Market Insight

Solvency II and real estate; our challenge to the current proposals

London 22 May 2013, by Arjan van Bussel, Marija Beleska and Mike Nawas

Real estate investments have always been one of the main investment categories of insurance companies, especially for life insurers. Despite the long-term nature of real estate assets, calculating their duration remains challenging. As a consequence, the policy-makers who are devising the new regulatory regime for European insurers, Solvency II, have decided to adopt very punitive capital requirements for insurance companies holding these investments. In this Market Insight, we contend that the uniform approach to all real estate assets across all jurisdictions that is adopted by Solvency II's standard model is not justified. We derive a statistically significant duration for residential real estate in multiple European countries. Based on this, we argue that Solvency II should adopt a much more tailored and risk-appropriate approach to capital weightings for real estate investments. Such a change is important because it could re-enable insurance companies to invest in real estate, a crucial ingredient to economic recovery in Europe.

Introduction

Real estate is an important asset category in the investment portfolio of nearly all insurance companies, due to its long-term nature, the ability to generate a steady income stream and the potential capital appreciation. But despite these attractive features, real estate's role in the asset liability management of insurance companies is under vehement debate – a debate, crucially important to Solvency II, that boils down to the question whether or not the value of real estate is sensitive to interest rate movements.

The Solvency II directive is primarily aimed at preserving the financial solidity of the European insurance industry and ensuring better protection for policyholders. The directive prescribes how insurance companies should calculate the minimum capital they must hold and provides a standard model that they can choose to use for this purpose. Unlike the current regulatory framework, Solvency II relates the minimum capital requirements to the characteristics of both assets and liabilities under various stress scenarios. Effective asset liability management, whereby the interest rate sensitivity of the assets mirrors the sensitivity of the liabilities, is therefore more important than ever. Unfortunately, the current proposals only identify a limited number of assets as being sensitive to interest rate movements, and real estate is not one of them.

In this Market Insight we put Solvency II's assumption to the test by analysing the interest rate sensitivity of residential real estate across Europe. We do this by empirically deriving its duration.

Duration

Duration as a benchmark was first introduced by Frederick Macaulay in his ground breaking work from 1938.[1] Unlike maturity, duration does not provide information about just the date of final payment of an investment; it also captures the timing of all other principal and interest payments.[2] As demonstrated by Hicks in 1939, the duration metric is also an accurate indicator of the interest rate sensitivity of an investment instrument.[3]

By matching the duration and hence the interest rate sensitivity of their assets to the duration of their liabilities, financial institutions mitigate their interest rate risk. Such an immunisation strategy requires that the interest rate sensitivity of each investment is correctly measured and incorporated in the asset liability management guidelines. Of course these guidelines need to tie in to the method prescribed by regulators. The problem though is that the parameters describing the interest rate sensitivity of real estate investments in the Solvency II standard model are counterintuitive. Consequently, real estate is becoming a much less compelling investment sector for insurers. A retreat of this historically active investor group from the sector could have a detrimental knock-on impact on the real estate markets across Europe.

[1] F.R. Macaulay, *"Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States since 1856"*, 1938.

[2] The duration of an investment is calculated as the weighted average of the time periods until cash flows are received, whereby the weight allocated to a time period equals the proportion of the present value of the corresponding cash flow to the value of the investment.

[3] J.R. Hicks, *"Value and Capital"*, 1939.

Solvency II – A closer look

Currently, under the Solvency I regime, the amount of capital an insurance company must hold is simply a function of the insurance premium it receives. Under Solvency II this will change, in order to make the capital weighting more risk-based.

The Solvency II framework is built on three pillars. The first pillar covers the quantitative assessment of the risks faced by insurance companies. It sets out rules regarding valuation of assets and liabilities as well as the stress tests that must be applied in order to calculate how much capital must be held. The second pillar addresses the qualitative risks that cannot be measured under the first pillar by laying down the requirements for risk management and review processes. Finally, the third pillar focuses on transparency and disclosure of information to supervisors and market participants.

Under the Solvency II draft proposal, pillar 1 prescribes that real estate investments have to be stress-tested by applying a 25% shock to their market value. The real estate industry is of the opinion that this shock is too severe and not in line with pan-European empirical evidence. For example, in a research paper commissioned by seven leading European trade bodies, IPD, a renowned analytics provider in the real estate sector, concludes that this shock should be no higher than 15%.[4] In the same paper, IPD disputes the limited diversification benefit given to real estate in the Solvency II standard model and argues that the correlation between real estate and corporate equity investments ranges from +0.39 to +0.5, rather than the proposed +0.75.

IPD also writes, in the same paper, that the correlation between real estate and interest rates is negative whereas the Solvency II

[4] IPD "*The IPD Solvency II Review - Informing a new regulatory framework for real estate*", 15 April 2011.

guidelines as currently drafted propose a correlation of 0 if interest rates increase and +0.5 if interest rates decrease. The latter positive correlation indicates that when running scenario analyses under the Solvency II standard model, insurance companies have to assume that property values go *down* if interest rates *decrease*. This counterintuitive assumption will have a disruptive impact on an insurer's asset liability management, as decreasing interest rates will cause the value of insurance-policy-liabilities to increase.

Fortunately, Solvency II allows for internal models as an alternative to the standard model. Developing a proprietary model allows an insurance company to focus on the segments in which they are actually active; they can then run stress tests on the volatility observed in those segments and determine the interest rate sensitivity of their investments using historic data relevant to those segments. Solvency II also permits application of partial models, meaning that insurers can develop proprietary models for those areas where they see the greatest benefit, while continuing to employ the standard model for other segments.

Our approach

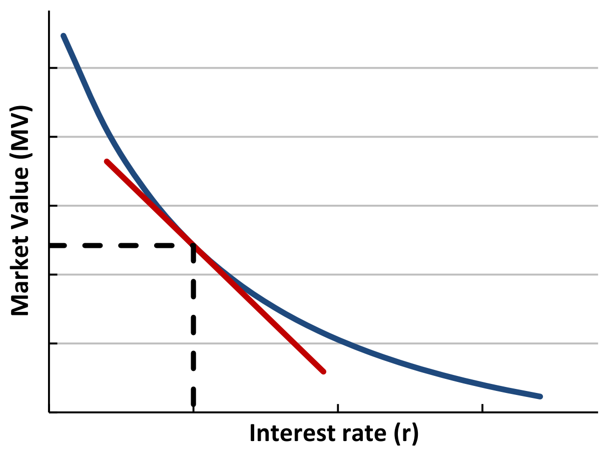
In recognition of the importance of matching the interest rate sensitivity of investments with the interest rate sensitivity of the liabilities, the remainder of this paper focuses on the relationship between property price fluctuations and interest rate movements. If we are able to demonstrate that the value of real estate changes when interest rates change, there is a strong argument for insurance companies to develop their own internal models, as doing so would strengthen their asset liability management capability and potentially give them capital relief. In order to demonstrate the interest rate sensitivity of real estate, we endeavour to empirically derive the duration of residential real estate in five European countries.

Why residential real estate? Firstly, residential real estate clearly forms a very important asset class in the investment portfolio of insurance companies. In the Netherlands for example, large insurance companies allocated between 20% and 40% of their real estate investments to residential properties in 2011. Secondly, residential property returns are generated by large numbers of valuations and transactions that are granular in nature. Datasets in this segment are therefore well suited to statistical analysis. And finally, the parameters in the Solvency II standard model are based on UK data including all real estate asset types except residential property. Hence, any empirical deviation from the standard model is likely to be particularly visible in this segment.

Interest rate sensitivity

The inverse relationship between interest rates and the market value of a fixed income instrument is well documented. The blue line in Figure 1 shows this relationship. For small interest rate fluctuations, the corresponding change in the market value of a fixed income instrument can be approximated by a line that is tangent to the convex blue line, as depicted in Figure 1 by the red line.

Figure 1: Theoretical interest rate sensitivity



This linear approximation is closely linked to the duration metric as the slope of the tangent line is the first derivative of the convex function that describes the relationship between market values and interest rates: [5]

$$\frac{dMV}{dr} = -\frac{D}{(1+r)} \times MV \qquad \text{Equation (1)}$$

whereby MV = market value, r = interest rate, D = Macaulay duration

This equation can be rewritten as:

$$\frac{dMV}{MV} = -\frac{D}{(1+r)} \times dr \qquad \text{Equation (2)}$$

From equation (2) it becomes clear that the interest rate sensitivity of the underlying asset is described by the Macaulay duration divided by 1 plus the interest rate. This fraction is widely referred to as the modified duration, so:

$$\frac{dMV}{MV} = -D_{mod} \times dr \qquad \text{Equation (3)}$$

whereby D_{mod} *= modified duration*

Equation (3) is commonly expressed in its discrete analogue:

$$\frac{\Delta MV}{MV} = -D_{mod} \times \Delta r \qquad \text{Equation (4)}$$

whereby ΔMV = change in market value, Δr = change in interest rates

Equation (4) states that the percentage change in the market value of a fixed income instrument resulting from a small change in interest rates can be approximated by multiplying the negative value of the modified duration with the absolute change in interest rates.

Duration of real estate investments

Unlike a fixed income instrument whose value solely depends on interest rates and the credit quality of the borrower, the value of a real estate asset also depends on many property-specific and macro-economic variables such as location, quality of the building, its current tenant, remaining lease length, vacancy of comparable properties, demographic variables, inflation expectations, etc. For that reason the modified duration cannot theoretically be determined for a real estate asset. Therefore we apply empirical techniques to examine the relation between real estate prices and interest rates.

To empirically derive the interest rate sensitivity of residential real estate we use the following regression equation:

$$Ln(MV) = \alpha + \beta \times r + \varepsilon \qquad \text{Equation (5)}$$

This function allows us to directly estimate the modified duration by empirically deriving the β parameter. This can be demonstrated by differentiating Equation (5) with respect to interest rates, r:

$$\frac{dLn(MV)}{dr} = \beta = \frac{dLn(MV)}{dMV} \times \frac{dMV}{dr} = \frac{1}{MV} \times \frac{dMV}{dr} = -D_{mod} \qquad \text{Equation (6)}$$

Equation (6) demonstrates that the first derivative of regression equation (5) is equal to β and also to the modified duration. Equation (6) therefore proves that the modified duration is equal to the β parameter that will be found when regressing the natural logarithm of market values, Ln(MV), against interest rates, r. Similarly it can be proven that this also holds if we substitute market values with price indices in the above equations.

We empirically derive the interest rate sensitivity of residential real estate by estimating the β parameter in Equation (5) for residential properties in Belgium, France, Germany, the Netherlands and the UK.

[5] See J.R. Hicks, "*Value and Capital*", 1939.

Data used

In Figure 2 we describe the data sources that we use to derive the dependent variable for the regression analysis in each of these countries. The independent variable is the 30-year EUR swap rate for countries in the Euro zone, and the 30-year GBP LIBOR swap rate for the UK. Both interest rates were retrieved from Bloomberg. Use of long-term interest rates is consistent with the long-term nature of real estate investments.

Figure 2: Description of the data

Country	Data source	Frequency	Period	Data description	Price index methodology
Belgium	ECB, referencing Directorate-General for Statistics and Economic Information and STADIM	Quarterly	Jan 1999 - Sep 2012	Transaction data for existing dwellings as submitted to the Registration office	Mix-adjusted method[a]
France	ECB, referencing INSEE	Quarterly	Jan 1999 - Dec 2012	Transaction data contained in notarial databases. The data covers flats only for Paris and Île-de-France and both houses and flats for the rest of the country	Hedonistic regression model[b]
Germany	Verband Deutscher Pfandbriefbankern ('VDP')	Quarterly	Mar 2003 - Dec 2012	Sale prices of owner-occupied properties in the VDP transaction database	Hedonistic regression model[b]
Netherlands	Dutch Land Registry Office ('Kadaster') in co-operation with the central bureau of statistics ('CBS')	Monthly	Jan 1999 - Jan 2013	Sale prices and appraisal valuations of existing owner-occupied houses.	Sale Price Appraisal Ratio model[c]
UK	Nationwide	Monthly	Jan 1999 - Feb 2013	Sales prices of owner occupied properties related to Halifax mortgage approvals	Hedonistic regression model[b]

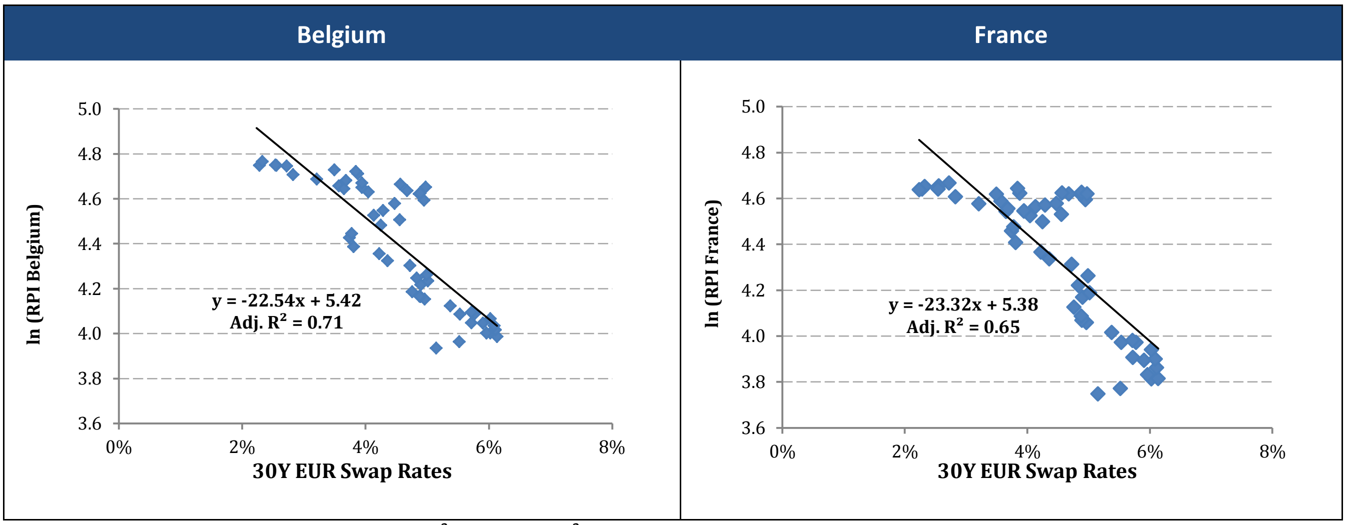
[a] Registered sales data is used to gather information on average price and number of existing homes at the district level. Dwellings are categorised according to type and location. The average price for each group is calculated; average prices that are unrealistic or based on less than six transactions are eliminated. The data is transformed into a Laspeyres chained price index, where districts are aggregated based on number of dwellings in the base period (the year 2005).

[b] The hedonistic method is based on models that break down housing prices in terms of the contributions of their characteristics. With the help of econometric models, the coefficients measuring the impact of multiple characteristics are estimated and serve to determine, using observed transactions, the prices of the housing in question for which the characteristics are fixed over time. Source: http://www.bdm.insee.fr

[c] The Sale Price Appraisal Ratio ('SPAR') methodology measures the price change of existing owner-occupied houses based on matched pairs of observed transaction prices and/or appraised valuations of the same property.

Results of our empirical analysis

Figure 3: Regression results



Note: Obs. = Number of observations, Adj R^2 = adjusted R^2 and P-val = P-value.

The results yield interesting similarities, but also noticeable differences. In Figure 3 we show the results of the regression analyses specifically for Belgium and France, in graph format, and in Figure 4 we show the results for all five countries in table format.

Figure 4: Empirical results

Country	Obs.	Adj R^2	β	P-val
Belgium	55	0.71	-22.54	0.00
France	56	0.65	-23.32	0.00
Germany	40	0.69	-3.74	0.00
NL	169	0.34	-8.65	0.00
UK	170	0.49	-27.37	0.00

Solvency II prescribes that parameters in an internal model have to be statistically significant at a 99.5% confidence interval over a one-year period. P-values less than 0.5% indicate that the corresponding parameters meet this requirement. As can be seen in Figure 4, the estimated modified duration benchmarks (i.e. the β parameters) are statistically significant and negative, confirming the expected inverse relationship between interest rates and the value of real estate.[6]

Looking at the adjusted R^2 for the period January 1999 until February 2013 we notice that this metric is 0.65 or above for Belgium, France and Germany, whereas it is below 0.5 for the Netherlands and the United Kingdom.[7] As expected, not all variations in house price fluctuations can be explained by fluctuating interest rates, but an adjusted R^2 of 0.65 or higher suggests a relatively strong linear relationship between the variables. However, such a linear relationship is much less clear in the United Kingdom and the Netherlands. What these two countries have in common is that the contribution of the financial industry to the gross domestic product is relatively large. The

[6] Moreover, the results in Figure 4 demonstrate that residential real estate has a long modified duration, making it a very attractive asset class for any insurance company with long-term liabilities. The one exception is Germany where the modified duration is only 3.7 years. The differences in duration are most likely caused by differences between local housing markets, mortgage markets and tax incentives stimulating home ownership in each country. However, an in-depth analysis of these differences is beyond the scope of this paper.

[7] An adjusted R^2 of 0.65 indicates that 65% of the variation in the dependent variable is explained by changes in the explanatory variable. In the context of our regressions this suggests that 65%, or more, of the variation in the natural logarithm of house price indices in Belgium, France and Germany can be explained by changes in the 30-year interest rate.

on-going turmoil in the financial markets might therefore have had a more severe impact on relationships between economic variables such as interest rates and price movements of real assets in those two jurisdictions than in other countries.

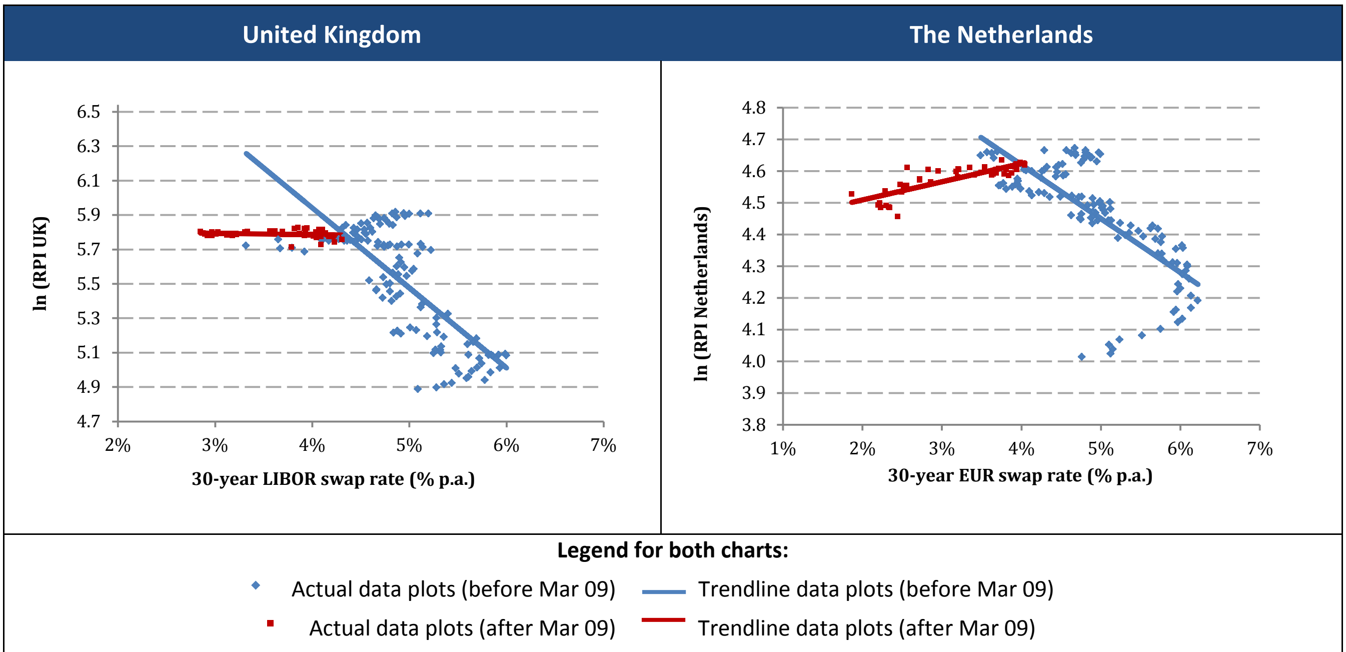
To test whether the interest rate sensitivity of residential real estate in those two countries has been impacted by recent developments in the financial markets we split the analysed period into two sub-periods, whereby we use March 2009 as the cut-off date between both sub-periods. March 2009 coincides with the announcement of the first quantitative easing operation by the Bank of England.[8] This monetary policy was used by the central bank to stimulate the national economy by buying large portions of financial assets. By injecting large quantities of money into the economy the central bank artificially lowered the interest rates.

Figure 5, which summarises the empirical results for the two sub-periods, demonstrates that the linear relationship between interest rates and the natural logarithm of UK house prices indeed differs substantially before and after the introduction of quantitative easing. In fact, the linear relationship appears to have disappeared entirely after the central bank intervened to keep interest rates artificially low. This is also illustrated in Figure 6. We appreciate that it is premature to conclude that this is solely caused by the intervention of the Bank of England, as other variables, which caused the central bank to take such drastic steps, have undoubtedly also contributed to this result.

Figure 5: Empirical results for two sub-periods

	Jan 1999 – Mar 2009				Apr 2009 – Feb 2013			
Country	Obs.	Adj R^2	β	P-val	Obs.	Adj R^2	β	P-val
UK	123	0.55	-46.51	0.00	47	0.01	-0.80	0.23
NL	123	0.50	-16.98	0.00	46	0.66	5.73	0.00

Figure 6: Regression results for United Kingdom and the Netherlands



[8] See http://www.politics.co.uk/reference/quantitative-easing

Also for the Netherlands we can see that the relationship between residential real estate prices and interest rates changed during the financial crisis. Our readers may be aware that in the Netherlands there has been an above-average uncertainty surrounding residential real estate policies, both with respect to the housing market and the mortgage market. This uncertainty was for example one of the reasons for Fitch, the rating agency, to revise their outlook on the Netherlands as a country from stable to negative in 2013.[9]

Since the onset of the financial crisis, the housing market in the Netherlands has been subject to contrasting political pressures with new rules being suggested and rejected at high speed. The same holds for policies regarding the tax deductibility of mortgage interest. Add to this the general uncertainty surrounding the volatile economic situation in the Eurozone and it is easy to see why (potential) homeowners, housing associations, landlords and tenants have been playing a waiting game.[10] As a result, the demand for houses dampened and house prices decreased significantly despite historic low interest rates. This is also illustrated in Figure 5 by the positive β parameter, and the corresponding increasing trend line in Figure 6, that we found for the period March 2009 to February 2013. This is in stark contrast to the negative β parameter and decreasing trend line for the period leading up to March 2009.

Hence, similar to the results found for the UK, we observe that the relationship between interest rates and the natural logarithm of house prices in the Netherlands changed substantially during the financial crisis. Prior to the crisis the relation is in line with economic expectations and in line with empirical results found for neighbouring countries, but in the midst of the crisis these relationships appear not to hold in the UK and the Netherlands.

Conclusion and recommendations

Following the introduction of the Solvency II directive, the amount of capital that must be held by an insurance company will no longer be only a function of the underlying insurance policies. For the first time, risks inherent in the investment portfolio will also have to be included in the calculation of the capital that insurance companies must hold to withstand adverse economic events.

Using the standard model to calculate the capital charges for different investment categories will result in punitive capital requirements for real estate investments. The approach that the policy-makers of Solvency II took so far is (a) too generic across real estate asset classes (not distinguishing between residential, retail or offices) and (b) exclusively based on UK data. Not surprisingly, they have received severe criticism from the real estate industry as the standard model findings are not in line with market thinking and empirical evidence from Continental Europe. We now also show empirical evidence for the residential market in Continental Europe that should give even more credence to this criticism.

We have demonstrated that the values of residential properties in Belgium, France and Germany are sensitive to interest rate movements similar to bonds: increasing interest rates correspond with decreasing market values and vice versa. Additionally, we have demonstrated that the same holds true for

[9] Fitch, "*Fitch revises Netherlands' outlook to negative; affirms at 'AAA'* ", 5 Feb 2013.

[10] Mortgage rates in the Netherlands have not decreased to the same levels as in surrounding countries. According to the Centraal Planbureau the mortgage rate in the Netherlands is on average 100 basis points higher than in surrounding countries. See Centraal Planbureau, "*De Nederlandse woningmarkt - hypotheekrente, huizenprijzen en consumptie*", 14 Feb 2013.

residential real estate in the UK and the Netherlands for the period January 1999 to March 2009, although no such relation was found for the UK and the Netherlands in the midst of the current financial crisis when economic relationships appear to be impacted by interventions and other exogenous factors.

Of course the above results do not prove that the same holds true for properties in other segments, or for residential property in other jurisdictions, but that is actually at the heart of the criticism that goes out to policy-makers: not all real estate assets classes in all jurisdictions can be captured by the same set of parameters in one standard model.

We therefore argue for fine-tuning the current Solvency II proposal and the standard model by introducing different parameters for different real estate segments in different jurisdictions. After all, isn't it precisely the objective of Solvency II to make the capital charges more risk-based and less blunt? Alternatively, in the absence of such modification, we recommend that insurance companies develop their own proprietary real estate risk model. We appreciate the complexity of such an endeavour for individual insurance companies, but once finalised and approved by the local supervisor, an internal model will most likely result in lower capital requirements under Solvency II and provide an insurance company with considerably improved investment returns and a better risk management tool when investing in real estate.

If you agree with our views in this Market Insight, and even if you don't, we would be delighted to hear from you

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