derivatives' notional amount. In addition, there is continued uncertainty as to how well the economies of high-income countries will survive another large, risky event associated with real estate markets. The need to build and strengthen markets in property derivatives is clear.

[3] One possible explanation proffered by Glaeser, Kolko, and Saez (2001) is urbanization. However, that explanation may be more true in some countries than others. For example, for the United States in 1900, 30 percent of the population resided in cities, increasing by 2010 to 80 percent of the population. In Germany in 1910, 60 percent of the population resided in cities, increasing to 75 percent by 2010. In contrast, in the United Kingdom, the cities were occupied by 77 percent of the population in the early 20th century and remained at that same level (approximately 79.5 percent) in 2010 (United Nations 2014; US Bureau of the Census 1975; General Register Office 1951).

Evolution of Real Estate Derivatives

Early Failures and Baby Steps

The first attempt to introduce a standardized house price futures contract occurred in August 1990 when Karl Case, Robert Shiller, and Allan Weiss, under the umbrella of the Case Shiller Weiss Research Group, proposed to the Coffee, Sugar, and Cocoa Exchange a futures market on single-family homes (Shiller 2008). A few months later in November 1990, the Chicago Board of Trade (CBOT) was presented with a similar idea (Jud and Winkler 2009), and Case Shiller and Weiss, Inc. investigated jointly with the CBOT the feasibility of launching a house price futures market. However, a survey in 1993 clearly indicated that the house price market was very one-sided: that is, there were plenty of investors willing to purchase futures contracts to protect themselves against a decline in housing prices, but not so many investors who wanted to sell such contracts, leading the CBOT to decide against launching a house price futures contract at that time.

At almost the same time, the London Futures and Options Exchange (FOX) introduced several property-related futures contracts in May 1991, including a housing futures contract and futures contracts based on prices and rents for a commercial real estate. However, these contracts did not last long. The underlying data series for the house price futures contract was the Nationwide House Price index (NAHP), where the index was constructed using data from home sales on which the Nationwide Anglia Building Society (since 1992, Nationwide) originated mortgage loans (Baum 1991). However, the index became contaminated by unlawful efforts to boost volume by employing "wash trades"—that is, trades in which a single investor is buying and selling equivalent amounts of the contract at the same time, which can be a way to push misleading information into the market. This manipulative practice led to the termination of this contract in October 1991 (Shiller 2008). The commercial property derivatives were terminated at the same time.

In late 1994, the London Futures and Options Exchange attempted to introduce other real estate derivatives based on an index from IPD (Investment Property Databank) but without great success. Barclays de Zoete Wedd introduced Property Index Certificates (PICs) that were later renamed Property Linked Notes because they were effectively euro-bonds that would replicate IPD returns when traded at par (Lizieri et al. 2012).

In 2001, the United Kingdom witnessed the introduction of a betting market based on house prices by the City Index Group and a year later by the IG Index Ltd. Because these markets were perceived as mainly betting opportunities rather than as hedging instruments, trading has been sparse over the years. In May 2005, the Cantor Index, created by a division of Cantor Fitzgerald Group, started offering betting on house prices based on the Average Greater London and Average UK House Price markets.

In the United States, the so-called "hedgelets," promoted by HedgeStreet in October 2004, were futures-type contracts offered online to small investors who had strong convictions on the direction of specific economic indicators (De Aenlloe

2004). These contracts could be used by individuals to make bets in $10 increments on the future direction of house prices. The contracts that individuals could use to bet on the future direction of house prices had a binary or digital characteristic: specifically, the contract was based on whether the housing price index from the Office of Federal Housing Enterprise Oversight (OFHEO) in one of six cities would fall into a given range on a specific date over the next three months. Such a contract implied that if the index failed to fall within the designated range, half of the participants lost their entire investment.

The Arrival of House Price Futures and Options

The first lasting house price futures contract finally arrived on May 22, 2006, when the Chicago Mercantile Exchange (CME) started trading house futures contracts and options based on the family of S&P/Case-Shiller® Home Price Indices, which covered both a national composite index and 10 major cities.[4] This initial contract was a joint collaboration of the CME and MacroMarkets LLC. In February 2008, Standard & Poor's acquired the S&P/Case-Shiller Home Price Indices from MacroMarkets LLC.

For the US commercial real estate market, Standard & Poor's and Global Real Analytics/Charles Schwab Investment Management constructed the S&P/GRA Commercial Real Estate Indices (Labuszewski and Souza 2007), which were then used by the Chicago Mercantile Exchange in November 2007 as the underlying basis for a futures contract. The intention was to trade commercial property futures on the office, warehouse, apartment, and retail property sectors, and more widely for the nation (as well as for the Northeast, Midwest, mid-Atlantic South, Pacific West, and Desert Mountain West regions) with electronic trading out 20 quarters. Trading volume in the S&P/GRA commercial property index futures has been very low. This is probably attributable to the diversity of commercial property indices in the United States, given that there are many indices constructed in different ways, all competing for the interest of market participants.

In the United Kingdom, only one commercial real estate index was recognized by market participants: the family of commercial property indices published by the IPD. The trading of total return swaps on various IPD country indices started the over-the-counter market in January 2005. According to Jud and Winkler (2009), total return swaps were also traded where the underlying was a commercial property index for the countries of Australia, Canada, France, Germany, Italy, Japan, Spain, and Switzerland, with about £17.3 billion (notional value) of swaps referencing the IPD UK index.

One of the most successful property derivatives so far has been futures contracts on the IPD family of commercial real estate indices traded on EUREX in London

[4] The 10 cities with their initial weighting in the composite index are Boston (7.4 percent), Chicago (8.8 percent), Denver (3.6 percent), Las Vegas (1.4 percent), Los Angeles (21.1 percent), Miami (4.9 percent), New York (27.2 percent), San Diego (5.5 percent), San Francisco (11.7 percent) and Washington, DC (7.8 percent).

(Fabozzi and Tunaru 2017). One possible explanation for the relative success of this contract is the fact that the IPD family of indices was and still is widely regarded as the main representative index family for commercial real estate in the United Kingdom. The IPD index construction methodology was extended to other countries such as Germany and France. (By contrast, the multitude of US commercial real estate indices may be detrimental to the innovation of new derivatives financial instruments.) The contracts as initially launched in February 2009 were annual contracts based on the total returns of the IPD UK Annual All Property index for individual calendar years. There are futures related to various property portfolios covered by IPD such as the composite level (UK All Property), sector level (UK office, UK retail, and UK industrial), and sub-sector level (UK retail warehouse, UK shopping centres, London city offices, London west end and mid-town offices, and south-east industrial). One important change that has occurred is the 2015 takeover by Morgan Stanley Capital International (MSCI) of the IPD. MSCI then changed the underlying IPD UK Annual Return All Property index into a quarterly calculation. This change was made to streamline the marking-to-market process to be more in line with the dynamics of the property index.

The Subprime Crisis and a Mortgage Derivative on House Price Risk

Collateralized mortgage obligations were created in the 1980s, as noted in the earlier discussion. These securities had often included a mixture of mortgage of different risk characteristics. However, as a rise in the issuance of subprime mortgages was accompanied by the run-up in housing prices in the early 2000s, there was a sharp increase in the number of investors who were willing to take one side or the other of the market for mortgage risk. This turn triggered the introduction of ABX.HE indices (the initials stand for "asset-backed securities, housing equity").

These indices, which are determined from 20 subprime mortgage-backed securities, employ credit default swaps (CDS). A CDS is an agreement whereby the buyer of protection makes a payment (called a premium) at a regular frequency to the seller of protection. In exchange for the premium, the seller provides some form of price protection for some reference entity over a specified time period should a credit event (such as bankruptcy) occur. CDS contracts initially provided protection for corporate bonds and sovereign bonds, allowing the pricing of credit risk for these issuers. In January 2006, Markit Group, Ltd. introduced the ABX.HE indices. Each index tracks the CDS contracts on subprime mortgages with a specified credit rating at the time the mortgages were originated and issued at a specified time (referred to as the "vintage"). For example, ABX.HE BBB tracked the CDS contracts for subprime mortgages that received a credit rating of BBB. With the introduction of the ABX.HE indices investors were able to obtain transparency about the price of subprime mortgage-backed securities by credit rating. Fender and Scheicher (2008) describe in more detail how changes in the price of the ABX.HE can be interpreted as a barometer for stress in the subprime mortgage market.

The main risk posed by a credit default swap is counterparty credit risk, which is the risk that the seller of protection will not cover the losses in case of a credit event. This type of risk appears not to have been on the radar of regulators prior to the global financial crisis, but it was managed among big market players through collateral posting. Regulators came to recognize this problem when a subsidiary of American International Group (AIG Financial Products) lost almost $100 billion in 2008 alone (for a more in-depth discussion of the AIG story in this journal, see McDonald and Paulson 2015).

On the positive side, the evolution of prices in the ABX.HE market confirms the important role that derivatives contracts can play in providing forward-looking information. The contracts were issued twice a year, in January and June, based on the securities issued in the preceding months. Starting in 2007 and 2008, for example, the prices of contracts issued in June 2006 started falling sharply compared to those issued in January 2006—thus showing that the risk of default on subprime mortgages was rising sharply. Conversely, the prices on the ABX.HE contracts in 2009 signalled the end of the subprime crisis.

Successes and Limitations of the Early Property Derivative Efforts

The combination of the rise and fall in housing prices, the crisis in subprime lending, and the Great Recession, taken together, hobbled the promise of the early direct hedging vehicles for real estate risks. The size of the futures and options markets for the S&P/Case-Shiller Home Price Index on the Chicago Mercantile Exchange peaked around the time of the subprime crisis and survives only in a diminished form. In London and other cities, the IPD swaps market grew dramatically until around 2008 but have languished since then. However, in 2009 Eurex launched futures contracts on several IPD indices for various sectors of the commercial real estate market which are still traded today. Overall, the UK property derivatives market has experienced more success than its US counterpart. Torous (2017) offers two possible explanations: 1) the UK market has one dominant commercial real estate index while the US market has several; and 2) there has been effective lobbying by UK property funds to adopt to new more favorable tax legislation.

Studies of the early efforts at creating property derivatives have clearly demonstrated their potential benefits, for example. Lee, Stevenson, and Lee (2014) and Wong, Chau, and Yiu (2007) provide empirical evidence on the stabilizing role of property futures on the volatility of spot property markets. Zhu, Pace, and Morales (2014) empirically investigate how well market information from the Case-Shiller house price futures performed as a forward-looking forecast. Using loan-level mortgage data covering over 90 percent of the residential mortgage loans included in the mortgage pool of US non-agency securitized deals, they found that forecasts extracted from the Case-Shiller house price futures outperformed other proxies preferred in the literature and employed in practice, both in sample and out of sample. Moreover, the Case-Shiller futures forecasts were the only series implying a downward housing price effect that would impact negatively on mortgage default behavior.

Property derivatives provided institutional investors, such as pension funds and insurance funds, a tool to manage their commercial real estate portfolio more efficiently. Bertus, Hollans, and Swidler (2008), for example, demonstrate that investors exposed to house price risk in Las Vegas could have hypothetically have used the CME house price index futures to reduce risk by more than 88 percent from 1994 to 2006 (one year prior to the subprime crisis). Information extracted from the price of property derivatives can play an important role in providing expectations of housing prices that can be used in modelling mortgage defaults. Dolan and Hume (2010) show that the CME futures market effectively predicted the home price crash in the United States before the news media did.[5] Jud and Winkler (2008, 2009) look at risk and return for an investor who participated in the house price futures market. Using daily data on CME-traded house price futures for the period May 2006–May 2008, they reported that the returns on futures were positive, even if the returns of investing in the spot market were negative.

Empirical evidence covering a few European countries including the United Kingdom also highlights the substantial benefits associated with house price derivatives when utilized to manage risk (Englund, Hwang, and Quigley 2002; Iacoviello and Ortalo-Magné 2003; Quigley 2006). These benefits include increasing the financial system's stability, and the ability of millions of homeowners to manage property risk more cost-effectively (Fabozzi, Shiller, and Tunaru 2009). Bond and Mitchell (2011) also find that property derivatives prices outperformed the consensus forecasts of future returns in the UK market.

Obstacles in the Development of Residential Property Derivatives

Several surveys of key players in real estate markets have inquired about the reasons for their reluctance to trade property derivatives.[6] Here, we focus on what we see as some of the most prominent impediments to growing a market for financial instruments based on house prices: 1) how real estate indexes may be mismatched with the needs of property derivatives; 2) a fear of negligible liquidity; 3) the lack of models to price these derivatives; and 4) concerns about an uncertain legislative framework vis-à-vis this new derivatives asset class. Along with the four concerns discussed here about hindrances to a more robust development of property derivatives, other concerns mentioned in the surveys include a lack of education by house

[5] John H. Dolan, market maker for eight years for the CME Case Shiller home price futures and options markets, has a web site, *HomePriceFutures.com,* that provides regular information about those markets,and moderates an online discussion on LinkedIn (the "CME Case Shiller Home Price Futures" group).

[6] For example, Lim and Zhang (2006) use a web-based survey of 37 US-based real estate investment managers, fund managers, and commercial lenders and brokers to identify the principal reasons for the stalling development of property derivatives. Venter (2007) interviews ten UK individuals that included tax lawyers, an index provider, investment bankers, brokers, investment advisors, and a property company. Puntener (2011) interviews six academic experts, 17 financial and property experts, and two advisors, in the United States and United Kingdom. Hanisch (2019) carries out 41 individual interviews and two group interviews between June 2016 and March 2017.

owners on appropriate use of derivatives and the number of asset managers who see little need to hedge real estate risk because of the low volatility traditionally associated with sectors of the real estate market. There was no evidence of regulatory or cost barriers that may have deterred potential entrants into the property derivatives sector prior to the subprime crisis. However, this has changed in the aftermath of the subprime crisis and some stringent regulatory risk measures have been imposed on derivatives in general.

Index Construction Mismatch

The construction of a house price index involves a number of choices, which in turn affects the financial derivatives that might be built using such an index. For example, house price indices can be national or regional, rural or urban, cover new or existing homes, or both. Prices for an index might be taken from market house sales, which runs the risk of not representing properties with the same characteristics over time. Alternatively, a house price index might use listed prices (whether or not a sale results) or appraisals by designated organizations, but these possibilities include more subjectivity on what a certain property is "worth."

The most widely preferred method is to construct real estate indexes by using sales prices, but in a way that adjusts for the quality of the houses being sold. One approach is to use hedonic regressions, thus adjusting for key qualities of the house. However, real estate has a wide array of unobserved heterogeneity, including aspects of location and quality of maintenance and upkeep, so there is reason to doubt that the assumptions made when using a hedonic approach are satisfied (Clapham et al. 2006). Thus, real estate indexes have mostly converged on the repeat-sales approach, which focuses on houses that have been sold at two different points in time. Case and Shiller (1987) propose the weighted repeat-sales method: in their version, repeat sales that happen with a longer time interval between sales are given less weight than repeat sales with smaller time intervals, because the quality of a house changes more over longer time periods. The S&P/Case-Shiller® Home Price Indices use this approach, and the Office of Federal Housing Enterprise Oversight (OFHEO) publishes a repeated sales index using its own version of the Case-Shiller approach.

The problem arises because a standard futures contract, like the CME house price futures contract, is based on the initial value of the real estate index (CME 2007a, b). Over the life of the futures contract, new information is gathered on contemporaneous paired sales. This new information most likely will create changes in the estimates of the house price index value in all previous periods. A large discrepancy can arise between futures settled on the initial value of the index and those settled on the revised value of the spot index. This potential discrepancy is sensitive to details of how the index is weighted and calculated (Shiller 1993a, b; Deng and Quigley (2008).

Problems in matching the timing of the real estate index to the property derivative can arise in a number of ways. In the United Kingdom, property futures traded on the IPD exchange use a December year-end maturity for five years ahead, but a post-March publication date for the real estate index: hence, there is a three-month period mismatch between the calculation period (December to December) and the information period (March to March). Another design problem for the IPD futures contracts was that the futures were traded on the IPD UK Annual total return index, while the marking-to-market was done on the IPD UK Monthly total return index. The latter index covered only a subsample of about 80 percent of the annual IPD index. The acquisition of IPD by the MSCI in 2012 had implications for the commercial real estate index family: the major change involved switching to a quarterly valuation. As another example, the existing MSCI UK Quarterly property index captures total returns of directly held standing property investment, based on tracking the performance of 8,913 property investments, cumulating to £160 billion by June 2019.

The ties between calculation of real estate indexes and the property derivatives based on those indexes are real ones. For example, using an extensive repeat-sales database for the Paris housing market, Baroni, Barthélémy, and Mokrane (2008) show that the revision problem may cause concern about the stability of some key parameters. However, the magnitude of the impact of revision on the property price indexes is not so substantial so as to make market participants pull out of property derivatives that would protect them against severe market downturns.

Negligible Liquidity: Missing One Side of the Market?

Most real estate owners recognize that they have made a long-term investment in an asset they will some day wish to sell at the spot price, and so they are at least potentially interested in property derivatives to hedge against the risk of falling prices. In addition, Jordà, Schularick, and Taylor (2015) show that in developed economies, by 2010, mortgage credit on the balance sheets of banks represented about 60 percent of assets on average. Moreover, the stress testing that has been introduced for systemically important banks and financial institutions requires those entities to pass an overall portfolio survival test against a decline of 30 percent in real estate markets. One way to satisfy the regulators would be to purchase an option on the major real estate indices that would only pay off after a substantial decline in property values. If such an option was traded regularly, liquidity in the property derivative market would receive a welcome boost. In general, futures contracts have provided a reliable vehicle to offset risk in capital markets. For property markets, futures contracts also allow investors to take positions that are equivalent to short-selling the property market, which is not possible to do in the spot markets for property.

But at first glance, it is unclear who should be the counterparty in those property derivatives trades: that is, who is willing to provide insurance against a fall in property prices or hedge against a rise in prices? Of course, a property derivatives market cannot flourish without participants on both sides. Any investor who has exposure to a drop in property prices should be interested in offsetting possible losses on their exposure with the financial gains from a position in property derivatives. This is the case for typical homeowners, real estate financial houses, institutional investors in mortgage-backed securities, pension funds invested in property portfolios, insurance funds using property investments for their asset-liability management, and building societies who carry mortgages on their balance sheet.

One can conjure up hypothetical examples for the other side of the market easily enough: as mentioned earlier, one can imagine young people, who expect to buy their first home when they are ready in the future, might use property derivatives to start investing in property synthetically to avoid being priced out of the market. Homeowners in one city who feel they will eventually move to some other city might combine a short position, that is, selling the futures contract in their current city, with a long position, that is, buying the futures contract in a national home index price. Providers of "target date" retirement funds might provide such a service, perhaps adjusting exposure to real estate risk in the local market and in likely retirement destinations as the beneficiary approaches retirement age. However, it seems implausible that these kinds of market participants will be substantial enough to make up the other side of the property derivatives market.

More likely, it would be mutual funds, insurance companies, pension funds and other managers of large pools of funds who desire to be fully diversified who take the other side of the real estate risk on derivatives. The role of speculators and sophisticated traders, such as hedge funds and private equity firms, becomes even more important to ensure liquidity for property derivatives. Once a market in property derivatives is clearly established, it's also easy to imagine that general investors might eventually, after a market is established, be enticed by how the combination of risks and returns fits within their broader portfolio.

Modelling Considerations

Given the non-standard characteristics of real estate indexes and property in general by comparison to commodities, equities, bonds, and currency exchange rates, it is perhaps not surprising that pricing even straightforward derivatives such as futures, put and call options, and total return swaps is not straightforward. Many pitfalls and caveats must be considered. For example, many of the models used for pricing derivatives depend on a no-arbitrage constraint: thus, the futures market for the S&P 500 as a whole is governed by what it would cost to buy the portfolio of underlying stocks. But buying a portfolio of houses that replicates a well-designed real estate index would be a costly and illiquid investment, so this no-arbitrage condition and its implications no longer hold. A standard no-arbitrage condition suggests that the relationship between the spot price of the derivative and the expected future price will be driven largely by the risk-free rate of return, but as Drouhin, Simon, and Essafi (2016) show in a study of IPD total return swaps contracts, this relationship does not hold in the context of property prices. Furthermore, without a no-arbitrage condition, the standard Black-Scholes option-pricing formula cannot be derived using the classical replication approach.

Indeed, one argument for the full development of a property derivatives market with futures contracts is that it sidesteps what can otherwise be some complex and disputable econometric work on valuing derivatives. If property futures do exist in the market, then it becomes possible to set prices for options on property prices using the Black (1976) formula. However, market-makers still need to decide those prices for futures somehow. While producing different valuations of property derivatives may attract more players into this market, market-makers need to make defensible decisions that are capable of resisting attempts by various other players to drive the market price too high or too low for non-economic reasons. Models that can be relied upon for property derivatives markets are also models that take into account the econometric features of the spot property markets. They must be easy to set up, not highly computationally intensive, and characterized by parameters that have a direct interpretation in financial terms.

There are currently two schools of thought about the appropriate models to price property derivatives. One school considers how to replicate the contingent claim of the property derivative given existing prices in the market, along with selecting a set of stochastic processes to represent dynamics of the underlying real estate index combined with risk-neutral pricing. Examples along these lines include Titman and Torous (1989), Buttimer, Kau, and Slawson (1997), Björk and Clapham (2002), Otaka and Kawaguchi (2002), Syz and Vanini (2011), and Fabozzi, Shiller, and Tunaru (2012).

A main challenge in this approach is that the choice of stochastic processes to represent dynamics of the underlying real estate index can lead to difficulties. One unreliable approach followed in some strands of the literature assumed that the underlying property indices or property prices followed a geometric Brownian motion. This assumption is inconsistent with the overwhelming empirical evidence starting with Case and Shiller (1987, 1989) that indicates that house prices 1) exhibit serial correlation and 2) are positively correlated over short horizons and negatively correlated over long horizons. More recent evidence across several markets is presented in Tunaru (2017). Mean-reverting processes are capable of generating pathways that match these empirical characteristics and they could be more appropriate as a starting point for pricing property derivatives as discussed in more detail in Fabozzi, Shiller, and Tunaru (2012).

The other school of thought in this literature is defined by various equilibrium models. For example, Geltner and Fisher (2007) and Lizieri et al. (2012) propose equilibrium-based models for calculating forward prices and the total return swap spread. Cao and Wei (2010) sidestep the non-tradability of underlying housing indices for the CME-traded housing futures and options by assuming a mean-reverting aggregate dividend process and a constant relative risk aversion utility function to derive analytical forwards and options prices, equilibrium, and no-arbitrage.

However, this approach also raises questions. Equilibrium models may be useful for marking-to-model property derivatives positions, particularly when there is no information on the derivatives either due to market closure or crises events. However, the connections between a known futures price given by markets and corresponding prices of put and call options are based on model-free, no-arbitrage relationships, and Tunaru (2017) provides several examples showing that equilibrium prices may not satisfy this requirement. Perhaps the biggest concern is that if one of the arguments for property derivatives is as a mechanism to foresee and to manage financial crises, it is difficult to reconcile the idea of a market being in equilibrium and in a financial crisis at the same time.

A final concern about modelling futures prices in property derivatives is that the market for single-family homes has been one of exceptionally high transactions cost and impossibility of short sales, which permit the high level of momentum and of apparent bubbles. The transition to a real estate market with functioning property derivatives that allow for extensive hedging may well alter the time-series properties of the underlying cash price. For that reason, the past time-series properties of home price indices may not be a good guide to the future. However, one can view this as a transition problem, which would become smaller over time as market experience increases with property derivatives.

Regulatory Issues

Before the subprime crisis, a number of large investment banks were involved in property total return swaps using over-the-counter trades—for example, Deutsche Bank, Merrill Lynch, Morgan Stanley, and the Royal Bank of Scotland. They were satisfied to enter trades with various clients and take the risk on their books for long periods of time until they were able to offload those risks.

In the aftermath of the subprime crisis, trading in the property derivatives market moved from over-the-counter to exchange-based. In addition, the Basel III Accord established a new set of rules requiring banks to allocate additional capital for each leg of a derivatives trade. As a result, trading property derivatives became very capital intensive. These increased regulatory capital requirements associated with property derivatives motivated banks and investment banks to exit this asset class. Given ongoing concerns about financial risk, bailouts, and systemic risk, there is ongoing concern about future rules that might further discourage large financial institutions from participating in property derivatives markets.

Lessons and Proposals for the Future

Since the 1970s, property price risk has affected investors and economies with increased frequency. Markets in property derivatives are the key to providing both investors and lenders with the tools to mitigate property-related risks. However, the market for real estate has various characteristics that differentiate it from other asset classes where derivatives were successfully introduced. Given the specific economic and econometric characteristics of the underlying asset, along with the house price and commercial property indexes based on that asset, property derivatives require a more complex process to be generally accepted by financial market participants. In particular, more needs to be done on the modelling side to facilitate pricing and hedging in this incomplete market. The ultimate goal is for property derivatives to be traded as a standard commodity, similar to the way that futures, options, and swaps are traded for stock and bond indexes.

Financial derivatives have sometimes attracted a bad reputation, often after prominent financial institutions (like the AIG example with credit default swaps mentioned earlier) suffered large losses. Derivatives can allow for high leveraging and when events turn bad, may magnify losses. In modern times, the majority of financial crises involved in one way or another the use, or rather, the misuse of derivatives. Of course, with or without financial derivatives, investors have many ways to underestimate risk and end up with substantial losses. In contrast, during the many times when financial derivatives have allowed parties to hedge risk, increase speed, reduce transactions costs, and balance investment portfolios, it has attracted almost no attention. By now, derivatives are commonly used worldwide, and their usefulness in spreading various types of risk in a sustainable manner is gradually passing the test of time.

Governments, banks, and other financial institutions have sound reasons to work together to give impetus to the development of property derivatives. As the largest asset class without corresponding liquid derivatives, property derivatives would offer some of the largest benefits from making the leap to a commoditization status. This leap would help directly and indirectly provide forward-looking price signals for a variety of uses, including their application to stabilizing financial systems, and in this way, reduce the risk of market crashes and the resulting economic instability.

The historical development of derivatives markets to deal with the risks of other asset classes such as equity, foreign exchange, bonds, commodities and credit default swaps, suggests that those derivatives markets were greatly helped by a model that was generally adopted by the important market players—the Black-Scholes (1973) model for valuing equity options being the most notable example. As market volume increased, so did the demand for innovation in those markets that led to the introduction of more sophisticated models. But currently, property derivatives lack a widely accepted model.

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