6th International Conference on Industrial Engineering and Industrial Management.
XVI Congreso de Ingeniería de Organización. Vigo, July 18-20, 2012

Property-Development Default Swaps: An Option Pricing Model to Assess the Risk associated to Bank Loans to the Real Estate Sector in Spain.

Tarradellas Espuny JR[1], Sismanidou A[2], Galariotis, E[3]

Abstract Property-related assets, along with sovereign debt, are the main burden for the balances of the Spanish Banking sector. This paper proposes a real-option approach to properly value the risk associated to loans to the property promoters. Banks could protect the loans to housing development projects by charging a premium based on the value of the real option associated to the project.

Keywords: Real Options, Risk Analysis, Banking, Real Estate, Financial Crisis

1.1 Introduction

The Spanish financial system has experienced an impressive consolidation over the last 5 years. On top of the mergers and evolution of most of the saving banks into commercial banks, some 3 entities have been bailed out by the Bank of Spain.

1 Joan Tarradellas Espuny (✉)
Dpto. de Organización de Empresas. Escuela Técnica Superior de Ingeniería Industrial de Barcelona. Universidad Politécnica de Catalunya. Av. Diagonal, 647, 08028. EADA Business School. Departamento de Finanzas. Joan.ramon.tarradellas@upc.edu

2 Athina Sismanidou
Dpto. de Organización de Empresas. Escuela Técnica Superior de Ingeniería Industrial de Barcelona. Universidad Politécnica de Catalunya. Av. Diagonal, 647, 08028. Athina.sismanidou@upc.edu

3 Emilios Galariotis. Centre for Financial and Risk Management (CFRM). Department of Finance. Audencia Nantes School of Management. Egalariotis@audencia.com

One of the main features of the Spanish financial system that makes it different from other European systems is the high exposure to the real estate sector, in percentages only shared by the Irish financial system which had to be bailed out some years ago.

Other European financial systems are currently facing difficult situations due to the banks exposure to sovereign debt. Many entities had the opportunity to hedge the default risk with the use of special derivatives –credit default swaps, among others- that provided some insurance against default. The risk of default of property developers, on the other hand, did not have any similar hedging scheme. This produced a risk asymmetry which ultimately could have been hedged or mitigated with the real-option scheme proposed here.

1.2 Real Estate developments as real options

Real estate projects typically have a maturity from 12 to 36 months and can end up having an asset value ranging from high to close to zero, depending on the market conditions, the main driver of value being the housing prices at the time of delivery. During the real estate bubble, the Spanish financial sector provided with abundant amounts of credit to property promoters. The collateral was typically the property. After the bubble crash in mid 2007, many ongoing projects were just abandoned or passed on the banks by the promoters as the development entities faced default.

This in fact created an asymmetry between the financial institution and the developer. The developer had to bear basically a limited (or zero) risk, since if the prices were to grow by the time of delivery, the project could yield a high return. If prices were to collapse, then the promoter could declare default and the bank would end up with toxic real estate assets and an unpaid principal.

In fact, banks were providing a free option to real estate developers. The symmetry would have been reestablished if the promoter had paid the bank the corresponding option price.

1.3 Literature Review

The real options concept has created a considerable excitement in the management literature in recent years (Kogut &Kutilaka, 2001; McGrath, 1997). To date, real options theory has been applied to different aspects of management research, in-

cluding multinational flexibility (Reuer & Leiblein, 2000), joint ventures (Kogut, 1991; Tong, Reuer, & Peng, in press), diversification (Kim & Kogut, 1996), governance structure (Folta, 1998), and entrepreneurship development (McGrath, 1999). But never they have been applied to study and analyse the firm's sustainability strategy.

More specifically it has never been used to propose an option-pricing based coverage of the risk exposure to property development loans. Although some risk coverage instruments such as Credit Default Swaps are available to investors to hedge debt positions, no similar product has been proposed to date for the property development in Spain. Such scheme could have reduced the impact of the real estate bubble in the Spanish economy in general an in the Spanish banking sector in particular.

1.4 Methodology

This paper aims at showing that the theoretical option price due to loans for real estate developments has been significant. The methodology has therefore consisted of assimilating a real estate development to a call option, were the option will be exercised (the development will be completed and sold) if the pricing scenario is positive, otherwise the project will be abandoned and the loan will not be repaid to the financial institution which provided funding.

1.4.1 Closed-form formula

We decided to use a closed-form model as a valid approximation to calculate the magnitude of the result. As in our case the component of the volatility is well defined (volatility of housing prices in Spain) and moreover the exercise price is well determined in the time (It will be exercised when the development is delivered, similar case than *a European call*), we decided to use a Black Scholes call option model (Trigeorgis, 1996).

We assimilate the real estate development to a title or security with a price St which follows a geometric Brownian motion with constant drift μ and volatility σ

$$dS_t = \mu S_t\,dt + \sigma S_t\,dW_t \tag{1.1}$$

The volatility σ of the permit prices S as well as the time T to exercise the option are the key parameters that will determine the extra value of the development project.

In our case, if Φ is the standard normal cumulative distribution function and *r* the risk free rate, the purchase right can be modelled as a European call option with strike price *K*, according to the Black-Scholes formulation

$$C(S,T) = S\Phi(d_1) - Ke^{-rT}\Phi(d_2) \tag{2.1}$$

Where

$$d_1 = \frac{\ln(S/K) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln(S/K) + (r - \sigma^2/2)T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}. \tag{3.1}$$

From this model we derive the variables required to determine the value of the option:

a) Time of expiration of the option T, years that the developer should decide if it will exercise the right to construct and deliver the project to the end customer.
b) Interest rate without risk r
c) Annual volatility of the price of housing acquisition
d) Present value of the returns of a real estate promotion at the current prices
e) Price of exercise K, expressed as the development cost

1.4.2 Data Gathering

The main data are based on the evolution of housing prices in Spain since 2001. The data are available through two of the main property portals in Spain, Fotocasa.com and Idealista.com. Although the evolution of prices varies depending on the geographical location, we have based the study example on major cities in Spain, to calculate the magnitude of the option price.

After some interviews with financial institutions, we have chosen for our analysis a standard property development consisting of a €2 million (cost of development) project with a development calendar of 3 years after the land has been acquired. The average expected margin for the real estate developer was estimeded at 16% over total development costs.

Finally the risk-free rate of choice is the 3-year German Government Bond. We have chosen this bond since after 2000 it eliminates the currency risk.

The following chart shows the evolution of housing prices in a major city in Spain.

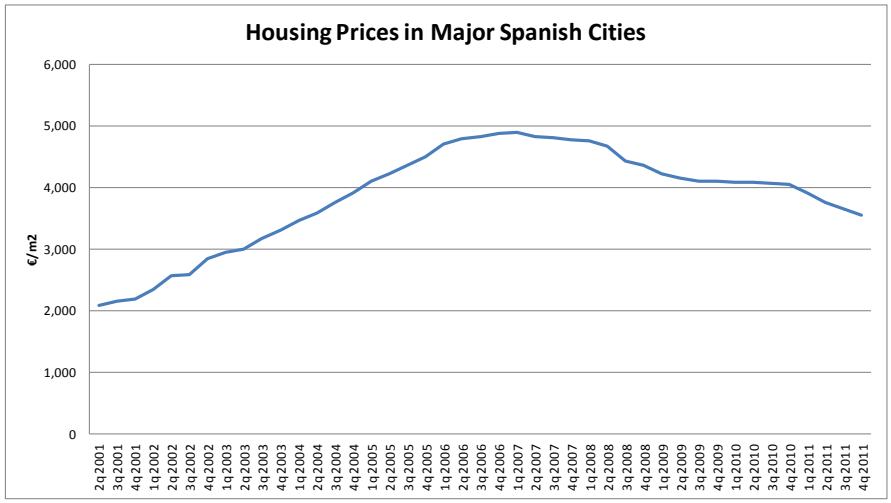

Fig. 1.1 Housing prices in major Spanish cities. The chart is based on supply prices published in the top property sites in Spain.

From **Table 1.2** we have determined a quarterly volatility on the logarithmic returns of the housing prices to be s=0.0339.

1.5 Results and Conclusions

With the above-mentioned parameters, the option price for the Project is €179,000. For a €2 million development loan this is approximately 8.9% of the total bank risk exposure. In case of longer projects, the option price increases, as shown in **Table 1.1.**

Table 1.1 Main parameters for the option value calculation and option price result

Development time	Bank Loan	Volatility (quarterly)	Option Price
3 years	€2 million	0.0339	€179,000
4 years	€2 million	0.0339	€223,000
5 years	€2 million	0.0339	€266,000

Interestingly, if an option scheme as the one proposed in this paper were implemented at the beginning of the past decade, the coverage in the Spanish Banks would probably have covered the current recapitalization needs. For an estimated real-estate exposure of some € 3 billion for the totality of the Spanish banking system, the coverage provided by the collection of the option price, would have ranged between €26 and 35 billion, which corresponds to almost 2 thirds of the required provisions for the Spanish banking sector for the period 2012-2014.

1.6 References

Amram, M.; Kulatilaka, N; (1999); "Real Options. Managing Strategic Investment in an Uncertain World"; Harvard Business School Press.

Black, F. y Scholes, M.; (1973); "The Pricing of Options and Corporate Liabilities"; Journal of Political Economy; mayo-junio; págs. 637-654.

Boyle, P. (1977); "Options: A Monte Carlo Approach"; Journal of Financial Economics; mayo; págs. 323-338.

Brealey y Myers; (1998)"Principios de Finanzas Corporativas"; 5ta edición; Mc-Graw Hill; Madrid-España.

Copeland, T; Koller, T.; Murria, J.; (1996); "Valuation, measuring and managing the value of companies"; 2 edición.

Copeland, Antikarov; (2001); "Real Options: A Practitioner's Guide"; New York.

Cox, J. C.; Ross, S. A. y Rubinstein, M.; (1979); "Option Pricing: A Simplified Approach"; Journal of Financial Economics; septiembre; págs. 229-263.

Coy P.; (1999); "Exploiting Uncertainty", Business Week, N° 3632 (7 de junio); págs. 118-124

Graham., J. y Harvey, C.; (2001); "The theory and practice of corporate finance: evidence from the field"; Journal of Financial Economics; N° 60; págs. 187 – 243.

Jensen, M. y Meckling, W.; (1976); "Theory of the firm: Managerial behavior, agency cost and ownership structure"; Journal of Financial Economics; Vol. 3; Octubre; págs. 305-360.

Katz, E. (1990); "History of Options", en The Options Institute (ed.). Options Essential Concepts and Trading Strategies, CBOE, Chicago.

Kulatilaka, N.; (1988); "Valuing the flexibility of flexible manufacturing systems"; IEEE Transactions in Engineering Management; Vol. 35; N° 4; págs. 250-257.

Lamothe, P. (2001); "Opciones Financieras y Productos estructurados"; 3° edición; Mcgraw Hill; España.

Samuelson, P.; (1965); "Racional Theory of Warrant Pricing"; Industrial Management Review; Vol. 6, Primavera; págs. 13-31.

Suárez Suárez, A.. (1995); "Decisiones óptimas de inversión y financiación en la empresa"; 20° edición; Pirámide; Madrid; págs. 31-35

Mascareñas, J.; Lamothe, P.; López Lubián, F.; De Luna, Walter; (2004); "Opciones Reales y valoración de activos"; Prentice Hall; Financial Times; Eapaña; págs. 15-16

Merton, Robert C.; (1973); "Theory of Rational Option Pricing"; The Bell Journal of Economics and Management Science; Vol. 4 N° 1; págs. 141 – 183.

Mongrut y Wong; (2005); "Un examen empírico de las prácticas de presupuesto de capital en el Perú", en Estudios Gerenciales N° 95 Abril – Junio 2005, Universidad ICESI, Colombia.

Myers; (1977); "Capital budgeting and the capital asset pricing model: Good news and bad news"; Journal of Finace; Vol. 32; N° 2; págs. 321-333.

Tong, J.; (2003); "Evaluación de inversiones en mercados emergentes"; Documento de Trabajo; Centro de Investigación; Universidad del Pacífico; Lima-Perú.

Triantis, A. y Hodder, J; (1990); "Valuing flexibility as a complex option"; Journal of Finance; Vol. 45; N° 2; págs. 549-565.

Trigeorgis, L. y Mason, S.; (1987);"Valuing managerial flexibility"; Midland Corporate Finance Journal; Vol 5; N° 1; págs. 14-21.