EDHEC BUSINESS SCHOOL

THE IMPACT OF SOLVENCY II PRUDENTIAL REGULATION ON PROPERTY FINANCING IN THE INSURANCE INDUSTRY

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MINISTÈRE DU LOGEMENT ET DE L'HABITAT DURABLE

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TABLE OF CONTENTS

This study was conducted in partnership with the French Ministry for Housing. DGALN - DHUP – French Bureau of Economic Studies (FE5): fe5.dhup.dgaln@developpement-durable.gouv.fr.

EXECUTIVE SUMMARY

In this study, we analyse the impact of Solvency II prudential regulations on property investments made by French insurers. Real estate has historically played an important role in the asset-liability management (ALM) activities of insurance companies, given its long duration, its contribution to the diversification of portfolio risk, its ability to hedge inflation risk, and its performance. Today, the role of real estate within the ALM activities of insurers must be assessed not only against these traditional indicators, but also in line with the Solvency II regulatory capital requirement. The 25% capital charge for property investments, required by EIOPA using the British property market as a reference, is highly controversial and often regarded as one of the major obstacles impeding insurers from boosting the property share of their portfolios. It restricts the duration matching of assets and liabilities, and also hinders the diversification of assets under management.

This study presents a critical analysis of the Solvency II prudential regulation while looking at the calibration of property risk. We test the robustness of the calculations for the two key calibration elements of Solvency II: the size of the property shock (*Value-at-Risk*) and the correlation of real estate with other asset classes. Using several data sources and several complementary methodologies, we show that VaRs are very sensitive to the geographical area and to the nature of the property. In absolute value, figures are higher for office property and in the United Kingdom than they are for residential property and within the euro area. However, in all cases, they are still significantly lower than those used by the prudential regulator. Furthermore, we show that the property/financial assets correlation coefficients used by EIOPA are systematically overestimated, regardless of the methodology, the geographic area and the type of property in question.

Given the systematic biases identified within estimations of VaR and of correlation coefficients, this study assesses the overall impact of Solvency II calibration choices on the market solvency capital requirement (SCR). A simulation using new estimates results in a significant reduction in capital requirements (between 10% and 20% depending on the share of real estate in the portfolio). This confirms that the current calibrations used by EIOPA are a real obstacle, impeding the return of insurers to the property market.

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INTRODUCTION

INTRODUCTION

Solvency II, the new prudential regulation framework for the insurance sector which came into force in early 2016, is a major transformation from the previous regime, Solvency I. The latter was based on a flat-rate approach, mainly as a function of technical provisions in life insurance and turnover in non-life insurance. Conversely, Solvency II offers an approach that extends to all of the risks faced by an insurance company. The main objective of this new regulation is, on the one hand, to protect policyholders and beneficiaries of insurance contracts and, on the other hand, to bring about better functioning of the competitive insurance market in Europe. To achieve this, it aims to encourage insurers to better identify, measure, manage and control all the risks they incur (underwriting, market, counterparty and operational).

One of the major changes of Solvency II is the explicit treatment of market risk. While, under Solvency I, the asset choice of insurance companies was typically restricted by national insurance codes, this new European standard offers complete freedom in terms of the choice of assets and their allocation, in return for a regulatory capital requirement intrinsic to each asset (referred to as the *Solvency Capital Requirement* or *SCR*). This structurally changed the asset allocation of the insurers, who now measure profitability in terms of regulatory capital requirements.

Specifically, we should remember that the insurance business is essentially based on a contract whereby, for the payment of a premium by the policyholder, the insurer agrees to pay a capital, an annuity, a return or to reimburse an insurance claim. With the exception of unit-linked contracts, ultimately, the investment risk is predominantly borne by insurance companies. Faced with this challenge, the aim of asset-liability management is to determine the optimal asset allocation allowing investors to manage all the risks faced by companies. The challenge is a great one because the level of outstanding investments for the European insurance sector is of the order of €10 trillion (Insurance Europe, 2016).

Within this context, real estate has historically played an important role in asset allocation, given its long duration, its ability to hedge inflation risk, its contribution to the diversification of portfolio risk, and its performance. The role of real estate in asset-liability management should be evaluated while taking into account the four factors of duration, liquidity, risk and profitability defined within the constraints of Solvency II capital requirements. The 25% capital charge for property investments, required by EIOPA using the British property market as a reference, is highly controversial and often regarded as one of the major obstacles preventing insurers from boosting the real estate share of

their portfolios. It restricts the duration matching of assets and liabilities, and also hinders the diversification of assets under management.

So, in this study, we analyse the impact of Solvency II prudential regulations on the financing of property investments made by French insurers. In the first section, we detail the new prudential system with a particular focus on the treatment of property assets. In the second section, we conduct a critical analysis of the calibration of property risk (size of the property shock and gains from diversification between real estate assets and financial assets). We test the robustness of VaR calculations for the property sector and correlations between real estate and financial assets by using data sources and methodologies other than those used by EIOPA for its calibration.

1. THE TREATMENT OF PROPERTY UNDER THE SOLVENCY II PRUDENTIAL REGULATION

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For more than two decades, the increasing complexity of risks has triggered a genuine desire to adapt accounting and prudential rules, with the aim of providing a better perception of the risks borne by businesses. With Solvency II, the European Union wanted to adapt solvency requirements to the risks faced by insurance companies and encourage them to better assess and monitor their risks. This first section aims to explain regulatory risk as defined by the regulator, looking at property risk in particular.

1.1. SOLVENCY II: MEASURING RISK AND MODULAR ORGANISATION

The regulator sets the solvency capital requirement or SCR as the amount of capital necessary to allow the company to deal with business activity risks for a given time horizon and confidence level. The benchmark risk measure chosen by the European Insurance and Occupational Pensions Authority (EIOPA) to measure SCR is Value-at-Risk (VaR). VaR[1] equates to a company's maximum potential loss, taking into account an investment horizon (one year for Solvency II) and a level of confidence 1-α (99.5% for Solvency II):

$$VaR_{\alpha}(X) = -\inf\{x : F_X(x) \geq \alpha\}$$

where X is the random variable of the gains made by the insurance company and $F_X(.)$ is the cumulative distribution function.

Thus, for each risk identified, the tested scenarios are calibrated in such a way as to obtain a capital requirement that corresponds to a 99.5% Value-at-Risk over one year. These capital requirements should enable any insurance company to be able to handle bankruptcy risk, the likelihood of which is once every 200 years, within a stationary environment.

The definition of SCR is based on a bottom-up approach that can be illustrated thanks to a modular risk structure (see Figure 1). Seven risk modules contribute to the determination of the solvency capital requirement (SCR): three underwriting risk modules (life, non-life and health); one market risk module; one default risk module; one risk module linked to intangible assets; and lastly, an operational risk module.

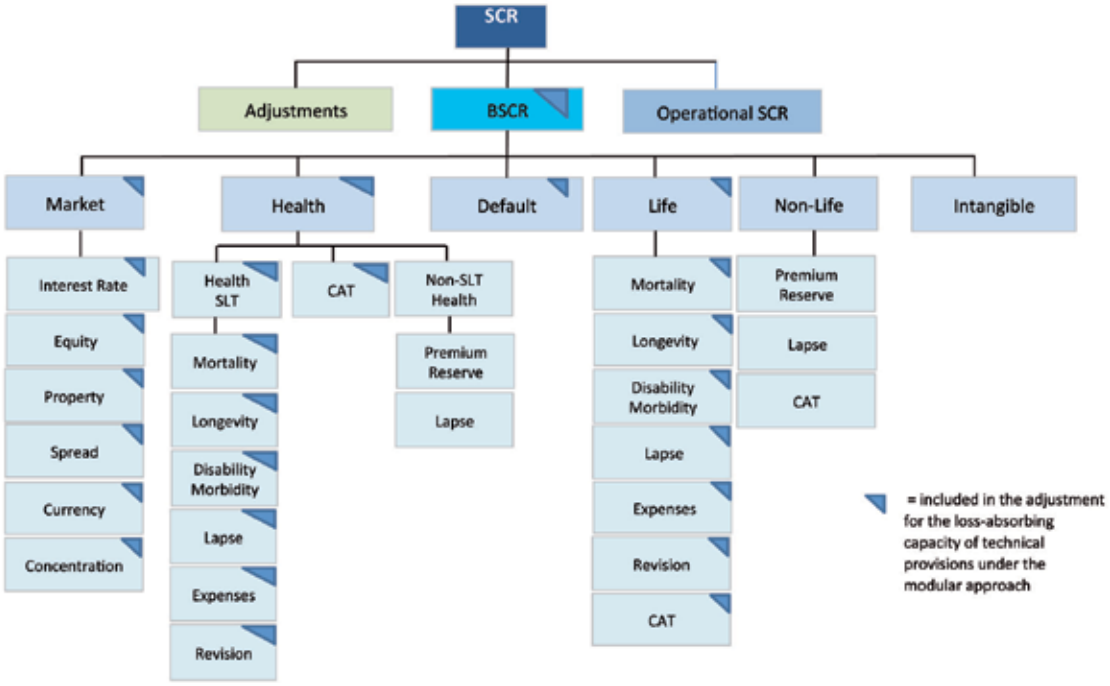
Specifically, the SCR of an insurance company is obtained by aggregating three elements:

- the Basic Solvency Capital Requirement (or BSCR);
- the SCR that stems from operational risk;
- the adjustments linked to loss absorption capacity of technical provisions and deferred taxes.[2]

1 - While this concept may be easy to convey, it is very controversial, because VaR is not additive (i.e. the overall VaR of a company is not necessarily less than or equal to the sum of the VaRs of each of the components). This means that the benefits of diversification are not always considered. To integrate these benefits when aggregating the different risk factors (life, non-life, market, etc.) that were initially measured independently, the European regulator was forced to define correlation matrices (Foulquier and Le Maistre, 2012).

2 - This adjustment indicates potential compensation of unexpected losses by looking at technical provisions and deferred taxes. In the case of technical provisions, the adjustment takes into account the fact that future discretionary benefits can be reduced in order to hedge unexpected losses. The case of deferred taxes involves establishing the time differences between the Solvency II valuation and the tax valuation, following the application of stress scenarios.

Figure 1: Modular structure of risk according to Solvency II



Source: Commission Delegated Regulation (EU) 2015/35

The key issue at the heart of our study led to us focusing on the market risk module, because it contains the risk sub-module for property investments (see Figure 1).

1.2. MARKET RISK

The market risk module measures the risk stemming from the market price and volatility level of financial instruments. It is composed of six risk sub-modules, which assess interest rate risk, equity risk, spread risk, property risk, currency risk and asset portfolio concentration risk. The capital charge of each market risk sub-module corresponds to the loss of basic own funds, after investment values have been subjected to a shock. These losses are then aggregated using a correlation matrix to obtain the capital required for market risk (SCR_{market}).

$$SCR_{market} = \sqrt{\sum_{i,j} Corr_{(i,j)} \times SCR_i \times SCR_j}$$

where the sum covers all possible (i, j) combinations of the market risk sub-modules. SCR_i and SCR_j correspond to the capital required for risk sub-modules i and j, respectively. $Corr_{(i,j)}$ is the correlation between risk sub-modules i and j. The correlation parameters are detailed in Table 1.

Table 1: Market risk correlation matrix

j / i	1	2	3	4	5	6
1. Interest rate	1	A	A	A	0	0.25
2. Equities	A	1	0.75	0.75	0	0.25
3. Property	A	0.75	1	0.5	0	0.25
4. Spread	A	0.75	0.5	1	0	0.25
5. Concentration	0	0	0	0	1	0
6. Currency	0.25	0.25	0.25	0.25	0	1

Source: Commission Delegated Regulation (EU) 2015/35

Parameter A is set to 0 in the case of rising interest rates and to 0.5 in the case of falling interest rates.

1.3. PROPERTY RISK

Property risk arises from the sensitivity of assets to the level or volatility of the property market prices. Investments covered by this risk sub-module include:

- land, buildings and immovable property rights;
- property investment for the own use of the insurance company.

The capital required for property risk (SCR_{prop}) is equal to the loss of basic own funds following an instant 25% fall in property values.

$$SCR_{prop} = \max(\Delta BOF | property\ shock; 0)$$

where ΔBOF is the change in the amount of *Basic Own Funds*.

By comparison, the capital requirements for equity investments vary between 22% and 49% depending on the type of investment (listed, unlisted, related companies, infrastructure, etc.).

Some property investments are treated as equity investments and therefore fall under the equity risk sub-module:

- an investment in a property management company;
- an investment in a company involved in a property development project or similar activities;
- an investment in a company that has obtained loans from institutions outside the scope of the insurance group in order to leverage its property investments.

Property holdings and collective property investment funds are treated using the so-called Look-Through Approach.[3]

This first section presented the calculation structure for the solvency capital requirement (SCR) and analysed the regulatory capital requirements for market risk, specifically risks relating to property investments. The second section presents a critical analysis of the calculation used for property risk capital requirements.

3 - The Look-Through Approach (LTA) involves calculating the SCR on the basis of each underlying asset within the collective investment schemes or funds in which the insurance company invests.

II. A CRITICAL ANALYSIS OF PROPERTY UNDER THE SOLVENCY II PRUDENTIAL REGULATION

2. A CRITICAL ANALYSIS OF PROPERTY UNDER THE SOLVENCY II PRUDENTIAL REGULATION

In this second section, we propose testing the pertinence of the property risk calibration used by the Solvency II regulation. As we have shown in the first section, the two key elements of the Solvency II calibration are (a) the magnitude of the property shock to determine the $SCR_{property}$ and (b) the calculation of the correlation of real estate with other asset classes present in the market risk module. We shall revisit the statistical analysis proposed by the regulator and evaluate its robustness in view of the data used and the methodology applied. First, we present all of the data sources used (those of the regulator and from additional sources). In a second sub-section, we provide a simple descriptive analysis of property and financial returns. In a third sub-section, we present several techniques for calculating property VaR and its correlation with financial assets. We then provide conclusions on the robustness of Solvency II's chosen calibration.

2.1. PRESENTATION OF THE DATA SOURCES

This section presents the data used for the calculation of property returns (both residential and commercial property). An appendix lists all of the sources used to produce returns for stocks and for bonds (interest rates and credit spreads). This financial data is, for the most part, used for the Solvency II calibration.

To establish the capital that insurance companies require for property, EIOPA has used the IPD (*Investment Property Databank*) indices, which are available for the United Kingdom market. More specifically, the SEC-40-10 document (*Solvency II Calibration Paper* CEIOPS Paper, April 2010) states that the 25% shock applied to property assets is determined from the 0.5% percentile of the distribution of total returns for the IPD UK monthly index calculated for the period from December 1987 until the end of 2008. Returns were obtained by using a 12-month rolling window. It is an index that encompasses the different types of property assets (residential, office, commercial, etc.). This is exactly the same source that helped determine the correlation coefficients between real estate and financial assets. Subsequently, this UK IPD index will serve as our benchmark: we will use it to try to replicate the EIOPA calibration by stretching it over time to include more recent data (i.e. from January 2009 onwards).

The use of UK property market data has advantages and disadvantages. The main advantage is the sampling frequency. Within Europe, practically only British data is available on a monthly basis. French or German data are, at best, available on a quarterly basis. This sampling frequency for the UK, which is relatively high, offers more flexibility in the calculation of a VaR with a 99.5% confidence level. This avoids

having to resort to old data that could be potentially unrepresentative of current property market conditions.

However, the use of the IPD UK index brings certain limitations. In terms of real estate, the UK is a separate market, quite clearly decorrelated from the main markets of continental Europe. The volatility of returns is much higher than in France, Germany and Italy. In addition, the turning points of the UK property cycle often materialise early, particularly in London. For instance, the subprime crisis of late 2007 hit the UK property market several months before the French market.

Moreover, by adopting, as we do in this study, the point of view of a French insurer, investing in UK property is not commonplace. To help illustrate this, the geographical distribution of the property assets held by Allianz and Axa shows that outside of France, there is a leaning towards the Swiss, Belgian, Dutch and German markets.[4] Additionally, as we will see later, while the property data retained by EIOPA is exclusively British, this is not the case for the other asset classes (equities, interest rates, spreads) which have much wider geographical coverage. We therefore propose complementing EIOPA's IPD index benchmark with other IPD indices covering other European markets, including France.

Beyond the UK market, choosing the IPD indices is questionable. In fact, these indices, regardless of the country in question, are based on expert appraisals and not on actual transactions. Underlying prices are therefore estimates and not market prices. A very large body of (predominantly US) literature (Geltner, 1991; Cho, Kawaguchi and Shilling, 2001) has detailed the shortcomings of appraisal-based indices: (a) they are usually smoothed out meaning that the actual volatility of returns is underestimated and (b) cycle turning points are estimated with delay. Some techniques have been put forward to address these biases (for instance Bond, Hwang and Marcato, 2005), but they have been applied to the US market and have not been proven to work for European indices. Therefore, to address this problem, we propose using indices based on actual transactions (in addition to the IPD indices).

Ultimately, by choosing an index that does not distinguish between the different types of property (offices, residential, etc.) as a benchmark, diversification gains by type of property are automatically ignored by EIOPA. The weaker the correlation between residential and office property, the more we should expect that the capital required to cover property risk has been overestimated by EIOPA. In our analysis, we examine different types of property assets and estimate the impact of this possible diversification on the SCR.

Table 2 summarises all the data sources used in this study. In addition to the IPD

4 - AXA: 30% France, 38% Switzerland, 10% Belgium, 9% Germany, 5% UK and 8% other. Allianz: 25% France, 24% Germany, 12% Switzerland, 8% USA, 7% Italy, 16% rest of the euro area and 9% other (Source: analyst presentations).

Table 2: Property data

Index	Geographical area	Type of property	Frequency	Period
IPD	UK	All types	Monthly	1987-2014
IPD	Euro France Euro + UK	All types	Quarterly	2003-2009
IPD	France	Residential Offices	Annual	1986-2014
Transaction-linked indices	Greater Paris (Île de France)	Residential Offices	Quarterly	1996-2013 1993-2005

monthly UK index used by EIOPA and supplemented over the period [2010-2014], we make use of other IPD indices (source: *Bloomberg*). On a quarterly basis, we compare the total returns (rental yields and capital gains) for the whole euro area, for the euro area and the UK combined, and finally for France only. All these indices were originally calculated on an annual basis and have since been recalculated quarterly using interpolation and ordinary least squares techniques, which were implemented by IPD.

This first set of data will allow us to test the robustness of the Solvency II calibration using geographical zoning. It should be noted that the historical depth of the quarterly data is very short (our sample begins in 2003), which will force us to use hybrid methods to calculate VaR. It is equally important to note that our sample includes the 2007-2008 crisis for the estimation of the VaR.

We also use the standard IPD annual indices (source: Bloomberg) to be able to distinguish between offices, residential and commercial returns.[5] We limit ourselves here to France, because the data by property type is not available for the entire euro area. Given the relatively low frequency of data observation, we are restricted to using the historical depth of this source. Our sample begins in 1986, meaning that it includes the significant drop in property values during the first half of the 1990s, and the subprime crisis.

Lastly, we make use of indices based on actual transactions. The first index concerns the property market for old housing for the period 1996-2013 (Gregoir et al., 2013). The second index concerns the market for office property for the period 1993-2005 (Nappi-Choulet and Maury, 2009). These two indices based on actual transactions have the downside of being geographically confined to Paris and its close suburbs. Nevertheless, investment in property by French insurers has largely remained concentrated in the Paris region (according to IEIF, in 2014, 80% of the property assets of insurance companies were in the Paris region). Furthermore, the correlation coefficients between the Greater Paris indices and indices for the rest of the country are very high (91.15% according to the INSEE seasonally-adjusted price indices for old housing

5 - The quarterly IPD indices are not broken down by property type.

over the period 1996-2015), at least for residential property. We therefore believe that these Parisian-focused indices provide a good approximation for all of France.

2.2. ANALYSE DESCRIPTIVE DES RENDEMENTS IMMOBILIERS

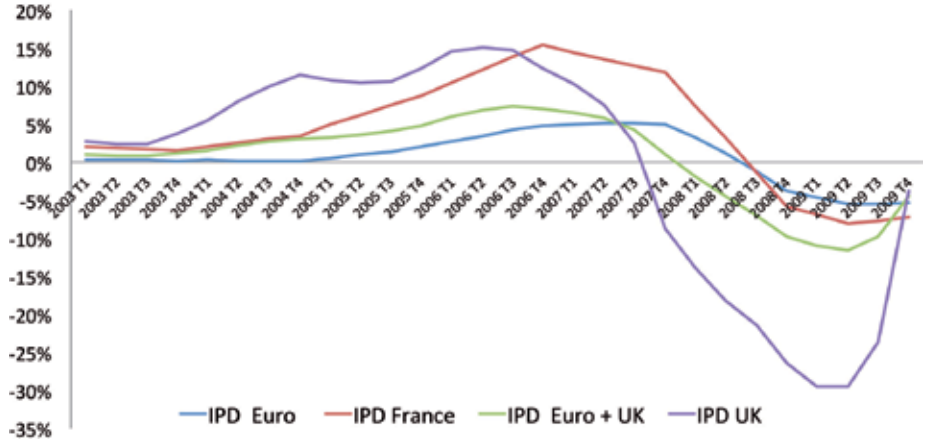
This section offers a comparative analysis of the evolution of overall property returns, based on the index used to measure them. Given our objective of re-estimating VaRs and correlation coefficients, we focus on first- (means) and second-order (variances, covariances, correlations) moments.

In Figure 2, we compare the evolution of returns for different global[6] IPD annual indices according to the geographical area: France, Euro, UK and Euro + UK.

Since 2003 and until the emergence of the subprime crisis, increases in property prices across much of Europe, and particularly in France and the UK, led to an increase in overall property returns. This increase was more pronounced for the Euro+UK area and for France than it was for the Euro area alone, given the weight of Germany where capital gains were rather modest. So, in 2006, property returns reached more than 15% in France while it was below 5% for the entire euro area.

Depending on the geographical area, the turning-point date for property returns is not the same. It is very early in the UK where property returns start to decrease as early as 2006, even before the outbreak of the US subprime crisis. In France, the turning-point came roughly a year after, in 2007. Across the euro zone, the turning point is even later, with the German market not having been heavily affected by the crisis. The magnitude of the turnaround is also quite variable depending on the country in question. In the Euro+UK area, property returns plunged to about -10% in mid-2009. The lowest values seen in France or anywhere

Figure 2: Returns of IPD indices



6 - Meaning all types of property.

in the euro area were more modest. All in all, the UK experienced the most severe housing crisis. It is therefore not a trivial choice to have this country as benchmark for the property shock calibration.

Furthermore, the UK also experienced the quickest recovery: property values began to rise back up from the third quarter of 2009 and rose very sharply in the fourth quarter (returns went from -24% to -4%). In contrast, returns in France and in the euro area remained fairly stable through the latter half of 2009.

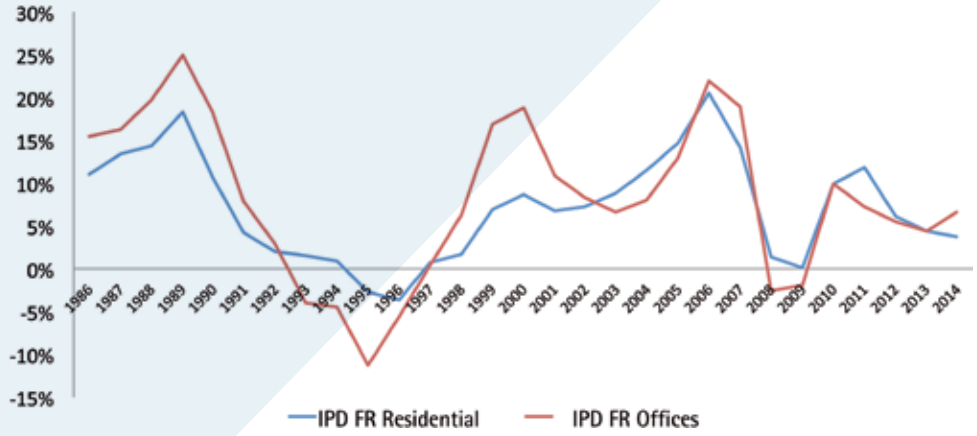
As we explained in the previous section, the IPD indices help some countries distinguish returns based on the type of property. Figure 3 compares the evolution of annual housing and office property returns between 1986 and 2014.

Over this period, we note two major slumps in returns: one during 2007/2008, which has already been commented on, and another at the beginning of the 1990s. In 1995, total returns of office property were around -10%. By comparison, the low point for office property following the subprime crisis was of the order of just -2% or -3%. In 1995 and 1996, residential returns also become negative, while this had never been the case in 2008/2009. So, for the calculation of VaR, using more historical depth should increase the size of the property shock.

It should also be noted that, based on the data, the potential gains from diversification between residential and office property are likely to be very modest. The correlation coefficient between these two types of assets is 89% throughout the period.

We now compare the IPD indices, based on expert appraisals, with indices based on actual transactions. As stated in the previous section, we have two "transactions" indices: one for housing (Gregoir et al., 2013) and the other for office property (Nappi-Choulet and Maury, 2009). The former has been live since 1996 and therefore does not cover

Figure 3: Returns of IPD France indices



the crisis experienced in the early to mid-1990s, but only that of the end of the 2000s. The latter has been live since 1993, but stops in 2005 (i.e. before the subprime crisis). Both are calculated on a quarterly basis.

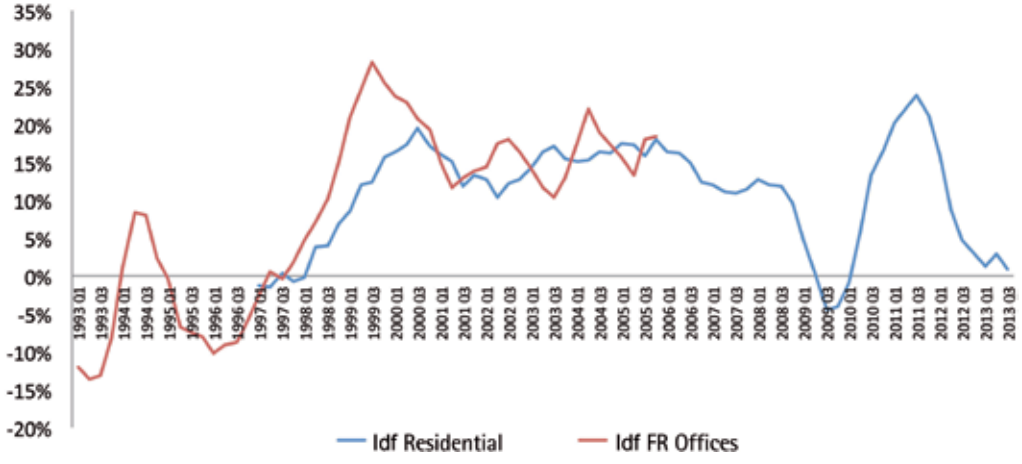
As expected, the returns of the transaction-linked indices are much more volatile than those of the IPD indices. Between 1995 and 2000, the magnitude of the increase in IPD returns for office property was 'only' 25% compared to over 40% for transaction-linked indices. In addition, the movements observed in the period 1993-1996 are significantly more erratic for the office property transaction-linked index than for the IPD index. Recent dynamics on the housing market are also significantly more volatile when looking at transaction-linked indices as opposed to the IPD indices. For instance, the total return of the housing market was -5% in 2009 according to the transaction-linked index, while it was positive according to the IPD index. Similarly, the recovery in 2010/2011 was much more marked based on the transaction index.[7] Throughout the periods available for each of the indices, volatility levels settle at 12% for the "office" transaction-linked index against 9% for the IPD offices index, and 7% for the "housing" transaction-linked index against 6% for IPD housing index. This excess volatility should, in theory, lead to an upward re-evaluation of the scale of the property shock.

For the common observation period for the two transaction-linked indices – from early 1997 to the end of 2005 – the correlation coefficient between the returns for these two types of assets is 85% (remember, it was 89% for the IPD indices between 1986 and 2014).

2.3. RESULTS

In the first sub-section, we calculate different VaRs for property assets (according to the geographical area, the period and the nature of the assets). We then compare these estimates with the Solvency II calibration. In the second

Figure 4: Returns of transaction-linked indices



7 - It is worth recalling that the transaction-linked index is limited to a portion of the Île-de-France (the Greater Paris region) while the IPD index is national. This discrepancy in terms of geographic zoning can explain some of the differences observed.

sub-section, we compare the correlation coefficients between real estate and financial assets obtained using our different data sources, pitting them against those from the Solvency II calibration. In the last sub-section, we simulate the market SCR based on different scenarios.

2.3.1. VaR Analysis

A number of statistical VaR estimation methods are detailed in the literature – see Hull (2015) for a summary. Overall, two main methodological families can still be identified – a historical approach and a model-building approach.

The historical approach involves selecting a sample of returns seen in the recent past and performing a random selection of these observed returns to establish a distribution of possible scenarios in the future. VaR corresponds to a precise percentile (a 99.5% confidence level, for example, in the case of Solvency II) within this distribution.

The model-building approach primarily involves defining a functional form for return distribution. The normal distribution is usually chosen for its simplicity. All that remains is to specify the parameter values for this distribution (the mean and the variance in the case of normal distribution) based on historical estimates, and then the VaR can be calculated with the specified distribution and parameters.

The two approaches can often produce rather different results, particularly within market finance. It has been empirically well established that, for a given level of variance, normal distribution tends to underestimate the likelihood of extreme events. However, it is precisely these extreme events that will help estimate the VaR. Therefore, it is automatically weaker with the model-building approach (which is based on a normal distribution) than it is with the historical approach.

So, each method has advantages and disadvantages: the historical approach requires large samples and the model-building approach tends to underestimate (the absolute value of) VaRs. In what follows, we shall discuss the adoption of a hybrid approach, which combines the historical and the model-building approaches. That firstly involves estimating VaR using the historical approach, but at a lower confidence level (e.g. 95%) for which the required data volumes are not too significant. Then, it involves making use of a modelling process (normal distribution for instance) to estimate the tail of the distribution (going from 95% to 99.5%).

In the case of Solvency II, it is not always easy to understand the methodological choices made by the regulator. However, it seems that EIOPA has benefited from the historical depth and monthly frequency of data availability for the IPD UK index to use one historical approach. In fact, the EIOPA documents of April 2010 (SEC 40-10) suggest that VaR is

Table 3: Descriptive statistics and 99.5% VaR

	IPD (M)		IPD (Q)		IPD France (A)		Île de France transactions index	
	UK		Euro	France	Residential	Offices	Residential	Offices
Period	1987-2008	1987-2014	2003-2009		1986-2014		1996-2013	1993-2005
Mean	9.08%	9.42%	0.74%	4.42%	7.22%	8.24%	10.82%	8.61%
Standard Deviation	11.96%	11.18%	3.27%	7.20%	6.19%	9.21%	7.01%	11.77%
IPD UK Correlation	1	1	0.75	0.79	0.33	0.27	0.41	0.46
99.5% VAR	-17.41%	-25.26%	-8.50%	-14.34%	-9.40%	-19.91%	-7.83%	-22.92%

directly estimated using the empirical tail of the distribution at a threshold of 0.5% for one-year rolling window returns of the IPD UK index between December 1987 and late 2008. However, as we will see, we have failed to replicate EIOPA's exact VaR calculations despite scrupulously following their calculation methods.

Subsequently, we will compare this historical estimation of VaR based on UK data with other VaRs based on different data, different periods and different methodologies.

All our results are shown in Table 3. The columns on the left-hand side of the table summarise the results obtained with the IPD UK data used by the regulator. By limiting the sample to the period 1987-2008, historical VaR is only -17.41%, roughly 8% less than the Solvency II capital requirement. When the period is extended until 2014, we obtain an approximation for EIOPA's VaR.

The VaR figures are even lower, in absolute value, when using quarterly IPD data for continental Europe (the euro area or France). As expected, average returns are much lower in the euro area (especially in Germany). Returns are also much less volatile. Consequently, by using a hybrid approach, VaRs for France and for the euro area are -14.34% and -8.50% respectively.

For France, the results obtained with the annual IPD indices allow us to refine our estimates based on the type of property: -9.40% for residential property and -19.91% for office property. These results seem relatively robust: using the transaction-linked indices for the Greater Paris region (Île-de-France), residential property VaR is -7.83% and office property VaR is -22.92%.

If we adopt the classical distribution of different property types seen in the typical portfolio of a French insurer (30% residential and 70% offices), we get a VaR of -16.49% with the annual IPD France indices and-18.08% with the transaction-linked indices.

To conclude, in this section we show that VaRs are extremely variable depending on the location and on the type of property (more expensive, in absolute value, for

offices and in the UK, than for residential property and in the euro area), but they are still significantly lower, in absolute value, than that used by Solvency II.

2.3.2. Analysis of the correlations

By referring to EIOPA's texts, the Solvency II correlations between the different asset types seem to be calculated only on the tails of the distribution. This means that, from a data sample with limited historical depth (monthly IPD UK since 1987), only the observations corresponding to crisis periods were identified. Whatever the chosen confidence level for defining the tails of the distribution, we find it difficult to follow this methodological approach given the size of the available samples. The approach we use is therefore more stable, based on simple static and linear correlations that are always calculated using all of the samples.

All results are summarised from Table 4 to Table 8. Correlations are calculated for each type of property index and then compared against the coefficients used by EIOPA.

Table 4: Property – Swap Rate correlations

	EIOPA		IPD Index (Q)			IPD France Index (A)		Île de France transactions index	
			2003-2009			1986-2014		1996-2013	1993-2005
	Rate - Reduction	Rate - Increase	Euro	France	Euro+UK	Residential	Offices	Residential	Offices
5-year Euro Swap Rate	0.5	0	0.66	0.57	0.28	0.32	0.67	0.41	0.39
10-year Euro Swap Rate	0.5	0	0.53	0.40	0.20	0.23	0.70	0.38	0.38

Table 5: Property – Swap Rate correlations during periods of rising and falling interest rates

	EIOPA		Île de France transactions index			
			Residential		Offices*	
	Reduction	Increase	Reduction	Increase	Reduction	Increase
5-year Euro Swap Rate	0.5	0	0.33	0.53	0.28	0.51
10-year Euro Swap Rate	0.5	0	0.26	0.53	0.37	0.40

* Low significance as limited data is available

Table 6: Property – Sovereign Rate correlations

	EIOPA		IPD Index (Q)			IPD France Index (A)		Île de France transactions index	
			2003-2009			1986-2014		1996-2013	1993-2005
	Rate - Reduction	Rate - Increase	Euro	France	Euro+UK	Residential	Offices	Residential	Offices
EMU 1-3 year AAA sovereign rates	0.5	0	-0.70	-0.77	-0.83	-0.39	0.40	-0.22	-0.39
EMU 10+ years AAA sovereign rates	0.5	0	-0.50	-0.48	-0.29	-0.29	0.46	-0.22	-0.58

Table 7: Property – Equity correlations

	EIOPA	IPD Index (Q)			IPD France Index (A)		Île de France transactions index	
		2003-2009			1986-2014		1996-2013	1993-2005
		Euro	France	Euro+UK	Residential	Offices	Residential	Offices
STOXX 50	0.75	0.66	0.72	0.77	-0.09	0.01	-0.10	-0.04
FTSE 100	0.75	0.56	0.63	0.76	0.02	0.00	-0.15	-0.31
S&P 500	0.75	0.63	0.64	0.78	-0.12	-0.10	-0.14	-0.25

Table 8: Property – Credit Spread correlations

	EIOPA	IPD Index (Q)			IPD France Index (A)		Île de France transactions index	
		2003-2009			1986-2014		1996-2013	1993-2005
		Euro	France	Euro+UK	Residential	Offices	Residential	Offices
EU 1-3 year AAA corporate bond spread	0.5	-0.74	-0.77	-0.74	-0.47	-0.37	-0.37	-0.41
EU 7-10 year AAA corporate bond spread	0.5	-0.43	-0.44	-0.17	0.02	0.01	-0.03	-0.64
EU 1-3 year BBB corporate bond spread	0.5	-0.66	-0.64	-0.49	-0.39	-0.37	-0.58	-0.31
EU 7-10 year BBB corporate bond spread	0.5	-0.30	-0.26	0.08	-0.29	-0.33	-0.45	-0.60

First, we calculate the correlations between property and interest rates. For interest rates, we alternate between European swap rates (for different maturities) and European sovereign rates (AAA for different maturities). The choice of interest rate index is critical, because if property returns are positively correlated to those obtained from swap rates (the coefficients fluctuates between 20% and 70% approximately), they are negatively correlated with total returns from the sovereign rate indices (unless the chosen property index is the annual IPD France office property index).

The return profiles for swap rates and sovereign yields rates differ substantially, particularly over the recent period, which explains these differences in correlation. EIOPA states that it uses both rates for its calibration of interest rate shocks. Nonetheless, in light of our results, it seems that choosing to set correlation to 50% in period of falling rates and to 0% in times of rising rates is incompatible with swap rates. With regard to swap rates, we note that EIOPA correlations seem to match ours only during downward phases (in this case, our estimated coefficients are close to 50%, if perhaps slightly lower). During phases of rising rates, our estimates are significantly positive (correlation coefficients are close to 50%) while they are nil according to EIOPA.

However, these disparities should be put into perspective in light of the low number of available observations when upward and downward interest rate phases are identified.

For assessing the correlation with equity returns, we used the EUROSTOXX 50, the FTSE 100 and the S&P 500. The Solvency II calibration for the property-equity correlation is 75%. This coefficient appears largely overestimated when it is not looking solely at the period of the subprime crisis. In fact, the correlation between the EUROSTOXX and the IPD France index over the period 2003-2009 is 72%, very close to that of EIOPA. On the other hand, over a longer period (1986-2014 with the IPD France indices or since the mid-1990s with transaction-linked indices), this correlation is close to zero, or even slightly negative. If we restrict ourselves to the period from 2007 to 2009, we see that the property market and the stock prices fell simultaneously. However, other financial crises (2001/2002 for example) were not followed by a massive decline in property returns. Similarly, the decline in property values observed in France in the first half of the 1990s was not matched in the stock markets. Limiting oneself to the period of the subprime crisis may therefore lead to an overestimation of correlation coefficients between property returns and stock returns.

The choice of a correlation coefficient of 50% between credit spreads and property is equally surprising. According to our estimates, based on a large number of corporate spreads[8] (ranging from AAA to BBB, for different maturities), these correlations are significantly negative. Indeed, the returns from credit spreads changed very little between 1997 and 2005 and were not affected as much as equity returns during the 2008 crisis. Lastly, the sharp rise in returns from credit spreads at the end of 2009 again corresponds to a period of dropping values for many European real estate markets.

In summary, our analysis in this sub-section shows that the property-financial assets correlation coefficients appear to be systematically overestimated by EIOPA, aside for the correlation with swap rates.

2.3.4 SCR Simulations

Given the systematic biases we identified in estimations of VaR and of correlation coefficients, it is worth assessing the overall impact on market SCR. According to our estimates, it appears that property SCR (which stems directly from VaR) is clearly overestimated by the regulator. As for the potential gains from diversification between property and financial assets, it seems that they have been underestimated. The combination of these two factors could lead to significant overestimation of the market SCR.

To examine this issue, we use the example of a listed European life insurance group whose portfolio consists of 88% bonds,

8 - Here, we use the exact same data as EIOPA.

5% equity, 5% real estate and 2% cash. We simulate three scenarios:

- EIOPA Scenario: we simulate the market SCR of this insurer under the constraints imposed by Solvency II (a 25% property shock and using the EIOPA correlation coefficients).
- Scenario 1: we simulate the market SCR by setting the property shock at 14.34% (value obtained from our VaR estimates on the quarterly IPD France index) and retaining the EIOPA correlations.
- Scenario 2: we simulate the market SCR by setting the property shock at 14.34% and applying our correlation estimates to equities (0%) and spreads (-60%). However, we use EIOPA's correlation coefficients for interest rates, which are in line with our own estimates as long as the swap rates are used.
- Scenario 3: we simulate the market SCR by setting the property shock at 14.34% and applying our correlation estimates (-69% with interest rates, 0% with equities and -60% with spreads). In this case, the correlation with the interest rates is based on our estimates using sovereign rates.

If we assume that the total value of this insurer's portfolio is €500 billion, the EIOPA scenario leads to market SCR of €56.3 billion, of which €6.25 billion is for property risk alone. With the other 3 scenarios, property-only capital requirements (property SCR) fall by 43%, or €3.59 billion. Additionally, depending on the scenario in question (1, 2 or 3), the gains from diversification lead to a market SCR reduction of up to 10% (€50.49 billion).

These results show the importance of the choice of calibration for property risk under Solvency II. By adopting a calibration based on our estimates rather than on those of EIOPA, we end up with a significant reduction in capital requirements. This result suggests that the property-related calibrations chosen by EIOPA could be an obstacle impeding the return of insurers to property markets.

To test this hypothesis, we conducted a second simulation exercise similar to the first, but assuming a real estate allocation of 10% (instead of 5%) and reducing the share of bonds to 83% (instead of 88%). In this case, the market SCR goes from

Table 9: Market SCR simulations

€bn	EIOPA	Scenario 1	Scenario 2	Scenario 3
Interest rate SCR	37.70	37.70	37.70	37.70
Equity SCR	10.12	10.12	10.12	10.12
Property SCR	6.25	3.59	3.59	3.59
Spread SCR	29.61	29.61	29.61	29.61
Market SCR	56.30	54.99	52.29	50.49
Saving		-2.32%	-7.11%	-10.32%

€57.14 billion (EIOPA scenario) to €45.04 billion (scenario 3), representing a drop of 21.17%. The magnitude of this adjustment suggests that Solvency II's choice of calibration could indeed strongly impede the return of insurers to property markets.

CONCLUSION

CONCLUSION

In this study, we presented a critical analysis of the Solvency II prudential regulation while calibrating property risk. We tested the robustness of the calculations of VaR and of correlations between real estate and financial assets, using different data sources and different methodologies. We show that VaRs are very sensitive to the geographical area and the type of property. In absolute value, figures are higher for office property and in the United Kingdom than they are for residential property and within the euro area. However, in all cases, they are still significantly lower than those used by the prudential regulator. Furthermore, we have shown that the real estate/financial assets correlation coefficients used by EIOPA are systematically overestimated, regardless of the methodology, the geographic area and the type of property in question.

There is a lot at stake with these results given that insurers have €10 trillion of investments in Europe (Insurance Europe, 2016). Real estate has historically played an important role in the asset-liability management activities of insurance companies, given its long duration, its contribution to the diversification of portfolio risk, its ability to hedge inflation risk, and its performance. In the current low-interest rate environment, the position of real estate within insurance company portfolios is a complex debate when looking at the four factors of return, volatility, liquidity and prudential capital requirements. Indeed, the dimensions of accounting and management fees adversely affect the perception of property's true profitability, to the extent that insurers have a very different view of the following:

- What is the value of the property asset in question? The accounting principle of amortising property assets leads to a discrepancy between the real value and the book value. Amortisation leads to (i) depreciation of the net book value, not in line with the market value; (ii) substantial capital gains which are out of touch with reality; and (iii) an accounting valuation disconnected from the real volatility of the property market.
- Should management fees be integrated into the analysis of returns? Some insurers don't include them, but these costs are particularly high thus penalising performance.
- What protections are there against inflation? Property has historically played an important role in hedging inflation risk. According to some insurers, the current duration of (commercial and office) leases and high vacancy rates reduce inflation protection.
- What is the appropriate management approach for property? Many property investment companies (known as *Sociétés Civiles Immobilières* or *SCIs* in France) have been created to diversify risks and generate economies of scale. This mechanism offers flexible and centralised

management, by steering the SCI's profits – in the form of dividends paid to insurance companies or transfer of the property – thus allowing returns to be distributed to the insured party independently of the property's performance.

Given these biases in determining the profitability of property, the optimal allocation of this asset within investment portfolios is the subject of much debate. However, once the cost of the Solvency II regulatory capital requirement for property is integrated into the analysis, a very strong consensus emerges on the fact that the 25% capital requirement is prohibitive. This is a real impediment for insurers seeking to increase the share of real estate in their investment portfolios, so much so that some already prefer to opt for structured products, covered bonds, securitised instruments (mortgage -backed securities, commercial loans, agricultural loans, etc.), collateralised loan obligations (CLOs), public or private loans (SMEs, middle-market companies, public authorities) and alternative investments (private equity, LBO funds, infrastructure funds, hedge funds, etc.).

APPENDIX: DATA SOURCES FOR FINANCIAL ASSETS

APPENDIX: DATA SOURCES FOR FINANCIAL ASSETS

In order to conduct the analysis of correlations between property and other sources of market risk, we used financial data representative of each type of risk and as close as possible to the data used by the regulator. To do this, we referred to regulatory texts published by the regulator, specifically to two papers: the first dealing with the QIS5 calibration (QIS5 Calibration Paper (CEIOPS-SEC-40-10) and the second dealing with Level 2 measures concerning the definition of correlations (SCR Standard Formula Article 111 (d) Correlations - CEIOPS-DOC-70/10). The data used are presented in Table 10.

For interest rate risk, we chose:
- Euro swap rates, available between 1999 and 2015;
- Sterling swap rates, available between 1990 and 2015;
- Bank of America Merrill Lynch indices for AAA-rated EMU sovereign bonds, available between 1995 and 2015;
- Germany's risk-free rates, available between 1997 and 2015;
- the UK's risk-free rates, available between 1982 and 2015.

For equity risk, we used three indices:
- the EUROSTOXX 50 index, available from 1986;
- the FTSE 100 index, available from 1984;
- the index Standard & Poor's 500, available from 1950.

For spread risk, the data used is that of the Bank of America Merrill Lynch EMU corporate bonds indices, composed of instruments with the ratings between AAA and BBB, and maturities between 1 and 10 years (available from 1995 to 2015). The data sets were obtained via Bloomberg.

Table 10: Financial data

Type of risk	Index
Equities	STOXX 50
	FTSE 100
	S&P 500
Interest rate	Euro swap rate (EUSA)
	BofA Merrill Lynch EMU AAA sovereign bonds indices
	Germany risk-free rate curve (BB)
	UK risk-free rate curve (BoE)
	GBP swap rate (BPSW)
Credit spread	BofA Merrill Lynch EU AAA corporate bond index
	BofA Merrill Lynch EU AA corporate bond index
	BofA Merrill Lynch EU A corporate bond index
	BofA Merrill Lynch EU BBB corporate bond index

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