An Options-Based Model for Valuing Commercial Mortgages

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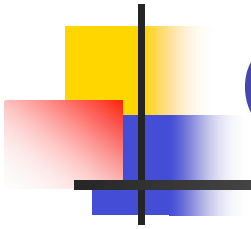

Contents

- Overview of the commercial mortgage market
- Current methods of valuing mortgages
- Optionality and mortgages
- The Zealand Model
- Example

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The Commercial Mortgage Market Today

- Very large and active sector of capital markets. Total capitalization in U.S. about $1.7 trillion (private mortgages)
- Public mortgages (CMBS) > $400 billion
- Active secondary trading

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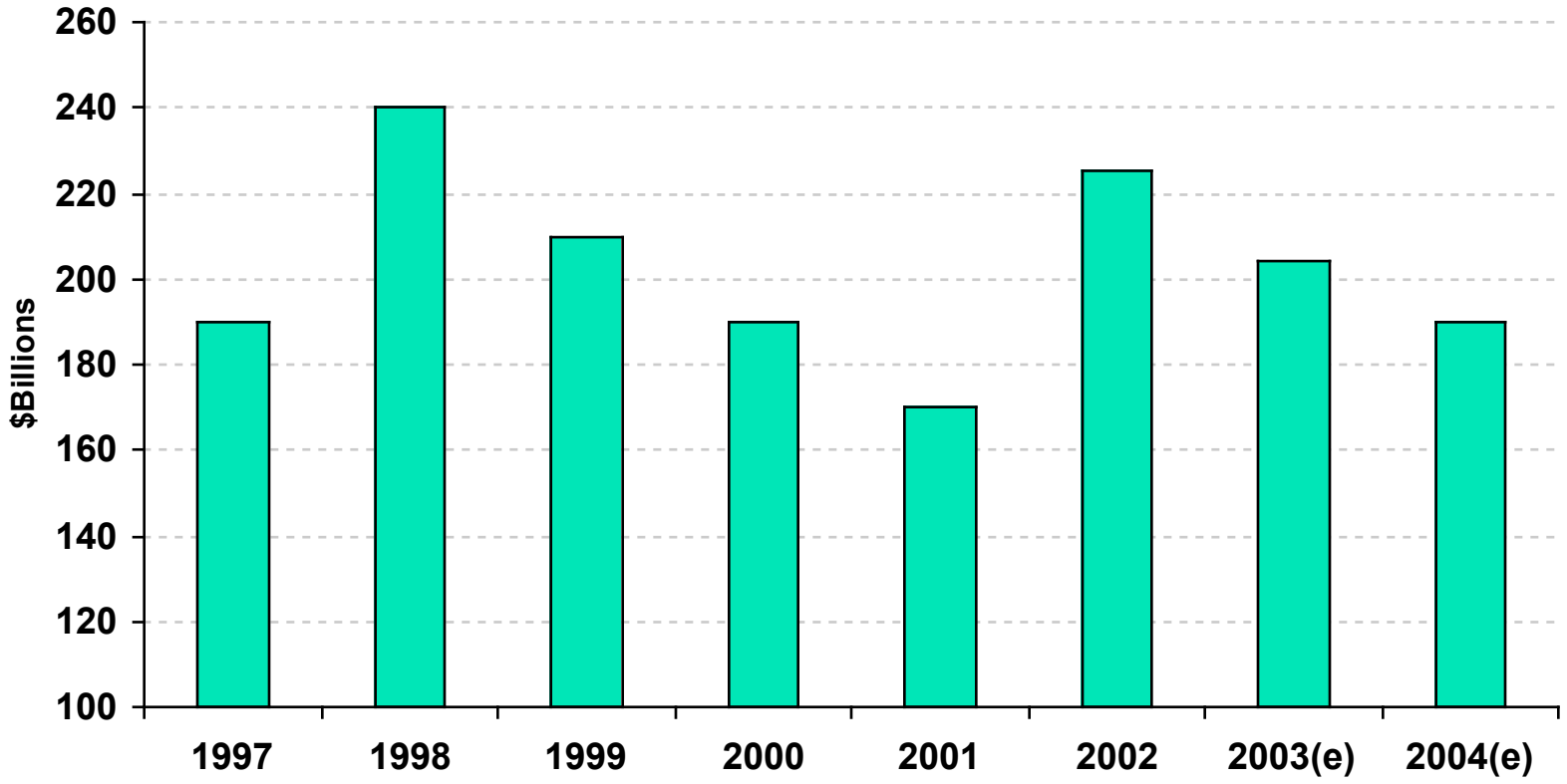
Commercial Originations



Source: HUD/MID

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Valuing Mortgages

- Goal -- Determine “fair market” value of mortgage loan
- What’s “fair” ?
  - Price at which loan will trade in an arms-length market trade or
  - “Intrinsic” value of a mortgage given its underlying creditworthiness and other structural features (e.g., call protection, rate adjustment, etc)

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Why so hard?

- Lack of standardization of loan terms
- Vastly different underwriting standard across lenders
- Heterogeneous collateral
- Mostly private market transactions with minimal reporting and disclosure
- Lack of representative data
- “Embedded optionality”

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Mortgage Optionality

- Value of loan inherently tied to default and prepayment risks (“embedded”)
- Thus to price loan we need to price these risks. How?
- Modern finance says we can apply formal options theory to model borrower behavior (Merton, ‘73)
- Credit event decisions are modeled as rational, profit-maximizing choices, not as “last resorts”
- Emerged as *the* dominant methodology for valuing risky debt

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Optionality, cont.

- Default
  - Put option -- borrower can “sell” the collateral for unpaid principal balance by “mailing the keys”
  - Collateral value and cash flow fluctuations determine value and timing of default
- Prepayment
  - Call option -- borrower can call in loan subject to covenants
  - Interest rate and credit spread fluctuations determine prepayment option value and optimal timing of exercise

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More Optionality

	Cash Flow vs. Debt Service	
	Positive	Negative
Positive Equity	**Perform to Maturity**	**Modify, DPO, Sale**
Negative Equity	**Balloon Default**	**Immediate Default**

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Current Methods

- “Comparables”
- “Empirical” methods
- Structural Approach
- “Ratings” approach
- A dart……

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Problems

- Insufficient data for comps, esp. for seasoned loans or unusual collateral
- What are good estimates of discount rates and residual value?
- Available loan data is lender-biased, limited samples, highly censored
- Fits are good for *ex-post* credit events, but not *ex-ante* ("backwards looking")
  - We observe option exercise, but
  - Cannot predict it!
- No *rigorous* measure of risk
- Often inconsistent with observed market pricing

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Structural Model Approach

- Formal way to model uncertainty faced by borrowers
- Equilibrium models, no systematic arbitrage
- Result is a (stochastic) pricing equation linking prices to risky factors (DSC, LTV)
- *Dominant* method for pricing risky debt, derivatives, options
- Black-Scholes is most familiar example

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Advantages

- Model borrower behavior directly as a function of loan and market parameters
- Embedded options priced directly, rational ex-ante pricing
- Model is fully predictive
- Results easily calibrated to existing market pricing
- Very general model that extends to other assets

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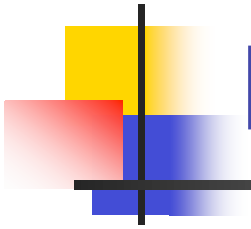

Drawbacks

- Formulating and solving options models can be difficult
- Mortgages demand at least two (or three) factor models
- Underlying options parameters need to be estimated
- Institutional real estate “inertia” -- not usually early adopters

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The Zealand Model

- Two stochastic factors structural model
  - Cash flow uncertainty
  - Building values
  - Correlated factors
- Overlay prepayment risk
- Views decisions as American options (early exercise)
- Result is an fair market value that reflects the underlying credit and prepayment risks of the mortgage

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Modeling Credit Risk

- Primary sources of credit uncertainty flow from unexpected change in cash flow and property values
- Key model inputs
  - Current DSC and LTV
  - Term, amortization, rate, call protection
  - Zealand --> volatility of cash flow, volatility of value, correlation between vols
- Credit-adjusted price and credit spread

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Capital Markets Calibration

- Need to ensure vols and resulting loan are consistent with current market pricing
- Shifts in time-varying credit risk premia (spreads) plus movements in relative pricing among other credit instruments
- Use available data on existing loans (e.g., CMBS), historical real estate pricing and fundamentals data, and implied distributions

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Modeling Prepayment Risk

- Forms of call protection vary widely for private mortgages (much less so for CMBS)
- Model incentive to prepay and ability to do so given prepayment restrictions
  - Financial incentives of the option
  - Behavior objectives and equity cash out
- Prepayment spreads also calibrated

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Tying it all together: OAS

- Zealand model ultimately produces a fair market mortgage value adjusted for both default and prepayment risk
- Derive an option-adjusted spread./option-adjusted yield (OAS/OAY)
- Can also derive expected default, LGD, expected loss, unexpected loss, etc.

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Example

- $11MM apartment loan in Phoenix, 7-year fixed rate at 5.56%, 30-Year amort, DSC=1.55x, 79% LTV, origin. 3/04,call protection: YM or 1% UPB, building value=$13.91 MM, current UPB=$10.909MM
- Results
  - Credit-adjusted value = $11.396MM (1.16% spd)
  - Final value = $10.991MM (1.007 dollar price)
  - Total OAS = 4.41%

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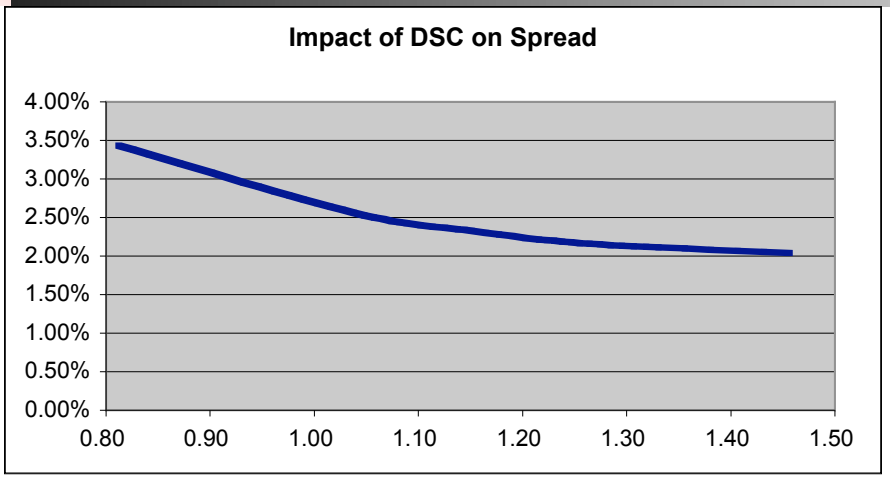
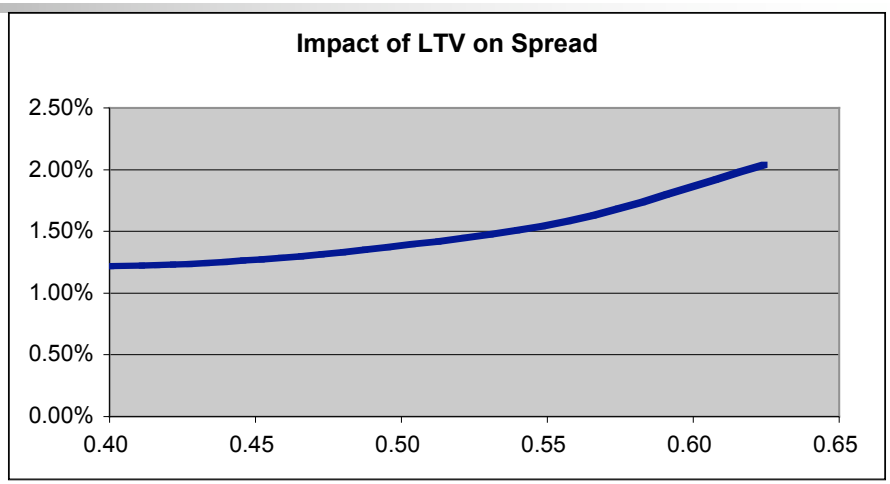
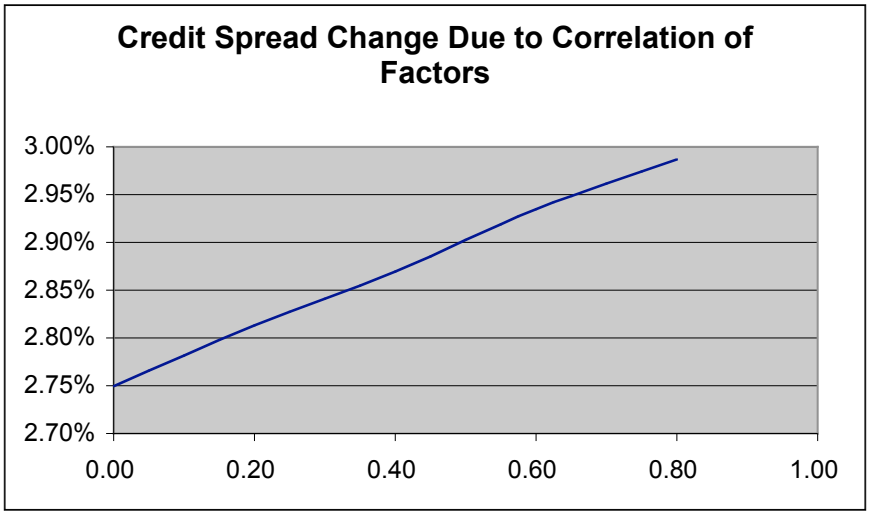
Model Sensitivities







DSC	Amort	Spread
1.49	361	2.15%
1.41	300	2.04%
1.30	240	1.97%
1.20	200	2.11%
1.02	150	3.23%

Shorter AM initially reduces balloon risk so value goes up and spread down.At some point the higher loan constant reduces DSCR and spread goes up.

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